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ORAL HEALTH OF PRESCHOOL CHILDREN AND RELATIONSHIP TO SOCIAL AND BEHAVIORAL DETERMINANTS IN TRINIDAD

Submitted for: **DOCTOR OF PHILOSOPHY IN ORAL BIOSCIENCE**

UNIVERSITY OF DUBLIN
TRINITY COLLEGE

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Supervisor: **PROFESSOR JUNE NUNN**

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SUMMARY

Aim:

The aims of this research were to describe the oral health of preschool children in Trinidad, in particular the prevalence and severity of ECC and explore relationships with social behavioural determinants. Additional aims were to evaluate the effectiveness and acceptability of a community-based oral health promotion intervention and to develop a preventive strategy for ECC, appropriate for this preschool population.

Objectives:

1. Describe prevalence and severity of ECC.
2. Describe levels of treatment need.
3. Describe prevalence of developmental defects of enamel, dental erosion and traumatic dental injury.
4. Describe oral health knowledge of parents and caregivers.
5. Describe the influence of social and behavioural factors on ECC and the impact of ECC on child and caregivers oral health related quality of life (OHRQoL).
6. Explore oral health attitudes and beliefs of parents and caregivers.
7. Describe parent and caregiver and experiences in accessing dental care and identify opportunities for oral health promotion.
8. Assess the effectiveness of an oral health promotion intervention on the oral health attitudes and behaviours of parents and caregivers.
9. Develop an oral health promotion strategy for ECC in Trinidad and Tobago.

Methodologies employed

Objectives 1-7: *Quantitative study* - Cross sectional survey from a random sample of preschools in Trinidad.

Objectives 8-9: *Qualitative study* -Focus group discussions with a sub-sample of parents and caregivers.

Objectives 10: *Interventional study* - Community-based randomized controlled trial with parents and caregivers of preschool children, comparing MI with traditional Dental Health Education (DHE) delivered in preschools.

MAIN FINDINGS

Quantitative: For the cross-sectional descriptive study on children aged 3-5 years in Central Trinidad, the prevalence of ECC was 29.1% with a dmft of 1.4 (sd 3.01), almost entirely due to decayed teeth (dt). Visible caries experience was much higher among those with ECC (dmft of 4.8 involving 1 -13 teeth). As indicated by the levels of untreated decay, treatment needs were largely unmet with most of the children with ECC requiring restorative care or extractions and over third needing urgent care for a caries-related problem. Logistic regression and statistical modelling indicated that ECC in this sample was associated with problems of access to dental care and more frequent intake of sugary foods and drinks. Consistent with literature there was also an association between ECC and enamel developmental defects (demarcated and diffuse enamel hypoplasia). Severity of ECC was also associated with greater impact on oral health related quality of life (OHRQoL).

Qualitative: Focus groups with a sub-sample of parents and caregivers whose children took part the oral health survey reported findings consistent with those from the clinical epidemiology. Participants experienced barriers to dental care related to previous dental experiences and negative perceptions of children's dental care, along with issues of affordability and low awareness of service availability, possibly leading to low dental attendance. Oral care at home was affected by confusion regarding fluoride toothpaste and effective tooth brushing, use of the feeding bottle and difficulty controlling of sugary drinks and snacks in the face of other parental responsibilities. Participants expressed a need for more practical information and support to improve their oral healthcare practices and wanted more contact with oral health professionals in non-dental setting such as the preschool or community groups.

Interventional: The interventional study comparing motivational interviewing to traditional dental health education for parents and caregivers of preschool children, showed a trend of greater effectiveness with respect to improved oral health knowledge and attitudes. In particular, participants in the MI appeared to show greater 'readiness for change' indicating that a person-centred counselling approach such as MI has utility in oral health promotion for this population group.

These research findings together with guidance from international-best practice, were used to develop an oral health promotion strategy for preschool children in Trinidad.

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CHAPTER ONE: INTRODUCTION

This chapter describes the socio-political and socio-demographic profile of Trinidad and Tobago along with key themes related to health and healthcare of the population. Oral health issues and an overview of dental services are also described.

1.1: Trinidad and Tobago

Trinidad and Tobago is a twin-island nation located near to the north-east coast of Venezuela and the most southerly of the Caribbean chain of islands. Trinidad is the larger island (1,864 square miles) compared to Tobago (116 square miles). This English-speaking Caribbean country is an independent republic within the British Commonwealth.

1.2: Socio-political history

Trinidad and Tobago has been shaped by its colonial and post-colonial history, having been a Spanish and then British territory within the Caribbean before becoming an independent nation.

1.3: The colonial period

During the 15th century, the first Spanish settlers in Trinidad and Tobago encountered simple farming communities of forest dwelling Amerindians, the original inhabitants of the islands. Almost a century later, a permanent Spanish base was established along with the first city, St Joseph, in 1592. However, The Spanish Empire in the West Indies was weak in comparison to France and Europe and Trinidad did not develop a viable plantation economy until the last decades of the 18th Century, firstly through cocoa and tobacco and eventually sugar. Spain therefore offered French Catholic settlers grants and tax incentives to establish plantations in Trinidad. These landowners prospered by replacing the decimated Amerindian workers with slaves from West Africa and increasing the yields of cocoa and sugar, for export to Europe (Brereton 1989). Spanish rule over the island ended when the last governor surrendered the island in 1797 to the British. Tobago, after changing hands many times, was finally ceded to the United Kingdom in 1814. The two islands were incorporated into a single Crown Colony in 1888 with Tobago reduced to the status of

a Ward of Trinidad until the formation of the independent nation of Trinidad and Tobago in the early 1960s.

With the abolition of slavery in 1833, Trinidad was left with a severe labour shortage. Despite a period of 'apprenticeship' that compelled some slaves to remain as paid workers, most declined to continue work on the estates and looked instead for employment in urban areas. In 1839 the British government began a programme of recruiting Indian labourers to be sent to Trinidad and British Guyana. These labourers bound themselves to work on the plantations under an indentureship system (usually five years), with a guarantee of free passage home at the end of their service. Following the end of their term of indentureship many did not return to India, choosing rather to set up businesses and smallholdings in Trinidad. Their descendants now make up a significant part of the population (Brereton1985 &1989).

1.4: Post-colonial administration

Trinidad was ruled as a crown colony with no elected representation until 1925. In August 1962 Trinidad and Tobago achieved full independence within the British Commonwealth, and became a Republic in 1976 (Brereton 1989). The government, which sits in the capital, Port-of-Spain, is based on the British Parliamentary system with an upper and lower house headed by a prime minister. Trinidad is currently organized into 14 local administrative areas (regional corporations) responsible for maintenance of the environment, public buildings, some utilities and solid waste disposal (PAHO 2001).

With the discovery of oil in the mid-19th century the country's economy gradually shifted from agriculture toward one of petroleum production. With the huge increase in demand for oil and natural gas from the 1970s to the present day, these commodities and the petrochemical industry have become the mainstays of the economy.

1.4.1: Socio-demographics

At the last census the total population of Trinidad and Tobago was 1.3 million with 20% of people under the age of 15 (Central Statistical Office 2012). The island of Trinidad has a multi-ethnic composition arsing mainly from its colonial history. Across the whole nation, the two main ethnic groups are people of Indian descent (35.4%), African descent (34.2%), mixed descent (20.5 %) and other groups

including: European, Chinese and Middle Eastern (1.4%) The ethnic mix of Tobago differs from the national profile, with people of African descent being the majority (85.2%), followed by those of mixed descent (8.5%). Catholicism is the largest religious group followed by Hinduism, Anglican and Pentecostal/Evangelical groups (Central Statistical Office 2012).

Due to its petroleum and natural gas reserves, Trinidad and Tobago is a relatively prosperous country compared to several of its Caribbean neighbours, with a Gross Domestic Product (GDP) in 2008 of US $20.9 Billion, 46% of which is generated by oil, natural gas and petrochemicals (US Department of State 2011).

1.4.2: Education and literacy

Since 2000 a policy of 'Education for All' (EFA) was established in Trinidad and Tobago to achieve universal primary and secondary education by 2015. In 2005 the net enrolment in primary education was 94% (PAHO 2007). There are 483 primary schools for children aged 5-11. Reflecting the rural population and transport / access issues, fifty per cent of children were considered at high-risk of missing school due to the school's geographic location (PAHO 2007). Low income families with children enrolled in public schools receive government subsidies for transport and books and the children receive breakfast and lunch as part of the National School Feeding Program (PAHO 2007). The adult literacy rate was 98.2 % in 2001 (PAHO 2001). The United Nations Development Fund (UNDP), reported the mean number of years of schooling for adults was 9.2 years (UNDP 2010).

In 2011, 29.8% of the population had attained primary education, 43.5% secondary, 6.2% Tertiary (non–University) and 8.4% University level education (Central Statistical Office 2012).

1.4.2.1 Early childhood education

At the last census there were 94,075 children under 5 years of age with 53,778 children of preschool age (3-5 years) (Central Statistical Office 2012). There are over 900 preschools in the country, 22% of which are government run. Formal education at preschool level is not compulsory in Trinidad and Tobago but demand for preschools has been rapidly increasing with a marked growth in private nurseries, day centres and preschools across the country. In 2006, the government of Trinidad and Tobago implemented a policy to formalize education of preschool children nationally. All

existing and new preschools are required to meet quality standards with respect to teaching methodology, staffing levels and the children's environment, to be registered with Ministry and re-classified as centres for Early Childhood Care and Education (ECCE). These centres include a wide range of programmes aimed at the physical, cognitive and social development of the children. The Ministry of Education has itself received approval and financial support to enable the construction of 150 purpose-built centres across the country with an aim to improve access to preschool education for families in lower socioeconomic groups who would not normally be able access preschool education.

1.4.3: Living standards

Despite having a stable economy and good oil and natural gas revenue the country still has pockets of poverty (PAHO 2012). In the 2005 Survey of Living Conditions, 16.7% of the population was poor and 1.2 indigent (i.e. cannot provide the basic necessities of life: food, clothing, shelter), with a tendency for poorer households to be headed by women (PAHO 2012). The most recently reported national unemployment rate was low, being 5.3% and 6.3% for males and females, respectively (PAHO 2012).

One quarter of the population live in rural areas (WHO 2002) and almost a third of the population have no pipe-borne water supply. Only 26% of households receive a continuous 24-hour water supply, seven days a week. Furthermore, due to an aging water distribution network and watershed disruption, pipe-borne water is unreliable for most areas (PAHO 2006) and almost 50% of the population use water storage tanks to supplement their supply (PAHO 2012).

In the 1990s, the United Nations introduced the Human Development Index (HDI), which is a composite measure of three basic dimensions of human development: health, education, and income. Between 1980 and 2010, Trinidad and Tobago's HDI rose by 0.4% annually from 0,656 to 0,736 which gives the country a rank of 59 out of 169 countries, which was above the regional average for Latin America and the Caribbean (PAHO 2007).

1.5: Health of the population

The following section describes the major health issues in Trinidad and Tobago and provides an overview of the healthcare infrastructure.

1.5.1: Leading causes of illness

In 2008 the adult mortality rate for the nation was 163 per 1000 adults as compared to a regional and global average of 126 and 180, respectively. The under-5 mortality was 35 per 1000 live births compared to regional and global averages of 18 and 65, respectively. Life expectancy at birth was 73 and 66 years for females and males, respectively. Sixty per cent of all deaths in Trinidad and Tobago were caused by chronic, non-communicable diseases with leading causes being cardiovascular disease, malignancy, diabetes mellitus, cerebrovascular disease and external injury (PAHO 2012).

The Caribbean Food and Nutrition Institute (CNFI) national nutrition survey, reported that, based on Body Mass Index (BMI) of a random sample of 1,254 of people aged 18-64, 45% of the sample were overweight (BMI> 25kg/m2) and 20% were obese (BMI>30mg/m2) (CNFI 2007). There has also been a trend of increasing levels of obesity in primary and secondary school children (PAHO 2012, Ministry of Health 2012).

Trinidad and Tobago has the highest prevalence of smoking in the English-speaking Caribbean (27%) (PAHO2012). The Global Youth Tobacco Survey reported that smoking prevalence among schoolchildren in Trinidad and Tobago was 23.6% in those aged 16 or over, with 19% having smoked a cigarette before they were 10 years of age (Ministry of Health 2000). To address this problem and also protect non-smokers from exposure to tobacco smoke, the Tobacco Control Act was enacted in 2009, banning smoking in public places and the advertising of tobacco (PAHO 2012).

1.5.2: People living with HIV and AIDS

The prevalence of HIV infection/AIDS in the Caribbean is second only to sub-Saharan Africa (7.2%) and in 2005, 30,000 people in the region were living with HIV/AIDS (Prabhu 2006). The national HIV/AIDS prevalence rate in 2008-2009 was 1.5 % and the largest increase in new HIV cases is in the 20-49 years age range (PAHO 2012).

Nationally, there has been a trend of more new cases in women and this is thought to be related to issues of domestic and sexual violence, biological factors, economic dependency on men, reduced power to negotiate safe sex and commercial sex work. In 2003-2004, 9% of infants were born to HIV-infected mothers but this has been improved through the National Prevention of Mother to Child Transmission (PMTCT)

programme. This involves improved access to testing and follow-up care for HIV positive mothers, including free access to anti-retroviral therapy and post-delivery counselling (PAHO 2007). The Queens Park Counselling Centre in the capital, along with seven affiliated regional centres, is responsible for treatment and care of all sexually transmitted disease (STDs), in particular HIV/AIDS. The National Aids Coordinating Committee (NACC) and several non-government organisations (NGO's) are also involved in health promotion and prevention activities at the local and national level in relation to management of HIV/ AIDS in the population (PAHO 2007).

1.5.3: People with disabilities

Nationally, 22% of people over 15 years of age were reported to have some type of disability. In people under 65 years of age, chronic medical conditions contributed 40% to this disability prevalence and 60% in people over 65 years of age (PAHO 2001). There are few data available on the prevalence of specific physical or intellectual disabilities. A survey of 7,982 people aged 0-18 years found that 2.1% had disabilities and of these, 25% had an intellectual disability (PAHO 2002).

1.5.4: Health of young children

During the current decade there has been a trend of a decreasing infant mortality rate, 15.4 per 1000 live births in 2005 to 13.2 in 2009 (PAHO 2012).

For children aged 1-4 years, the five leading hospital discharge diagnoses were respiratory disease, injury, poisoning, infectious and parasitic disease and diseases of the digestive system. In 2009, approximately 6% of children under 5 were underweight and The United Nations International Children's Emergency Fund (UNICEF), reported that less than 20% of children are exclusively breast fed for at least six months. In response to these issues a national breastfeeding policy has been implemented at all public institutions (PAHO 2012).

1.5.5: Health services

National health priorities and policy frameworks are under the direction of the Ministry of Health (MoH). Four RHA's are responsible for delivery of health services at local level: the North Central (NCRHA), South West (SWRHA), Eastern (ERHA) and Tobago (TRHA). Services are commissioned from these RHAs through a

purchaser / provider arrangement with the MoH. The RHAs geographic boundaries, that are mostly co-terminus with the Regional Corporations, enables some coordination of programmes and services within their catchment area. Recently, several of the RHAs have also partnered with private institutions and international professional bodies to improve service delivery (PAHO 2012). The MoH continues to have oversight for health policy formulation, legislation, regulation, financing and evaluation. The national expenditure on health increased from (6.3%) in 2006 to (8.1%) in 2010, with a 51% increase in total expenditure on health in the public-sector (PAHO 2012).

Public sector health institutions include three tertiary level hospitals, four district health facilities and one hundred healthcare centres. These health facilities and centres offer emergency care, pharmacy services, specialist clinics for chronic diseases, family planning, ante / post-natal clinics, and child health services. The number of health centres varies across regions, resulting in different ratios to population served, with 3,000 per health centre in Tobago to 21,000 per health centre in parts of the North Central Region of Trinidad (PAHO 2012)

As part of the Government goal to gain developed nation status by 2020, a national policy was developed to achieve this aim, including a health sub-committee that focused on a strategic framework for the public health sector (Ministry of Health 2005, PAHO/WHO 2006). The mission statement for this strategy was "to create a nation of individuals, families, and communities empowered to achieve and sustain the highest standards of health and well-being through the provision of efficient, effective, equitable and collaborative services that support good health."

1.6: Oral health

Oral health and oral health services in the private and public sector are discussed in the following sections.

1.6.1: Oral health of adults

No national data exist on the oral health of adults in Trinidad and Tobago. However, some information is available from samples of patients attending hospital services, for instance, preliminary data from adult patients attending a diabetic clinic reported a

finding of advanced periodontal disease of 38%. (Balkaran *et al* 2011). The authors suggest this may be related to the high prevalence of diabetes and the population problems of diabetic control.

Tooth surface loss (TSL) was a significant problem based on data from patients attending the dental school adult polyclinic (Rafeek *et al* 2006) with a fifth of participants presenting with moderate to severe TSL.

I.6.2: Oral health of people with special needs

As part of the Healthy Athletes Special Smiles programme of the Special Olympics event held in Trinidad in 2004, oral health screenings were undertaken on 410 participants aged 5-58 (mean 19 years). All of these participants had an intellectual disability and in some cases a degree of physical disability. Of these participants, 28% were in need of urgent dental care (Naidu *et al* 2006a).

1.6.3: Oral health of children

In 1989 the mean number of decayed, missing and filled teeth (DMFT) of 12-year-old school children was 4.6, which is considered high by the World Health Organisation (Donnelly 1990). However, the 2004 national survey that used similar parameters of assessment, reported a DMFT of 0.6 in this age-group (Naidu *et al* 2006). Not withstanding some minor methodological differences between the studies, the observed lower DMFT has been attributed to greater fluoride use, better oral health awareness of children and parents and improving living standards (Naidu 2006b). Nevertheless, untreated caries in the primary dentition remains a major problem as in 2004 the mean dmft for 6-8 year-olds was 2.5 with 62% having caries experience. Some areas of the country may have higher levels of caries experience, as data from a sample of 700 children in rural area of Eastern Trinidad indicated a DMFT of 2.18 in 12 year-olds (Adewakun *et al* 2005).

1.6.4: Dental services

There are approximately 350 registered dentists in the country, giving a dentist population ratio of about 1:3700. However, most dentists work in private practices, generally clustered in urban centres, resulting in people with limited resources and/ or

living in rural locations having difficulty in accessing this type of dental treatment (PAHO 2012).

Free dental care is available in the public sector for children and adults in Health Centres throughout the nation (PAHO 2001), mainly for emergency care and exodontia. Although some services are commissioned and co-ordinated locally by the RHAs most dental services are run as a vertical programme under the Ministry of Health (i.e. line-managed directly to the Chief Medical Officer, through the Manager of Dental Services in the Ministry of Health).

Free dental care (including preventive and restorative treatment) is available for children up to 18 years of age and emergency and palliative care is also available free at the point of use for adults.

Currently, 20 dentists work in the government sector supported by 46 dental nurses (the equivalent of dental therapists in the UK). These dental nurses were trained using the model begun in New Zealand in the 1970's in response to the critical shortage of dentists in the country during the early post-colonial period. These now provide the mainstay of dentistry in the public sector, being mandated to treat children up to the age of 12 years for preventive and restorative care.

Specialist oral and maxillofacial services are available in the general hospitals but most other specialist services, e.g. orthodontics, restorative, periodontal services and paediatric dentistry are only accessible in the private sector, except where they are offered in relation to undergraduate teaching at The University of the West Indies (UWI) School of Dentistry. The Dental School produced its first graduates in 1994 and, in addition to the other secondary care services outlined above, offers a full range of primary dental care services through its teaching clinics (including emergency care and an oral medicine histopathology/diagnostic service) at a nominal fee to adults. Free treatment is provided in the paediatric dental unit for children up to the age of 16. Due to difficulties in accessing dental services some members of the public, particularly those with lower socioeconomic status (SES), obtain dental care from unqualified practitioners (locally known as dental quacks) particularly in the rural areas (Naidu *et al* 2003).

1.6.5: Oral health policy

Overall, the lack of data on oral health has made strategic planning for improvements in oral health / healthcare for the population difficult (PAHO 2012), however in 2010, the Government developed The Oral Health Policy and National Oral Health Plan (Ministry of Health 2010). This strategic document focused on the need for decentralisation of dental services from the Ministry of Health to Regional Health Authorities along with more effective oral health promotion programmes and improved services for vulnerable group, (preschool children, the elderly and people with special needs (Ministry of Health 2010).

The Oral Health Policy and National Oral Health Plan was developed in the context of international and regional health policy and involved consultations with stakeholders in the public and private sector and was made available for public viewing and feedback. The policy addresses issues related to oral health promotion, primary prevention and improving access to care for vulnerable groups such as the elderly, people with special needs, infants and young children Some of the key policy aims related to children such as a reduction in caries experience in children and a reduction in number of extractions and general anaesthetic sessions required by children under 5 years of age.

Although in draft form, several policy objectives are being implemented by the Ministry (PAHO 2012). In particular, addressing the manpower shortage in the public sector dental services and increasing access to care for children have been seen as priority areas and this added impetus to the commissioning of training mid-level providers (dental therapists).

The National Oral Health Policy (Ministry of Health 2010) also highlights the importance and immediate need for high quality locally-based research to aid strategic direction and programme planning/evaluation, stating: 'in addition to epidemiological information, decision makers-makers and health planners need information about risk-factors for oral health, oral health related quality of life, service coverage, utilization of oral health services, interventions and quality of care'.

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CHAPTER TWO: LITERATURE REVIEW.
EARLY CHILDHOOD CARIES AND OTHER ORAL CONDITIONS IN PRESCHOOL AGED CHILDREN

This chapter reviews the literature on early child oral health with an emphasis on the epidemiology and risk factors for dental caries. Other conditions reviewed include dental erosion, developmental defects of enamel and traumatic dental injuries.

2.1: Search and retrieval of papers

Scientific literature was retrieved from on-line databases including: MEDLINE PubMed, MEDCARIB, EBSCO, Google Scholar, UK Department of Health, Cochrane Database of Systematic Reviews and professional organisation websites: British Dental Association (BDA), American Dental Association, British Society for Paediatric Dentistry (BSPD), American Academy of paediatric dentistry (AAPD), American Academy of Paediatrics (AAP), and public health organisations: World Health Organisation (WHO), Pan American Health Organisation PAHO, Centre for Disease Control (CDC). On site searches of medical / dental literature of library holdings at the University of the West Indies, Dublin University Hospital and the BDA

Search terms included: dental caries, early childhood caries, nursing caries, baby bottle tooth decay, rampant caries, prevalence, risk factors, oral health, preschool children, and early childhood. Searches were limited to documents published / translated into English.

2.2: Definitions

The following section reviews the development of terms and nomenclature relating to dental caries in early childhood.

Dental caries (tooth decay) has been described as one of the most common health problems during early childhood in western countries (Fayle 2005) and considered as being of epidemic proportions worldwide (Edelstein *et al* 2009). Dental caries is defined as a biofilm (plaque) induced, acid demineralization of enamel or dentine, mediated by saliva (AAPD 2008). It is particularly prevalent among infants and preschool children from low-income families in the developed world and disadvantaged children in developing countries (Tinannoff *et al* 1998, Reisine and

Douglas 1998). Since its early reporting in the literature, this condition has been described as a pattern of rapidly developing caries typically affecting many teeth soon after they erupt (Harris *et al* 2004). In early research on this subject, Fass (1962) noted the buccal surfaces of the maxillary incisors are commonly affected, along with the upper and lower primary molars and lower canines. He termed the condition "nursing bottle mouth" after observing that most of children in the study had received a nursing bottle when being put to bed to help them fall asleep. As the lower incisors are usually not affected, Fass attributed this to the tongue covering these teeth during bottle feeding. This description has become one of many terms used for of dental caries presenting in the primary dentition along with: 'labial caries' (James *et al* 1957), 'nursing bottle mouth' (Fass 1962), 'rampant caries' (Winter, 1966), 'baby bottle tooth decay' (Bruerd *et al* 1989), 'nursing caries' (Johnsen 1982), 'nursing bottle caries' (Derkson and Ponti 1982) and 'maxillary anterior caries' (O'Sullivan and Tinnanoff 1993). Early names suggested causality but as the terminology developed and expanded other names have been used that attempt to also include disease outcomes, lesion location, aggressiveness, and complexity. Most of the terms that have been used can therefore be grouped under the following six themes (Edelstein *et al* 2009):

- Causality: e.g. *baby bottle, nursing bottle, night bottle, sippy cup*
- Disease outcomes: e.g. *caries, cavities, tooth decay*
- Lesion location: e.g. *labial, anterior, maxillary*
- Aggressiveness; e.g. *rampant, severe*
- Complexity: e.g. *syndrome*
- Age of onset: e.g. *early infant decay*

This wide diversity of names and terms, for essentially the same condition, is unhelpful, particularly when trying to compare prevalence and severity of caries across populations from different studies. This is particularly so as many young children present with extensive caries in the primary dentition that does not follow a typical 'nursing caries' pattern, being slightly older at initial presentation (3- 4 years of age) and having multiple carious teeth (Fayle 2005). To resolve this situation a call for consensus in definitions and nomenclature was made at a conference convened by the Centre for Disease Control and Prevention (CDC) in 1994, where it was the agreed that the link between bottle habits and caries in young children was not

absolute and a less specific term was required that did not indicate causation (Tinanoff *et al* 1998). The term 'Early Childhood Caries' (ECC) was therefore recommended to replace the previous terms (Tinanoff *et al* 1998). It was also agreed that there was no clear distinction between nursing caries and rampant caries (Edelstein *et al* 2009).

2.2.1: Nomenclature and diagnostic criteria

Further scientific debate on caries in infants and preschool children occurred at the *Conference on Early Childhood Caries* held in Bethesda, Maryland in 1997. This conference critically examined the existing knowledge on ECC, in particular biological and psychological mechanisms, public health implications, prevention and research needs (Burt 1998). Following this conference a paper was commissioned by the National Institute for Dental and Craniofacial Research (NIDCR) to review case definitions and clinical diagnostic criteria used in studies of ECC in children 1-5 years of age (Drury *et al* 1999).

The subsequent systematic review undertaken by Ismail and Sohn included 95 published studies that met their inclusion criteria and revealed a general lack of consensus regarding the definition of ECC (Cleaton-Jones 2002). In their review, the authors also introduced the term Severe Early Childhood Caries (S-ECC). They used this term to encompass 'nursing caries, baby bottle caries/ tooth decay, rampant caries, labial caries, maxillary anterior caries and other terms indicating a more severe presentation of the condition. The review found wide variation in diagnostic criteria, along with 22 studies reporting no diagnostic criteria. Most studies used frank cavitation with or without the use of probe to diagnose caries, (eight stating explicitly that caries was diagnosed when an explorer got stuck in a carious lesion (Ismail and Sohn 1999). A small number of studies reported diagnosis at pre-cavitation (i.e. white spot lesions) but without an indication as to whether examiners were trained and calibrated to identify theses lesions and the criteria for diagnosing early enamel lesions were vague. The reviewers also concluded that case definitions varied significantly. For instance, for S-ECC, 27 studies used the presence of one decayed, missing or filled (dmf =1) maxillary incisor, 23 studies used dmf =2 and 9 papers a dmf of 3 or more in the maxillary dentition. Some had no case definition and some included maxillary and posterior teeth (Ismail and Sohn 1999). They concluded that this lack of clear case definitions and diagnostics criteria makes it very difficult to

evaluate data from different studies with respect to aetiology, clinical progression, frequency and impact of dental caries in early childhood.

To discuss the finding from Ismail and Sohn's review and build on work from the earlier conference on ECC, three US federal health agencies convened an expert workshop in 1999. This workshop was charged to establish diagnostic and reporting criteria that would be useful for research (Edelstein 2009). Institutions and expert bodies represented at the workshop included the American Dental Association (ADA), American Academy of Paediatric Dentistry (AAPD), Centre for Disease Control and Prevention, The National Institute for Dental and Craniofacial Research (NIDCR) and American Association of Public Health Dentistry (Drury et al 1999).At this workshop it was agreed that, to overcome the variability in reporting, there should be a move away from terms that are specific and descriptive to ones that are more general and inclusive. It was therefore agreed that the term 'early childhood caries' (ECC), which was already being used by some researchers, should be adopted as standard nomenclature with the definition being: "*the presence of one or more decayed (cavitated or non-cavitated), missing due to caries or filled tooth surfaces in any primary teeth in children under 6 years of age.*" i.e. any caries in any tooth in children under 6. Some evidence suggested that non-cavitated lesions may be more prevalent than cavitated during the first 18 months of life (Mattos-Graner *et al* 1996). It was therefore considered important to include pre-cavitated lesions in this definition i.e. incipient (white spot) lesions on smooth surfaces often close to the gingival margin, chalky white or brown lesions in enamel adjacent to pits and fissures and localised hypoplasia as reports including these conditions were becoming more common and of relevance to preventive strategies.

It was also noted that early carious lesions in a one- year-old child represented a different level of severity than a single lesion found in a 5-year-old child and that some children develop more severe forms of dental caries in smooth surfaces before 3 years of age. This often occurs in multiple maxillary anterior and posterior teeth. To distinguish this more extreme presentation from ECC, the term Severe-ECC (S-ECC) was also formally adopted, being defined as: "*children with atypical, progressive, acute or rampant patterns of dental caries*".

S-ECC has been specifically defined by the AAPD (2008):

- *For children under 3 years of age as any sign of smooth surface caries.*

- *For children 3-5 years of age as 1 or more cavitated, missing due to caries or filled smooth surfaces in primary maxillary anterior teeth.*
- *A dmf score of >4 in age 3, >5 at age 4, or >6 at age 5.*

Despite these definitions, some groups have argued that ECC is still too vague a term, particularly for the general public (Wyne 1999, Horowitz 1998). They suggest it is unrealistic to assume a single term could encompasses aetiology, signs, symptoms and management and be understood by the dental profession, medical colleagues and the general public (Wyne 1999). Further refinement of the definition may be required to include clinical expressions of varying severity (Vadikas 2008). Wyne (1999) also suggests that a single definition based on number of lesions, teeth involved and age of child lacks utility, as situations differ greatly with respect to the nature and magnitude of the prevention and management efforts in both individuals and populations. He proposed a classification of ECC based on 3 categories related to clinical picture, probable cause and age:

Type 1 ECC (mild to moderate)

Isolated carious lesion(s) involving molars and/or incisors. (Usually occurs in children aged 2 to 5 years-old due to cariogenic semi-solid food and poor oral hygiene).

Type II ECC (moderate to severe)

Labiolingual carious lesions affecting maxillary incisors, with or without molar caries depending on the age of the child and stage of the disease, with unaffected mandibular incisors. (Usually due to inappropriate bottle feeding or at-will breast feeding with or without poor oral hygiene and occurring soon after tooth eruption).

Type III ECC (severe)

Carious lesions affecting almost all the teeth including the lower incisors. (Usually due to a combination of cariogenic food, poor oral hygiene in children aged 3-5 years old). The condition involves tooth surfaces which are usually unaffected by caries. However, unlike the AAPD definition, Wyne's definition and classification system have not been widely adopted.

2.3: Epidemiology of ECC

Despite these efforts to standardize reporting of ECC, differences in case definitions and diagnostic criteria still exist and may contribute to some of the variation seen in prevalence rates (Weintraub 1998). This may be particularly true with the reporting of

severe ECC. When reviewing epidemiological data for this age group, the effect of differences in research methodologies must also be considered i.e. type of study (cross-sectional, case-controlled or cohort studies), selection of age groups, use of convenience or random samples, national data versus surveys of sub-groups, use of single or multiple examiners with or without calibration and clinical diagnostic threshold (e.g. inclusion of non-cavitated lesions) (Edelstein *et al* 2009).

Notwithstanding these methodological issues, differences in prevalence rates and trends in ECC are apparent between developed and developing countries (Weinstein 1998).

The following section reviews data on ECC for preschool children from several countries and regions in the developed world: The UK, North America (USA and Canada), Australia, continental Europe and the developing world: Asia and the Far-east, the Middle-east, Africa, Latin American and the Caribbean.

2.3.1: Developed countries

National oral health surveys can reliably describe population caries prevalence in children as these studies are usually based on representative samples, using standardized survey methods (Tinanoff and Reisine 2009). These types of studies often require significant public funding for materials and manpower and are dependent on established dental public health infrastructure. This is less common in developing or middle income countries, due to fewer trained oral health personnel and less availability of resources for public health dentistry.

2.3.1.1: The United Kingdom (UK)

The severity of caries attack in the primary teeth for an individual child can be expressed by the number of decayed (d), missing (d) and filled (f) teeth or tooth surfaces. For a given population this is reported as mean value (dmft), and essentially describes average lifetime caries experience, including its treatment. Depending on survey methods, examination criteria and reporting preferences, caries experience in the primary dentition can also be reported as decayed and filled teeth (dft) decayed, missing and filled surfaces (dmfs), decayed and filled surfaces (dfs), or decayed, extracted and filled teeth (deft). With secular declines in dental caries in some populations, these presented averages can be less meaningful, with only a small proportion of the sample experiencing disease and the majority disease free.National

data on ECC in the UK is available from oral health surveys of preschool aged children conducted as part of the National Diet and Nutrition Surveys in 1992/3 (Hinds and Gregory 1995) and 1997 (Walker *et al* 2000). Table 2.1 presents data from these national studies as well as findings from other UK studies that report data for ECC from different cities and localities. These previous national data and more recent studies in major cities (Glasgow and London) suggests the ECC prevalence in preschool children in the UK to be in the range 25-30%. It should be noted that comparisons between these data sets are difficult due to differences in age groups, and socio-demographic factors among the sub-populations sampled, (e.g. ethnicity and socioeconomic status) however the data do reveal regional differences.

Table 2.1: Prevalence and severity of ECC in the UK

Location	Study /year	age	N	caries prevalence	caries severity (dmft/dft)	Sampling method / examination criteria
East Cumbria (England)	Jones and Nunn (1995)	3 years	135	18.5%	0.59	Multistage cluster random sample (post code districts) Single trained and calibrated examiner, Visual examination. Mirror, probe, portable light. BASCD criteria. Caries diagnosis d3.*
UK (national survey)	Hinds and Gregory (1995)	1.5-4.5 years	1658	17%	1.3 (age 3.5-4.5 years)	Multistage, random sample. Single examiner. Visual examination. BASCD criteria. Caries diagnosis at d3.
UK (national survey)	Walker *et al* (2000)	4-6 years	1726	37%	0.2	Multistage, random sample (private households - post codes). Multiple examiners. Visual examination. Mirror, probe, portable light. Caries diagnosis at d3.
Glasgow and Clyde	McMahon *et al* (2010)	3 years	10,022	25%	1.0	Cluster Random sample of all preschools in city. Stratified by area deprivation scores. Three trained and calibrated dentists. Modified BASCD criteria. Caries diagnosis at d3.
North east London	Marcenes *et al* (2013)	3-4 years	1,285	24%	0.92	Cluster random sample of preschools form 3 city boroughs. Single examiner. Visual examination. BASCD criteria, Caries diagnosis at d3.

*d3 = caries into dentine

2.3.1.2: North America

In the US, national data on children's oral health has been described by the National Health and Nutrition Examination Survey (NHANES III) which have been conducted from 1998 to 1994 and from 1999-2004. These large, national surveys have been used as the yardstick to monitor progress towards reducing dental disease among young children in the US (Edelstein *et al* 2009). Data from the most recent of these studies indicate that the prevalence of dental caries in children aged 2 to 5 years increased from 24% in 1994-1998 to 28% in 1999-2004 (Dye *et al* 2007) (Table 2.2), with 72% of decayed surfaces remaining unfilled (Tinanoff and Reisine 2009). Findings from smaller samples based in cities and States (Boston, Connecticut, Arizona) are consistent with the national picture. A notably higher prevalence and severity were reported in studies undertaken in Alaska and northern Canada but theses samples of preschool children were predominantly from Native and First Nation communities (Table 2.2).

2.3.1.3: Continental Europe and Australia

Findings from continental Europe show considerable variation, with generally low prevalence and severity of ECC in Northern and Western Europe: Switzerland (Mengahnini *et al* 2008) , Sweden (Bankel *et al* 2006), Belgium (Declerk *et al* 2008), Italy (Ferro *et al* 2010, Nobile *et al* 2014) and Greece (Boka *et al* 2012) but higher disease levels in Southern and Eastern areas: Poland (Szatko *et al* 2004), Kosovo (Begzati *et al* (2010) (Tables 2.3, 2.4). Again, differences in sampling methods and examination criteria may account for some of this variation.

Australian studies on preschool children show a much higher caries prevalence than those from the developed countries in Europe and the US ibid. Data from the North Brisbane area (Hallet and O'Rourke 2002) and rural Western Australian (Kruger *et al* 2005) both found a higher prevalence in non-Caucasian children with the latter study finding caries experience in Aboriginal children double that of non-Aboriginal children (Table 2.4).

Table: 2.2 Prevalence and severity of ECC in developed countries – North America

Region / country	Author (year)	Age / age range	N	Caries prevalence	Caries severity	Sampling method / examination criteria
National NAHNES III	Dye *et al* (2007)	2-5years	1988-1994 15,133 1999-2004 14,504	24.2% 27.9%	dft: 2.15 2.58	Multistage, stratified random sample of households. Trained and calibrated examiners (dentists and dental hygienists). Number not stated. Visual and tactile examination. Mirror, probe, portable light. Mobile screening clinic. Caries diagnosis at d3.
Arizona	Tang *et al* (1997)	2-5 years	5,171	24.6%	dmft 1.35	Stratified cluster random sample of children attending, Early Head-Start Well-child clinics, health fairs and day care with stratification by region size .Five trained dentists. Visual examination. Mirror, probe, artificial light. Diagnostic criteria not specified. Caries diagnosis at d2.Water fluoride level 0.6ppm
Connecticut	Montenero *et al* (2005)	2-5 years	517	38.%	dmfs: 3.00	Non-random sample of Head-Start Children attending for annual health screening. Two trained and calibrated examiners. Visual and tactile examination. Sharp probe, mirror, torch. Radike criteria. caries diagnosed at d2
Boston	Johansson *et al* (2010)	1-4 years	1,206	33%	deft: 2.78	Non-random. Consecutive children attending Well-child clinics in Boston over 12 months. Two trained and calibrated examiners (hygienists). Visual examination. Mirror, probe, good light. Drury (1999) criteria. Caries diagnosed at d1-d3.(Majority non-white ethnicity)
Alaska	Phipps *et al* (2012)	1-5 years	8,461	54%	dmft: 3.5	Native children attending Well-child clinics and preschools stratified by geographic area. One hundred and seventy-eight trained examiners (dentists, hygienist, and dental therapists). Not calibrated. No examination criteria
Manitoba (Canada)	Schroth *et al* (2005)	6 years-olds	408	53.7%	dmft: 4.2	Non-random. Preschool children in urban, First Nation communities. Single examiner, portable chair and light. Knee to knee position for youngest children. WHO criteria. Caries diagnosed at d3.

Table 2.3: Prevalence and severity of ECC in developed countries - Europe

Region / country	**Author (year)**	**Age / age range**	**N**	**Caries prevalence**	**Caries severity**	**Sampling method / examination method**
Italy (North) Veneto region	Ferro *et al* (2010)	3-5 years	1410	28%	dmft: 0.70	Cluster random sample of kindergartens in one health district. All children in selected preschools included. Two examiners (No information on training). Visual and tactile examination, mirror, probe, portable light. WHO criteria Caries diagnosis at d3.
Italy (Southern)	Nobile *et al* (2014)	3-5 years	540	15.9%	dmfs: 0.94	Cluster random sample of all kindergartens in city (Lamezia Terme) and simple random sample of children in selected kindergartens Single trained and calibrated examiner. Visual and tactile examination. Mirror, probe, natural light. WHO criteria. Caries diagnostic threshold not stated. S-ECC=Caries on 1 or more smooth surface in primary maxillary teeth
Sweden	Bankel *et al* (2006)	2-3 years	221	18%	def: 0.6	All children in city of Goteburg. Two trained and calibrated examiners. Visual examination at Public Dental Clinics. Mirror, probe, d3- Koch (1967) criteria
Greece	Boka *et al* (2013)	3-5 years	804	22.6%	dmfs: 1.3	All children in all municipal kindergartens in one city. Single trained examiner. Visual examination, mirror and penlight, no drying. No examination criteria specified. S-ECC=caries on labial surface of 1 or more maxillary incisors
Switzerland (Zurich)	Mengahi ni *et al* (2008)	2 year-olds	771	12.6%	not reported	Simple random sample of children in Zurich. Selected children invited to be examined (at home) 3 trained and calibrated examiners. Visual and tactile examination. Mirror, probe, fibre optic light, cotton roll .Caries diagnosed at precaviation and cavitation (Dury 1999 criteria). S-ECC=Cavitation in all maxillary incisors.

Table 2.4: Prevalence and severity of ECC in developed countries- Europe / Australia

Region / country	Author (year)	Age / age range	N	Caries prevalence	Caries severity	Sampling method / examination criteria
Belgium	Declerck *et al* (2008)	3-5 years	1,250	6.9% age 3 30.8% age 5	not reported	Stratified cluster random sample of kindergartens (stratified by school type with probability proportional to size) school type = state/ municipal/ private. All children in sample. Eight trained and calibrated examiners. Visual examination, mirror with built in light source, CPITN probe. BASCD criteria. Caries diagnosis at d3.
Kosovo	Begzati *et al* (2010)	1-6 years	1,008	86%	dmft: 5.8	Stratified cluster random sample of kindergartens in city of Prishtina. Two trained and calibrated examiners. Visual examination. Mirror and torch. No criteria specified. Caries diagnosed at d3.(Follow-up examinations after 1 year)
Poland	Szatko *et al* (2004)	3 years-old	1,114	56.2%	dmft: 2.9	Stratified random sample of 3 year-old children. Stratified by administrative district (urban/rural). Twenty nine trained and calibrated examiners. Visual examination. Mirror, probe, headlamp. WHO criteria. Caries diagnosis at d3. Child examined at home.
Western Australia	Kruger *et al* (2005)	2-5 years	70	60%	dmft: 2.95	Non-random. All children attending preschools and health centres in one town (12% population Aboriginal) Two trained examiners. Visual examination. Mirror, probe, torchlight. WHO criteria. Caries diagnostic threshold not stated (d3 assumed). S-ECC= caries in 2 or more maxillary anterior teeth (water naturally fluoridated 0.3ppm)
Australia North Brisbane	Hallet and O'Rourke (2002)	4-6 years	1,668	43.7%	dmft: 1.4	Simple random of children from all state preschools in region by zone. Eight trained and calibrated examiners (dental therapists). Visual diagnosis. Mirror, artificial light. BASCD criteria. Caries diagnosed at d3.

2.3.2.4 Developing countries (including the Caribbean)

Tables 2.5 to 2.9 describe findings from caries prevalence studies among preschool children from several developing countries in Asia and the Far-east, the Middle-East, Africa, Latin America and the Caribbean. Notwithstanding differences in study design and examination methods reports from India (Sankeshwari *et al* 2013, Srimritvir *et al* 2009, Virdi *et al* 2010, Sri Lanka (Perara 2012) Pakistan (Dawani *et al* 2012,) and mainland China (Zhang *et al* 2014) show high prevalence and severity of ECC (30-85%). Findings from Singapore (Gao *et al* 2009, Hong *et al* 2014), Thailand (Vachirarojpsian *et al* 2004) and Hong Kong (Lo *et al* 2009) are more consistent with levels in the UK and Europe but these areas have fluoridated water. Data from African studies in Tanzania Masumo *et al* 2012), Uganda (Kiwanuka *et al* 2004) and South Africa (Postma *et al* 2008) show large variations in prevalence , ranging from very low to very high rates (4%-65%) but this may be influenced by age differences, urban versus rural-based samples and inclusion of communities with naturally fluoridated water.

High prevalence and severity was reported among Middle-Eastern countries (Saudi Arabia (Al- Malik *et al* 2003), Kuwait (Al-Mutawa *et al* 2010), United Arab Emirates (Hashim *et al* 2009) and several studies across Brazil: Dini *et al* (2000), Azevedo *et al* (2005), Piovesan *et al* (2010), Gradell *et al* (2011), Rosenblatt and Zarzar (2002).

Very little data on ECC has been reported in the Caribbean region. Lopez de Valle *et al* 1998 reported a very high prevalence (62%) in Puerto Rico although this included non-cavitated lesions. In Antigua an island in the English-Speaking Caribbean, caries prevalence was 33% among 482, 3 to 4-year-old children with dmfs of 1.26 and S-ECC present in 4.6% of the sample (Vignarajah and Williams 1992). In a similar island in the British West Indies, Anguilla caries prevalence among children aged 36-71 months was 21% (Adewakun and Beltran-Aguilar 2003). Also of note was a high prevalence of decay in primary molars where they were often the only affected teeth and the fact that this study followed closely the recommendations on description and reporting of ECC recommended by Drury *et al* (1999).

Summary

Disease levels for ECC in developed countries and regions such as the US, the UK and continental Europe show broadly similar patterns for prevalence, generally in the range of 20-30%. However there are also some regions of higher prevalence, in particular in Eastern Europe and among First Nations and Aboriginal communities in North America and Australia, respectively, suggesting socio-demographic and cultural influences on ECC.

Data from developing countries indicate a prevalence of ECC generally higher than that found in developed countries of the UK, US and Western Europe with most in the range 30-70%. Similar to developed countries, several studies from developing countries show skewed data with disease being concentrated in a minority of children.

Table 2.5: Prevalence and severity of ECC in developing countries – Asia

Region / country	Author (year)	Age / age range	N	Caries prevalence	Caries severity	Sampling method / examination criteria
India Karnataka	Sankeshwari *et al* (2013)	3-5 years	1,250	63.2%	dmft: 3.04	Simple random sample. Children selected from preschools in 4 city zones. Single trained and calibrated examiner. Visual examination using mouth mirror and "adequate' illumination. WHO criteria. Caries diagnosed at d3.
India (Ludiana city)	Simratvir *et al* (2009)	3-5 years	608	52.9% (age 3) 45.1% (age 4) 58.6% (age 5)	deft: 1.82 (age 3) 1.57 (age 4) 2.21 (age 5)	Random cluster sample. All children from 6 preschools clusters. Single examiner (no information of training) Visual examination using mouth mirror, spatula natural light. Caries diagnosed at d3.
India (Haryana)	Virdi et al (2010)	1-5 years (mean 4.3 years)	709	68.5% S-ECC = 42%		Non-random. Children attending paediatric dental department No information on examiner training or examination criteria. Caries diagnosed at d_3. (Possible overestimation of ECC due to sample frame). S-ECC= (AAPD definition)
Sri Lanka (Ghampaha)	Perera (2012)	2-5 years	410	38%	deft: 1.41	Non random. Children attending for immunization at Child Welfare Clinics (CWC). Two examiners - medical doctors trained and calibrated for dental exam. Visual examination using tongue spatula /'good' light / no mirrors. (Possible underestimation of ECC due to limited view of upper molars)
Pakistan (Kerachi)	Dawani et al (2012)	3-6 years (mean 4.3 years)	1000	51%	dmft: 2.08	Random cluster sample of preschools from 11 city districts. Single trained and calibrated examiner. Visual / tactile with use of CPI probe to confirm caries diagnosis.WHO criteria. Caries diagnosed at d3

Table 2.6: Prevalence and severity of ECC in developing countries (continued) - Far-East

Region / country	Author (year)	Age / age range	N	Caries prevalence	Caries severity	Sampling method / examination criteria
Singapore	Gao *et al* (2009)	3-6 mean age 4.8 years	1782	40% S-ECC	deft: 1.54	Stratified random cluster (preschool Single trained examiner. Visual and tactile examination in portable dental chair – mirror, probe, fibre-optic light. Caries diagnosed at d3. S-ECC=16.5% (caries on 2 or maxillary incisors) (Fluoridated community)
Singapore	Hong *et al* (2014)	mean age 3.3 years	190	31%	dft: 1.0	Non-random. Children attending for immunization at 6 medical clinics. Single trained and calibrated examiner. Visual / tactile examination with use of mirror and probe, artificial light. Cavitation at d2 and d_3. (Fluoridated community).
Thailand	Vachirarojpsian *et al* (2004)	6-19 months	520	40.8%	not reported	Non-random. Children of families attending health centres. Two trained and calibrated examiners Visual examination. Mirror, natural light. Modified WHO criteria. Caries diagnosed at d3
Hong Kong	Lo *et al* (2009)	3-5 years mean age: 3.9 years	1343	35%	dmft: 1.5	Simple random sample from children attending 12 preschools stratified by enrolment size. Two trained and calibrated examiner. Visual examination with mirror and LED light. WHO criteria. Caries diagnosed at d3 (Fluoridated community)
China (Bulang province)	Zhang *et al* (2014)	5 year-olds	723	85% S-ECC= 38% (pufa index	dmft: 5.8	Non-random. Rural population. Children accessed through preschools and villages community centres. Single trained and calibrated examiner. Visual examination. Mirror, LED light. WHO criteria. Caries diagnosed at d3.

Table 2.7: Prevalence and severity of ECC in developing countries (continued) - Middle-east / Africa

Region / country	Author (year)	Age / age range	N	Caries prevalence	Caries Severity	Sampling method / examination criteria
Saudi Arabia (Jeddah)	Al-Malik *et al* (2003)	3-5 years	987	73% S-ECC=34%	dmft: 4.8	Stratified random cluster sample of preschools in city. Stratified by school funding (Private / Public). Single trained and calibrated examiner. Visual examination (mirror and cotton rolls), portable light. BASCD criteria. Caries diagnosed at d3. S-ECC= smooth surfaces of 2 or more maxillary incisors
Kuwait	Al-Mutawa *et al* (2010)	4-5 years	1,277	68% (age 4) 76% (age 5)	dft: 3.7 age 4 4.8 age 5	Multistage, stratified random cluster sample. Stratified on region size and number of kindergarten. Five trained and calibrated examiners. Visual examination und artificial light. Mirror and ball-end probe. WHO criteria. Diagnostic threshold not stated.
Saudi Arabia (Riyadh)	Wyne (2008)	3-5 years mean age 4.7	789	74.8%	dmft: 6.1	Cluster random sample from all preschools in the city. Two trained and calibrated examiners. WHO criteria. Diagnostic threshold not stated.
United Arab Emirates (Ajman)	Hashim *et al* (2009)	5-6 years	1,036	Not reported.	dmft: 4.0 age 5	Random cluster sample of preschools Single trained and calibrated examiner. Visual examination, Mirrors, daylight. WHO criteria. Caries diagnosed at d3.
Tanzania (Manyara Uganda (Kampala)	Masumo *et al (2012)*	6-36 months	1221	3.7% Tanzania 17.6% Uganda	not presented	Non-random. Children attending immunization outreach clinics (including mobile clinics) in Tanzania (covering very large geographic areas). Two trained and calibrated examiners. Visual examination. Mirror and gauze. BASCD criteria. Caries diagnosed at d3. Manyara Fluoridated

Table 2.8: Prevalence and severity of ECC in developing countries (continued) - Africa/ Latin America

Region / country	Author (year)	Age / age range	N	Caries prevalence	Caries severity	Sampling method/ examination criteria
Uganda (Kampala and Nakawa)	Kiwanuka *et al* (2004)	3-5 years	589	45% age 3 59% age 4 65% age 5	dmft: 1.4 age 3 1.9 age 4 2.1 age 5	Random cluster sample (urban/ peri-urban preschools) Stratified by size. All children in selected preschools. Single trained and calibrated examiner.Visual examination. Mirror and probe WHO criteria. Caries diagnosed at d3.
South Africa	Postma *et al* (2008)	3-5 years	5,882	55.0% S-ECC= 28%	overall mean not given	Two-stage random cluster. Preschools stratified by geographic location (urban, peri-urban, rural, Examiner information not given. Wyne Classification: type I (mild), II (moderate), III (Severe). S-ECC= caries on maxillary incisors (sample included fluoridated communities)
Brazil (Araraquara)	Dini *et al* (2000)	3-4 years	245	46.0% S-ECC= 23%	dmft: 1.8	Systematic random sample of children attending municipal kindergartens. Single trained and calibrated examiner. Visual examination. WHO criteria. Caries diagnosis at d3. S-ECC=caries in primary incisors)
Brazil	Azevedo *et al* 2005	3-5 years Mean age 4.3	369	Overall prevalence not reported. S-ECC= 36%	not reported	Random sample of children attending public health centres. Single examiner. Visual examination using mirror and gauze. WHO criteria. Caries diagnosis at d3. only S-ECC reported =caries in smooth surface of 1 or more maxillary incisors
Brazil (Santa Maria)	Poivesan *et al* (2010)	1-5 years \	455	33% (age 3) 43% (age 4)	dmft: 0.8 1.0 (age 3) 1.7 (age 4)	Two stage. Cluster random health centres. Systematic sample of children attending national vaccination programme. Eight trained and calibrated examiners. Children examined in dental chair. WHO criteria. Caries diagnosis at d3.

Table 2.9: Prevalence and severity of ECC in developing countries (continued) - Latin American / Caribbean

Region / country	Author (year)	Age / age range	N	Caries prevalence	Caries severity	Sampling method/ examination criteria
Brazil (Macapa)	Gradella *et al* (2011)	2-4 years	765	62.0% S-ECC =42%	Not reported.	Systematic sample of children attending national vaccination programme. Fifteen trained and calibrated examiners. Visual exam. WHO criteria. Caries diagnosis at d3.S-ECC=pufa index – presence of severely decayed teeth + visible pulpal involvement / fistula /abscess
Brazil (Recife)	Rosenblatt and Zarzar (2002)	1-3 years	486	46.2% S-ECC=28.4%	dmft: 1.29	Non-random. Convenience sample children attending a paediatric clinic. Four trained and calibrated examiners. Visual examination. Natural light teeth dried with gauze. Caries diagnosis at d2. S-ECC=caries on 1 or more maxillary incisors
Puerto Rico	Lopez De Valle *et al* (1998)	6mths to 4years	167	62.0%	Not reported	Non-random. Families in Head-Start programme. Two examiners. No information on training. Visual and tactile examination. Mirror and probe. Caries diagnosis at d1.
Antigua	Vignarajah and Williams (1992)	3-4 years (n=)	482	Overall prevalence not reported. S-ECC=4.6%	dmft: 0.8	All (60) preschools in the island (urban and rural) included. All children included. Single examiner. No information on training. Visual examination using mirror under natural light. No diagnostic criteria described. S-ECC = caries on 2 or more maxillary incisors (*Water naturally fluoridated)*
Anguilla	Adewakun and Beltran-Aguilar (2003)	2-5 years (n=)	523	37.0% S-ECC=17%	dmfs: 3.72	All children enrolled in preschools in the island. Single trained and calibrated examiner. Visual examination. Mirror, probe, natural light, no drying. NIDCR criteria (includes precavitated lesions). Caries diagnosis at d2. S-ECC=caries on 1 or more smooth surfaces on maxillary incisors

2.4: Risk factors for ECC

The dental caries process and risk factors for the development of ECC are reviewed in the following sections.

2.4.1: The dental caries process

Dental caries is a disease process that can potentially affect any tooth surface in the oral cavity (child or adult) where dental plaque is able to accumulate over time (Kidd 2005). Dental plaque is a natural biofilm composed of a bacterial community whose active metabolism of fermentable dietary carbohydrates (e.g. sucrose), enables attachment to the tooth surface along with production of acid which can reduce the plaque pH sufficiently to cause demineralization of the enamel surface. As enamel can also remineralize due to the alkalinity of saliva and availability of dissolved minerals (calcium and phosphorus), the caries process is dynamic, alternating between destruction and repair. When the destructive phase is predominant, breakdown of the enamel surface leads to cavitation and bacterial infection of the underlying dentine. This can result in further destruction of the tooth, death of the pulp and spread of the infection into the surrounding tissues, causing pain (Kidd 2005).

The carious process can therefore be seen as the outcome of complex interactions between plaque bacteria, available substrate and host defences mechanisms (Seow 1998). As first described by Keyes (1963), the essential requirements for initiation of the caries process can be summarized as: oral microflora on a susceptible tooth surface in the presence of fermentable carbohydrate, over a period of time.

2.4.2: The caries process in young children

Beyond these basic conditions for occurrence of the disease, other unique risk factors can influence the development of caries and rate of progress in infants and young children (Seow 1998). In young children teeth are newly erupted with bacterial flora and host defence systems in the process of being developed. The oral environment is not static and during this period the child (under the influence of the parent/caregiver) will experience a dietary transition through breast and / or bottle feeding, to introduction of first solid foods (Harris *et al* 2004).

Understanding the caries disease process in young children is vital for its management and has increasingly focused on the concept of risk assessment to enable effective clinical decision making for prevention and management (Tinanoff and Reseine 2009). Several reviews have been undertaken to determine the main risk factors for the development of ECC (Vadikas 2008, Tinanoff and Reseine 2009, Harris *et al* 2004). It has been established that the interaction between biological and socio-behavioural factors is highly complex (Petti 2010).

Tinanoff and Reseine (2009) categorize the various risk factors into 8 main themes:

1. Microbiologic factors.
2. Visible plaque
3. Dietary factors.
4. Enamel developmental defects.
5. Socioeconomic status.
6. Sociocultural factors.
7. Psychosocial factors.

2.4.3: Microbiological factors

The principle bacteria isolated from children with ECC are 'mutans streptococci' (MS), being in the main *S. mutans* and *S. sobrinus* (Seow 1998, Weber-Gasparoni 2012). MS are considered particularly important with respect to caries aetiology and caries risk in preschool children (Tinanoff and Reisine 2009, Harris *et al* 2004, Grindefjord *et al* 1996, Zoitopoulus *et al* 1996). Although other oral bacteria in the plaque biofilm are known to be involved, MS has virulence factors specific to its role in the caries process, making it more effective. These factors have been summarized by Seow (1998): (a) ability to synthesize water-insoluble glucans from sucrose that increase the thickness of the plaque biofilm and allow it to adhere to tooth surfaces and enhance the rate of sugar diffusion to the deeper layers (b) synthesis of intracellular polysaccharide which supports continued acid production even when oral substrate availability is low and (c) maintenance of a low pH in the oral environment and its high tolerance of this level of acidity (d) very high acid production that drive demineralization (e) ability to replace other less virulent dextran-producing bacteria such as *S. mitis* and S. *sanguis* through the production of the enzyme dextranase. It should be noted that methods of sampling for oral bacteria vary across studies and

include: tongue scraping, plaque samples and saliva samples (stimulated and un-stimulated) but following incubation, counts are generally expressed as colony forming units (CFU).

Lactobaclli, although associated with the caries process (Hallosten *et al* 1995, Aaltonen and Tenovuo 1994, Zoitopolous 1996), are not as closely correlated to presence of ECC, probably due to their inability to initiate the caries process and most likely to be more directly involved in caries progression (Seow 1998, Harris *et al* 2004).

Several reviews have found an increased risk of ECC associated with the presence of MS (Petti 2010, Harris *et al* 2004 and Vadiakas 2008). Specifically, ECC risk increases with higher bacterial counts of MS (Seow *et al* 1999, Milgrom *et al* 2000, Thibodean and O'Sullivan 1999, Zoitopolous 1996).

In a study of the experience of ECC among different ethnic differences in south London, Zoitopolous (1996) reported that although dmft scores in 3-4 year-olds Afro-Caribbean children were lower than Caucasion children, the relationship between ECC and MS levels was consistent in both populations.

MS is not usually detectable in infants and young children before tooth eruption (Harris *et al* 2004), hence early colonization (before 12 months), has also been implicated in increased risk of ECC (Alaluusua and Renkonen 1983, Kohler and Andreen 2010, Thibodeau and O'Sullivan 1999). This early colonization has been attributed mainly to transmission of cariogenic bacteria from the primary caregiver to child (Tinanoff and Reisine 2009) both vertically (mother to child) and horizontally (other family members or day-care staff) (Vadikas 2008, Weber-Gasparoni 2012). This would most commonly be via salivary transfer either directly (kissing) or indirectly (e.g. using the mouth to clean pacifier, pre-tasting / chewing of baby food), (Seow 1998, Aaltonen 1991, and Aaltonen and Tenouvo 1994).

Douglass and Tinanoff (2008), in their review of 46 studies concluded that strong evidence demonstrated that mothers are the primary source of MS colonization of their child and this transmission could also be influenced by maternal MS levels

Maternal salivary concentrations measured in colony forming units (CFU) of 10^5 were associated with 52% infection rate in their children, compared to 6% when the maternal saliva concentration was 10^3 CFUs or below (Seow 1998). However, Mitchell *et al* (2009) reported that from plaque and saliva obtained from mothers and children aged 18 months to 6 years with severe ECC, 41% of children had MS strains from the

mother, whereas 74% had strains from another source. They concluded that while evidence for maternal transmission was observed it was neither the exclusive nor predominant mode of MS acquisition in children with S-ECC.

Debate therefore still exists with respect to whether MS levels can reliably predict development of ECC. For instance, Thenisch *et al* (2006) in their review of studies from 1966 to 2003, to assess the reliability of MS as predictor of ECC risk, state that confounding by other variables makes interpretation difficult. To further confuse the role of MS, some research has also indicated that transmission of saliva from mother to child may be protective, by increasing resistance to caries (Aaltonen and Tenovuo 1994). A recent double-blind randomized controlled trial of mothers with active caries and their preschool children reported that xylitol wipes were effective in reducing caries incidence compared to a placebo suggesting that minimising MS levels could be an adjunct to prevention of ECC (Zhan *et al* 2012). In an another RCT Kholer and Andreen (2010) found that although an intensive preventive regime for mothers at high risk of caries (based on high MS levels) was shown to be effective in reducing early transmission of MS to their children and effective in reducing caries over a long term, however several mothers found the regime to arduous, and dropped out of the trial suggesting that the appropriateness of such intervention would need further assessment.

2.4.4 Visible plaque

Cross sectional studies have reported a high correlation between visible plaque on primary teeth and caries risk (Alaluusa and Malmivirta 1994, Bankel *et al* 2006, Declerk 2008) and in the reviews by Seow (1998) and Harris *et al* (2004). In a recent cross-section study of 804 children aged 3-5.5-years-old in Greece, Poisson regression analyses found significant association between the presence of visible plaque and dmfs (Boka *et al* 2013).

In a case-control study of children in childcare facilities and public hospitals in Western Australia, visible plaque was found to be a common risk factor for ECC when compared to caries free children Seow *et al* (2009).

In a multivariate analysis of children enrolled in a feeding programme in Iowa, those with visible plaque on the maxillary incisors had a 2.78 times greater risk of ECC (Nair *et al* 2010). The presence of visible plaque has been associated with lower maternal educational level (Leroy *et al* 2012) and Gibson and Williams (1999) found

that children from families with a non-manual head of household were more likely to have parental help in tooth brushing, suggesting that visible plaque may be related to parental behaviours and SES. In a longitudinal cohort study of 1057 Belgium children from age 3 to 5 years, multivariable logistic regression analyses found the presence of visible plaque accumulation on at least one tooth at age 3 was a significant risk factor for an increment in caries experience by age 5 (Leroy *et al* 2012). Visible plaque was also significantly associated with ECC among a sample of over one thousand infants and children aged 6-36 months attending health facilities in Uganda and Tanzania (Masumo et al 2012).

Since visible plaque on anterior teeth in young children has also been associated with MS colonization and re-growth (Lee *et al* 2008), it has been suggested that plaque on anterior primary teeth could be used as relatively simple screening method for young children at risk of ECC (Tinanoff and Reisine 2009).

2.4.5: Dietary factors

There has been much research on the relationship between diet and dental caries, with most studies focusing on the role of sugar, specifically sucrose (Moynihan 2003, Moynihan 2002, Tinanoff and Reisine 2009). Evidence for the role of sugar on caries prevalence and progression comes from human observational and interventional studies, animal experiments, plaque pH studies, enamel slab and incubation experiments (Moynihan 2003). Frequent consumption of sugar leading to a significant increase in caries experience was one of the main findings of the Vipeholm study (Gustaffson *et al* 1954), which remains the most extensive interventional study on humans. The disaccharide sugar, sucrose, appears to be particularly susceptable to plaque metabolism due to the ability of MS and other cariogenic bacteria to utilise it for the synthesis of extracellular glucans. These glucans aid adhesion, acid production and diffusion of substrates leading to proliferation of the plaque bio-film, demineralization of enamel and dentine with resulting progression of the caries lesion.

2.4.5.1: Non-milk extrinsic sugars (NMES)

The UK Scientific Advisory Committee on Nutrition introduced what has now become standard nomenclature to distinguish between cariogenic and non-cariogenic sugars: those implicated in caries causation have been classified as Non-Milk Extrinsic Sugars (NMES), that is, those sugars which are added to foods and drinks

during processing, such as sucrose, glucose and fructose. Sugars occurring in the cells of fruits and vegetables and eaten as such, are considered non-cariogenic and termed Intrinsic Sugars (Levine and Stillman-Lowe 2009).

Sugar in the diets of infants and preschool children and its relationship to ECC has been investigated in many populations. Frequent sucrose consumption by preschool children has been reported as an independent risk factor for ECC by several studies (Grindefjord *et al* 1996, Wendt *et al* 1996, Rodriguez and Sheiham 200, Karjalainen *et al* 2001).Although the monosaccharides, glucose and fructose, found in some foods and drinks have similar acidogenicity to sucrose (i.e. the ability to cause a drop in plaque pH), sucrose appears to be more significant in the development of ECC (Seow 1998).

Sweetened foods have been implicated in several studies (Gibson and Williams 1999, Moynihan and Holt 1996, Ye *et al* 1999, Aalatonen 1991, Cleaton Jones et al 1984).

A longitudinal study of infants and young children in Thailand examined at 9, 12 and 18 months of age found a significantly higher caries incidence among children who started snacking on sugary foods and soft drinks at 5 months of age (Thitasomakul *et al* 2009). Longitudinal studies in Sweden found frequent consumption of sweets during early childhood (1 and 3 years-old) was a strong predictor of proximal caries in 15-year-olds (Alm *et al* 2012). Interestingly, the predictive effect was greater where brushing was infrequent and dental attendance had been poor.

Much of this research is based on questionnaire data but dietary data on young children obtained from adult caregivers can be affected by parental recall. Gibson reanalysed data from the 1995 UK National Diet and Nutrition Survey by undertaking a regression analysis based on information from four-day weighed dietary records that were available from the survey (Gibson and Williams (1999). The study reported that children who ate sweets every day rather than once a week had a 7% higher rate of caries, confirming that frequency of sweet consumption was a risk factor for ECC.

Using 3-day diet records Sankeshwari *et al* (2013) reported that high intake and frequent between-meal consumption of sucrose in foods and drinks, were significantly associated with ECC among a large sample of 3-5 year-olds in Karnataka, Northern India. Daily consumption of sweet snacks (including soft drinks and sweets) was associated with severe ECC (S-ECC) among 431 First Nation children in Manitoba, Canada (Schroth, *et al* 2013) and snacking more than three times day was associated with increased caries risk in a case-control study of 380 Indian preschool children

where cases were recruited with a def > 0 and controls with a def = 0 (Mahesh *et al* 2013).

Importantly a recent Cochrane systematic review (Moynihan and Kelly 2014) confirmed a positive relationship between total daily sugar intake and caries. From a review of 55 eligible studies the authors identified evidence of moderate quality showing that caries rates are lower when intake of NMES is less than 10% of total energy intake.

2.4.5.2: Bottle feeding and comforters

Early Childhood Caries (ECC) associated with sweetened drinks consumed via a feeding bottle has been reported in several studies (Winter 1980, Holt *et al* 1996, Wendt *et al* 1991, Weinstein 1992, Seow 1998).The feeding/nursing bottle has been associated with an increase in caries prevalence and severity, for instance, seventy per cent of children under 5 years of age, referred for extraction of grossly carious teeth under GA were reported to have been given a bottle before bedtime every night (Hunter *et al* 1997). Cultural practices also influence bottle use. The high prevalence of ECC (64%) among preschool-aged children of immigrant families in Canada was found to be related to the common use of a night-time bottle and sweetened comforter, 65% and 85%, respectively, (Harrison *et al* 1997) and a national survey of Asian families in the UK reported that most mothers in the study added sugar to milk given in bottles to their young children (Watt 2000).

Putting a child to sleep with the a sweetened bottle can also influence cariogenicity of its effect on salivary flow rates during sleep decreases oral clearance of sugars and increases contact time between plaque and substrate (Seow 1998). Furthermore, slower oral clearance times at different sites in the mouth may be related to the characteristic presentation of ECC on the maxillary incisors and the buccal surfaces of the mandibular teeth (Hanaki *et al* 1993). Multivariate analysis revealed significant relationship between ECC and reported consumption of sugared drinks at night among a sample of 1,250, 3 year-olds in Belgium (Declerk *et al* 2008). Frequent sugar consumption via sweetened nursing bottles and sweet snacks at night were significant risk indicators for ECC in Australian preschool children (Seow *et al* 2009). In a multivariate analyses of 540 children under 5 years of age in Italy, the use of a feeding bottle and sweetened pacifier were significantly associated with presence of ECC, along with greater number of siblings, lower parent education level, and mother being

in employment suggesting that bottle feeding practices, are also influenced by socio-behavioural factors (Congiu *et al* 2013). It should be noted that most of these studies focus on sugar content and frequency / timing of sugared foods however, more information on the child's overall diet would provide a wider context for prevention health promotion.

2.4.5.3: Breastfeeding

Breast milk is understood to have high nutritional value and health benefits for infants (Kramer 2007), hence exclusive breastfeeding is recommended by international public health bodies for infants for the first six months and as a supplemental nutrition for up to two years (WHO 2003). The American Academy of Paediatrics (AAP) policy on breastfeeding and the use of human milk indicates several health benefits for the child, for example, being protective against acute ear infections, gastroenteritis and asthma (AAP 2012). Compared to Bovine milk, human breast milk has a lower mineral content, more lactose and less protein (Seow 1998), however, its cariogenic potential has been demonstrated in animal models (Peres *et al* 2009). Concerns regarding frequent breastfeeding / delayed weaning and with ECC have also been reported in case studies (Dilley, Dilley and Machen 1980, Curzon and Drummond 1987).

Prolonged breastfeeding and its relationship with ECC has been evaluated in systematic reviews but the findings have been equivocal (Ribeiro and Ribeiro 1998, Valaitas *et al* 2009), with the respect to there being a clear association. A longitudinal study in Brazil, where children were examined at 6 and 12 months and 4 years of age, it was noted that the prevalence of S-ECC (1 or more decayed maxillary anterior teeth), increased when breastfeeding occurred more than seven times a day (Feldens *et al* 2010). These findings were, however, linked with overall high sugar consumption and sweetened bottle use. A longitudinal controlled study involving 1, 3000 children that were exclusively breastfed up to a year old, found no increased risk for ECC, although the use of many examiners who were not calibrated reduces the reliability of these findings (Kramer *et al* 2007). Similarly, Rosenblatt and Zarzar (2004) found no statistically significant relationship between breastfeeding and tooth decay but the number of sugary snacks between meals and a cariogenic diet were strongly related to ECC. Similarly, Mohibi *et al* (2008) found no association between breastfeeding and ECC in a Finnish population where prolonged breastfeeding is the norm. These studies confirm that the relationship between prolonged breastfeeding

and ECC is complex and confounded by biological, social and behavioural factors (Seow 1998).

In an attempt to account for the influence of confounding in relation to breastfeeding, Nunes designed a longitudinal study of children aged 1 to 3.5 years, involving a 'hierarchical theoretical framework' of factors associated with ECC in a low income community where normal / nocturnal / prolonged breastfeeding were common. Twenty per cent of these children were still breastfeeding at one year (Nunes *et al* 2012). Along with breastfeeding, the factors considered included: child's age, general health, mother's educational level, access to dental care, daily sucrose consumption, oral hygiene and *S mutans* counts. Based on their forward multiple Poisson regression, no significant relationship was found between prolonged breastfeeding and ECC when these factors were taken into account. ECC was actually associated with child's age, oral hygiene and sucrose consumption between main meals (Nunes *et al* 2012).

Summary

Overall research suggests that the relationship between breastfeeding and ECC is still unclear, despite the American Academy of Paediatric Dentistry's statement that "ad libitum breastfeeding should be avoided after the first primary tooth begins to erupt and other dietary carbohydrates are introduced" (AAPD 2011). Based on their recent review and the earlier systematic review by White (2008), Salone *et al* (2013) therefore suggest that any policy advising against continuation of breastfeeding beyond 6 months be viewed cautiously and tempered with concerns for the child's general health needs.

2.4.6: Enamel developmental defects.

Defects in enamel can be the result of disturbances during enamel formation. During amelogenesis, reduced enamel matrix results in hypoplasia i.e. thinner enamel that usually appears grooved or pitted. If the matrix is poorly mineralized this presents as hypomineralized enamel with a yellow/brown discolouration (Crawford and Aldred 2005). These conditions have also been termed *quantitative* and *qualitative* defects, respectively (Carvalho *et al* 2011). Enamel defects may be the result of genetic or environmental factors or a combination of both. Genetic causes include amelogenesis imperfecta and environmental include systemic upsets, childhood illness, local factors, antibiotics and excess fluoride ingestion (Crawford and Aldred 2005). Although often more obvious in the permanent dentition, enamel defects also occur in the primary

dentition following a systemic upset or marked physiological changes at birth or neo-natally resulting in abnormal or incomplete enamel maturation. The resulting defects can increase the caries risk in preschool children (Milgrom *et al* 2000, Seow 1998,) due possibly to the greater susceptibility of poorly mineralized enamel to plaque acid and the rough surface aiding plaque accumulation (Tinanoff and Reisine 2009, Hong *et al* 2009, Seow *et al* 2009, Carvalho *et al* 2009 & 2011, Caufield *et al* 2012).

Enamel defects are more common in children who are malnourished, pre-term or low birth-weight (Seow 1998; Seow *et al* 1987).The prevalence of enamel defects in full-term children has been reported as ranging from 13-39% compared to 62% in pre-term/low birth-weight children (Tinanoff and Reisine 2009). In a longitudinal case-controlled study comparing very low birth-weight (VLBW) pre-term children to normal birth-weight (NBW) full-term children at the same Australian hospital, 96% of the VLBW children had at least one enamel defect compared to 45% of the NBW group (Lai *et al* 1997). In this study, defects showing hypoplasia and opacity were those most significantly associated with ECC. Similarly, among children aged 6-36 months, the prevalence of developmental enamel defects (mainly diffuse opacities / hypoplasia in the maxillary incisors), were significantly associated with low birth-weight (Masumo *et al* 2013).

A case-controlled study among children referred for treatment of ECC found that ECC was four times more likely in children who had enamel hypoplasia (Seow *et al* 2009). A study of Head-start children (US publicly funded education, health and nutrition, services for low-income families with young children), reported a higher prevalence of ECC in children with enamel defects (Montenero *et al* 2003) using the modified Developmental Defects of Enamel (DDE) index. In this study 49% of children were found to have enamel defects. Most lesions were on anterior teeth with hypoplasia being the most common. This is similar to the prevalence in a study of children under 5 years of age, in Jedda, Saudi Arabia where 45% had defects and a positive association was noted with ECC (Farsi 2010). Again, upper anterior teeth were those most affected although in this study, demarcated opacities were the most common defects.

In a longitudinal study conducted in children of 12 to 36 months of age in a population with low SES in Northeast Brazil 79% of children had enamel defects at 36 months (using the DDE Index) (Oliveira *et al* 2006). Again enamel hypoplasia and opacities were the most common defects. Multivariate analyses found enamel defects

to be the single predictor of caries development at 36 months, with children presenting with enamel defects being 15 times more likely to develop caries than those with no defects.

In another longitudinal study from Brazil, of 224 children assessed using the DDE index from birth to 54 months, at least one tooth with an enamel defect was found in 81% of children by 54 months of age. Among the 44% of children who had caries, logistic regression analysis found an association between enamel defects, ECC, night bottle-feeding and absence of exposure to fluoride (Targino *et al* 2011). This study was conducted on families from lower socioeconomic groups and this may also have influenced the use of fluoride and feeding practices. However, the findings support the view from previous literature that enamel defects predispose to an increased risk of ECC.

In a cross-sectional study of 1,178 children aged 2 to 5 years-old living in a fluoridated area of Brazil were assessed for quantitative and qualitative defects of enamel using the DDE Index (after cleaning and drying the teeth) and for decayed, missing and filled surfaces (defs with non-cavitated lesions at d_1 and d_2). This study included explicit criteria to differentiate between active non-cavitated lesions, inactive non-cavitated lesions and enamel defects, which all have a similar presentation ECC (Carvalho *et al* 2011). However by contrast, no significant association was found between enamel hypoplasia and non-cavitated lesions in a study on Ugandan children but those with enamel hypoplasia were twice as likely to have cavitated teeth, than those without the condition (Masumo *et al* 2012).

Recently, a new term has been proposed to recognise the association between enamel development defects and severe early childhood caries: '*Hypoplasia-Associated Severe Early Childhood Caries*' (HAS-ECC) (Caufield *et al* 2012). This term acknowledges that in such cases, enamel hypoplasia is already present prior to tooth eruption, hence these teeth are structurally damaged before entering the oral cavity and predisposed to developing ECC once other risk factors are present (Caufield *et al* 2012).

2.4.7: Socioeconomic status

There is a relationship between environmental, social and economic factors and oral health (Locker 2000, Newton and Bower 2005), with the often profound social gradient in general health around the world also affecting oral health (Marmont and

Bell 2011). Exposure to almost all risk factors is inversely related to social position, hence those at the top of the social gradient have better oral health than those below them and this can also present as oral health inequalities in caries levels among preschool children (Watt and Sheiham 1999).

Studies investigating relationships between social gradients and health usually employ measures of socioeconomic status (SES). Measures of SES typically incorporate economic, social, and work status (CDC 2013). These measures are either *Compositional* (proxy) measures e.g. household income, social class, parental employment category, mother's /caregiver educational level or *Composite* measures constructed by combining information about SES from several data sets e.g. area-based deprivation scores (Shavers 2007).

There being no single universally agreed measure of SES, however the available international data on the oral health of young children show a clear trend in the relationship between SES and oral health (Pine *et al* 2004), with overwhelming evidence that ECC disproportionately affects children from lower SES families (Marcenes *et al* 2013).

The oral health of young children in an industrial suburban area in the northwest of England, with a mixed socioeconomic structure was described by Gratrix and Holloway (1994). Using indicators of SES such as home ownership, car ownership, social class and area deprivation scores, they assessed caries in 5-year-old schoolchildren (as this represented the end-point of caries activity in the preschool period). They reported that children with the highest caries experience were those from communities of low SES (Gratrix and Holloway (1994).

A clear social gradient among the dental health of five-year-old children in England was also reported in the last national oral health survey (Davies *et al* 2013). Despite a reduction in the overall prevalence and severity of caries as compared to the 2008 survey (which had the same methodology), variations reported at local area level were positively correlated with the index of multiple deprivation, with the highest levels of dental disease seen in the most deprived areas (Davies *et al* 2013).

The UK National Diet and Nutrition Survey (1993/4) reported that 40% of children aged 1-4 years-old from manual classes had caries experience compared, to 16% from non-manual classes (Hinds and Gregory 1995) and this was confirmed by the subsequent National Diet and Nutrition Survey (2000), which reported that children aged 4-6 years-old, whose mother had no formal educational qualifications, had more

primary teeth with active decay than those whose mother had secondary level qualifications (Walker *et al* 2000).

An inverse relationship was observed between dental caries and social class in 3-year-old children in the north of England, with the lowest prevalence of disease in the higher social classes (Jones and Nunn 1993). Tang *et al* (1997) reported that Arizona preschool children with caregivers in the lowest income category had a mean dmft four times higher than those with caregivers in the highest category. In another more recent UK based study, McMahon *et al* (2010) reported that 3-year-old children living in the most deprived areas of Glasgow, had significantly higher odds of having caries experience. Similarly, using educational level and family income as measure of SES, the third US National Health and Nutrition Examination Survey (NHANES III) showed that the percentage of all children aged 2-5-years with untreated decay, declines consistently as family income increases (Dye *et al* 2007). Despite general reductions in the prevalence of dental caries at the national level in the US, the disease was still highly prevalent among socially disadvantaged children population (Vargas and Ronzio 2006), confirming that ECC is related to a social gradient. The pathway may be in part explained by differences in availability and utilisation of dental care in populations of different economic means, for instance preschool children living in poverty are two times more likely to have decay and half as likely to visit the dentist then their more affluent counterparts (Edelstein *et al* 2009).

Along with the UK and US, other European studies have reported similar findings. For instance, in Italian children aged 3-5-years-old Ferro *et al* (2010) used social class position based on highest occupational level between mother and father to investigate the effect of SES on caries levels. In this study, children from lower social classes were almost twice as likely to have experienced caries as those from higher groups. By contrast, higher parental educational level and the mother being employed significantly reduced the odds of children under 5 years-old being caries-free in Sardinia, Northern Italy (Conjiu *et al* 2013)

A risk factor for higher caries levels among Swedish children aged 2-3 years-old was found to be related to mothers' state of employment (Bankel *et al* 2006). Strong evidence for a social gradient in oral health of preschool children was reported by (Van den Branden *et al* 2013). In their study of 1057 Belgium children, based on logistic and ordinal regression, those with a mother of low educational level were seven time more likely to present with experience of ECC.

2.4.8: Socio-cultural factors

The following sections present the role of socio-cultural risk factors for ECC under the areas of ethnicity and parental knowledge beliefs and attitudes.

2.4.8.1: Ethnicity

Using regression models to control for SES, the risk of ECC was found to be more then three times higher, for Asian families compared to those from White families in a Head-Start programme in California (Shiboski *et al* 2003), suggesting that ethnicity was an independent variable for caries risk in a preschool aged population. Using data from the NHANES III Vargas and Ronzio (2006) reported that while 18% of white children aged 2-5 years had experienced dental decay, the percentage increased to 40% among Mexican American children, who were also more likely to have severe ECC. The authors state that the uneven distribution in caries prevalence among preschool children based on SES and being from an ethnic minority, suggests that oral health inequalities exist among young children in the US. This is consistent with data from the US National Survey of Children's Health, involving 82,000 children aged 2-17 that found Hispanic and Non-Hispanic Black children were more likely to have unmet dental needs than non-Hispanic white children (Fisher-Owens *et al* 2013).

Ethnic minority preschool children from low income families are likely to be from environments where oral health may be a low priority for caregivers, increasing their risk for ECC (Vadikas 2008). Hallet and O'Rourke (2003) in their study of an Australian population found significantly higher caries experience among non-Caucasian children compared with Caucasian groups, with all non-English-speaking children having a higher prevalence of severe ECC.

In Western Europe and the US, being from a minority ethnic group may also link to being a from recent immigrant group. Petti (2010) describes social risk factors for ECC as including low parental education, low household income, lack of awareness of oral health and immigrant status. Immigrant status has been defined as being born of a mother from a non-Western Country (e.g. Eastern Europe, Asia, Africa, Middle East, Central / South America) (Skie *et al* 2006). In their study of Italian children aged 3-5 year-old, Ferro *et al* (2010) determined that those from an immigrant family were 3 times more like to have caries experience. In a survey of 2-year-olds in Zurich, Menghini *et al* (2008) found that children from an immigrant background (mother not

born in Switzerland) had significantly higher caries prevalence than those born to Swiss mothers.

Risk for ECC can also vary within immigrant groups highlighting the effect of cultural differences. For example, data from 3-4 year-old in a multi-ethnic area with several immigrant communities in East London, showed that White Eastern European children had a significantly higher severity of caries experience (dmft of 1.91) than Bangladeshi (1.05), Pakistani (1.11) and White British children (0.56) (Marcenes *et al* 2013). It can therefore be concluded from studies worldwide that being from an ethnicity minority and / or immigrant population are risk factors for ECC.

2.4.8.2: Parental knowledge, beliefs and attitudes

Based on a systematic review of parental influences on the development of ECC, Hooley *et al* (2011) concluded from the 55 studies that met their inclusion criteria, socio-demographic factors such as SES and ethnicity have received more attention than knowledge, beliefs and attitudes, although studies that included these parent level factors can improve the understanding of oral health outcomes in early childhood.

Parental knowledge, attitudes and beliefs influence the health choices they make and the behaviours they model to their child (Hooley *at al* 2011). The process whereby parents transmit and children internalise routines of behaviour is termed primary socialisation (Blinkhorn 1991). Patterns of behaviour, once learned in early childhood often become established routines for the remainder of the child's development.

Higher rates of ECC have been associated with poor parental knowledge and attitudes towards oral health, healthy diets, children's dental needs and use of fluoride (Hooley *et al* 2011).

The relationship between ECC familial and cultural perceptions and beliefs were investigated in a 17-country study by Adair *et al* (2004) using psychometric measures of parent's attitudes about (a) engaging in twice a day tooth-brushing for their child, (b)control of sugar snacking to predict these behaviours in their children. The attitudinal measures were based on three theoretical constructs operationalized into specific questions: Health Belief Model (Rosenstock *et al* 1988) which proposes that an individual's health behaviour is influenced by belief in susceptibility to a disease (*our child eating sugary foods and drinks between meals would cause tooth decay*), Theory of Planned Behaviour (Ajzen 1991) which states that an individual's behaviour can be predicted by their attitudes, subjective norms and perceived

behavioural control *(people in my family feel it is important to help brush my child's teeth twice a day*) and Health Locus of Control (Wallston and Wallston 1978) which refers to the extent of an individual's perceived control over their health outcomes *(it is the responsibility of the dentist to prevent our child getting tooth decay*). Socioeconomic status (SES) was measured by educational level of the caregiver. Although caregiver attitudes toward prevention differed significantly between different SES / cultural groups, these attitudes were least likely to predict the behaviour of twice daily brushing. Overall, parental self-efficacy (i.e. a person's belief in their ability to successfully perform a specific task) was the strongest predictor in the establishment of tooth-brushing habits and controlling sugar snacking (Adair *et al* 2004).

Similarly, self-efficacy among caregivers of Head-Start children in Connecticut was an important predictor of sugar intake in a longitudinal study by Litt and Reisine (1995). In this study, using multidimensional modelling, children of more self-efficacious mothers had less sugar intake which could predict bacterial levels and ECC.

Maternal oral health self-efficacy (OHSE) was also strongly related to tooth brushing frequency in a study of African- American mothers of 1-5 year-olds in low income families (Finlayson *et al* 2007a). In this study, mother's knowledge of oral health was significantly positively related to the child's tooth-brushing frequency. Interestingly those mothers who had more knowledge about their children's oral hygiene needs felt more efficacious, indicating the importance of imparting oral health information.

In this same population Finlayson also reported that maternal *'oral health fatalism'* (OHF) nearly tripled the odds of a child having ECC (Finlayson *et al* 2007a). 'Fatalistic' individuals believe that there is nothing they can do to cure or prevent any condition that they are fated to develop (Petti and Polimeni 2011).

Self-efficacy has also been linked to the concept of *Health Literacy*. Health Literacy has been defined as *'the degree to which individuals have the capacity to obtain and understand basic health information and to make appropriate oral health decisions'* (Reardon 2010). Oral health literacy encompasses educational, social and cultural factors that influence expectations and individual preferences regarding oral health. It is therefore also likely to be related to oral health knowledge and self-efficacy. This was confirmed by an investigation in low-income female caregivers of young children that showed that low oral health literacy was associated with night-time feeding bottle

use and less than daily tooth-brushing, along with decreased oral health knowledge and poor self-rated oral health (Vann *et al* 2010).

2.4.9: Psychosocial factors.

The effect of stress on many chronic illnesses is well established but its relationship to oral health remains unclear. With respect to children's oral health, families of low SES could be assumed to have increased life stress due to financial and social instability, which in turn may impact on the health care of their children (Reisine and Douglass 1998). Together with SES and other environmental factors, psychosocial variables such as parenting stress, anxiety and social support have been theorized as having a role in the development of ECC (Tinanoff and Reisine 2009).

While controlling for behavioural and biological variables, Quinonez *et al* (2001) analysed the effect of psychological factors on ECC in a high risk, minority population of children 18-36 months old. Using the Parent Stress Inventory–Short Form (PSI-SF) they reported that when combined with the effects of ethnicity, oral health behaviour, dietary practices and biological variables, parental stress did appear to have some influence. However parental stress did not independently fit the best predication models Quinonez *et al* (2001).

Similar findings were reported by Tang *et al* (2005) who along with oral health behaviours used the Parent Stress Inventory-Short form (PSI-SF) in their study of ECC in 4-5 year-olds. The 36–item PSI-SF includes the domains: *Parental distress, parent-child dysfunctional interaction* and *difficult child*. In their bivariate analysis parent stress was found to have a definite role in the development of ECC but again, regression modelling indicated that it had little independent effect. This, they suggest, may have been due to the much stronger effect of other social and behavioural determinants such as diet, ethnicity and SES (Tang *et al* 2005). Another explanation offered relates to the limitations of a cross-sectional study design in that the psychosocial variables and behavioural practices present at the time of the onset of caries may differ significantly from those measured at the time of the study.

More recently, Jabbarifar *et al* (2009) employed the PSI (long version) among mothers of 4-6-year-olds in a case-control study in Iran. Although in this study, mothers of children with ECC had greater stress levels than those of caries free children (controls) in some of the PSI domains (e.g. life-stress and relationship with

spouse), the authors did not find a significant association between total parenting stress scores and ECC (Jabbarifar *et al* 2009).

Finlayson *et al* (2007b) reported that among African-American mothers of 1 to 3-year-olds stress was inversely associated with ECC and that each unit increase in stress accounted for a one third reduction in the odds of a child having ECC. Paradoxically, this suggests a possible protective effect of parental stress, contradictory to the findings of Quinonez *et al* (2001) and Tang *et al* (2005). Thus the role of psychosocial factors requires further investigation.

In the theory of 'locus of control' (Wallston and Wallston 1978), mothers who have an internal locus of control are more likely to value their health and pursue health promoting behaviour, whereas those with an external locus believe that good health is due to fate or the influence of factors over which they have no control (Seow 2012). Mothers having an external locus of control have been associated with higher rates of caries experience in their children (Amin *et al* 2006). Parenting style has also been proposed as influencing caries risk in early childhood. In the preschool age-group dysfunctional parenting styles may include lack of persistence with tooth brushing and permissiveness by giving in to children's demands for sweets snacks (Seow 2012).

Another explanation for the role of stress in health was proposed by Antonovsky (1979, 1987) in his theory of 'Salutogenesis'. In this theory, life stress was considered to be ubiquitous and health and illness to be on a continuum. The impact of stress on health of individuals would therefore depend on individual coping mechanisms, might involve material resources, and social support. The construct at the core of this theory is *Sense of Coherence* (SOC). Antonovsky defines SOC as "a global orientation that expresses the extent to which one has a pervasive enduring, though dynamic feeling of confidence that: (i) the stimuli deriving from one's internal and external environments in the course of living are structured, predicted and explicable, (ii) the resources are available for one to meet the demands posed by these stimuli and (iii) these demands are challenges, worthy of investment and engagement". Therefore, someone with a strong SOC will tend to manage the stresses of life better whereas those with weak SOC will tend to be more vulnerable to ill-health (Larsson and Kallenberg 1996). A validated measure of SOC has been developed (the SOC scale), which operationalizes the construct using a 13 item questionnaire (SOC-13) (Antonovsky 2009).In a study of 546 mothers of 5-year-old preschool children in Brazil, Bonanato *et al* (2009) used the SOC-13 to investigate whether parental sense

of coherence was related to their child's oral health status. Multiple logistic regression showed that mothers with a lower SOC were more likely to have children with caries and this was regardless of social class. This lends some support to the findings of Quinonez *et al* (2001) and Tang *et al* (2005), that stress (and how well people cope with it), is a risk factor for ECC.

2.5: Conceptual models

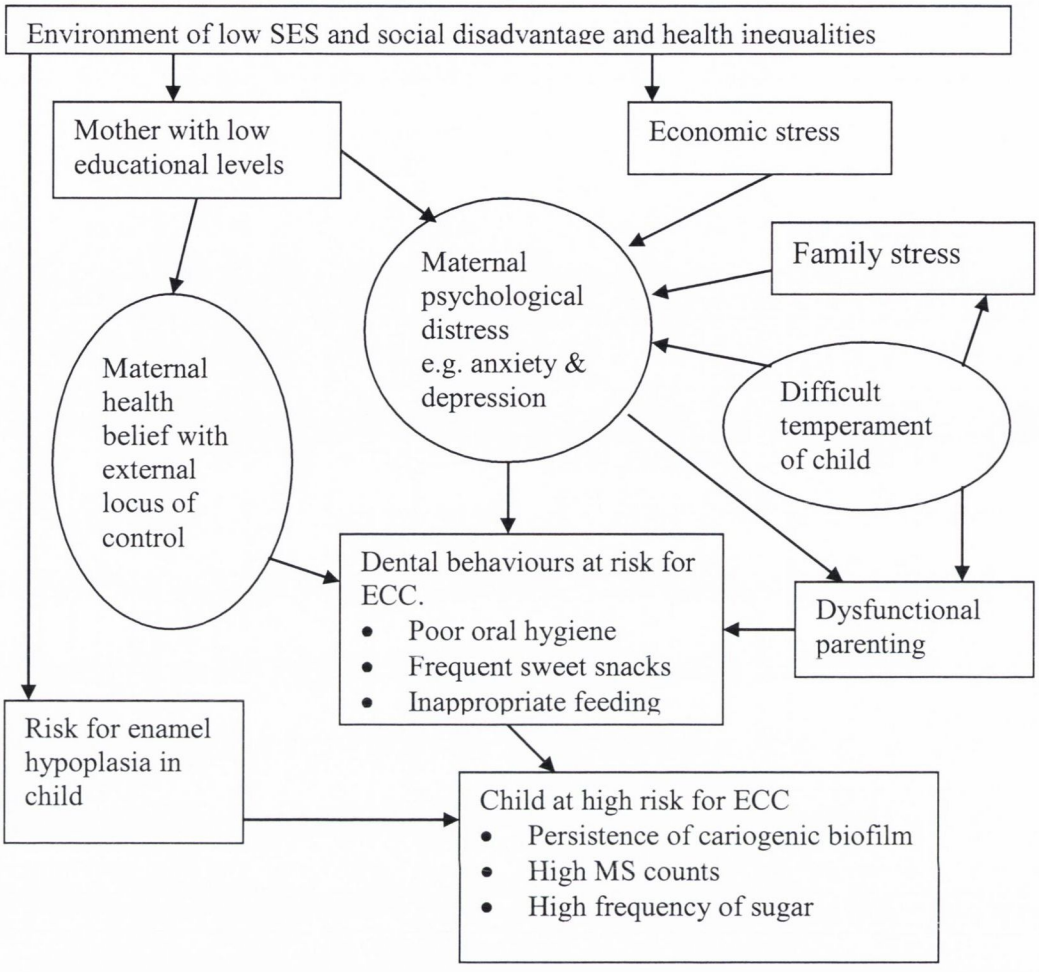
The preceding review for ECC presented the main risk factors for ECC. Hooley *et al* (2011) states that a strength of the research on risk factors for ECC has been the consideration of a range of social, cultural and parenting factors which extend beyond biological factors. The actual causal pathways for the development of caries in preschool children appears to be complex as these risk factors do not work independently but are likely to have a complex interplay. Fisher-Owens *et al* (2007) proposed a multilevel conceptual model to explain the influences on children's oral health. This model includes five key domains of determinants of oral health, as identified from the literature: *genetic and biological factors, the social and physical environment, health behaviours and dental care.* Importantly the authors recognise that the effects of these factors on oral health are not mutually exclusive and occur at the level of the child, family or community suggesting that approaches to address this problem must consider social, environmental and behavioural factors (Table 2.10).

Table 2.10: Multilevel influences on oral health of young children (adapted from Fisher-Owens *et al* (2007)

Risk factors	Level of influence		
	Child	**Family**	**Community**
Genetic and biology	Genetic & biological development. Physical attributes (race / ethnicity) Microflora, host & teeth	Health status of parents	
Social environment	Substrate, diet & microflora	SES, social support, family function, culture, health behaviours, & coping skills of family	social environment capital, culture, community oral health environment
Physical environment	Health behaviours and practices (including injury protection gear)	SES, Family function, physical safety	Social capital, physical safety, physical environment (fluoridation)
Health behaviour	oral health behaviours practices (diet, oral hygiene, fluoride use)	Family composition, function, culture, health beliefs & behaviours, coping skills and self-efficacy	Culture
Dental /medical Care	Use of dental care and insurance cover	Health behaviours & healthcare utilisation (Health literacy) and coping skills of family	Healthcare & dental health care system characteristics

Seow (2012) has proposed a conceptual model that connects social, psychological and behavioural mediating factors involved in EEC, specifically those that impact directly or indirectly on the mother such as distress, anxiety and depression, economic stress, personal health beliefs, parenting styles and temperament of the child, along with behavioural and biological factors: The model shows the complex and overlapping nature of socioeconomic, cultural and psychosocial factors. Seow (2012) states that causal pathways still remain unclear and may need further exploration through qualitative research, particularly aspects of maternal health beliefs and attitudes.

Fig: 2.1: Conceptual model for ECC (Seow 2012)



2.6: Other conditions affecting the dentition in early childhood

The following sections describe the aetiology and risk factors for other dental conditions seen in early childhood (i.e. dental erosion, dental trauma)

2.6.1: Dental Erosion

Affecting both children and adults, dental erosion has been defined as '*the irreversible loss of tooth substance caused by a chemical process that does not involve the action of bacteria*' (Pindborg 1970), Along with dental caries, dental erosion is believed to be the most prevalent oral health problem among preschool children (British Society for Paediatric Dentistry 2003). Dental erosion is one of three recognised factors that can lead to loss of tooth hard tissue, generally referred to as 'tooth wear' or 'tooth

surface loss' (TSL). The other factors being *Abrasion* (wear from mechanical action) and *Attrition* (wear from tooth to tooth grinding). The effects of these three mechanisms can superimpose on each other, resulting in an overall loss of tooth substance but with one factor usually being predominant.

The precise aetiology of the tooth wear in any given clinical situation can often be unclear and dental erosion is itself known to have a multi-factorial aetiology (Moazzez and Bartlett 2007). Tooth wear by this mechanism is due essentially to exposure of the teeth to an acid medium and categorised based on the source of this acid, being either 'Intrinsic' or 'Extrinsic'.

2.6.1.1: Intrinsic causes

Dental erosion can be caused by acid reflux which is defined as being 'the passive movement of regurgitated acid into the mouth' (O'Sullivan and Milosevic 2008). Demineralization of enamel occurs below a critical pH of 5.5 and the solubility of enamel apatite is about 100 times greater at pH 3 than at the critical pH (Ten Cate *et al* 2004), hence, reflux of gastric acid (pH 1.5-3.5), into the oral cavity, can cause significant loss of enamel if not quickly neutralized or diluted by saliva. Erosion from this source of acid tends to particularly affect the palatal surfaces of the upper incisors. Repeated gastric acid reflux into the oral cavity is also known to occur in Gastric Oesophageal Reflux Disease (GORD). In these conditions, teeth that are exposed to gastric acid over several months can develop distinctive erosive lesions (Bartlett 2005, Bartlett *et al* 1996). GORD can be brought on by excessive intake of carbonated drinks or spicy and fatty foods and also associated with symptoms of heart burn, dysphasia and epigastric pain.

Although thought to affect up to 7% of adults in the Western World (O'Sullivan and Milosevic 2008), the prevalence of GORD in children is unclear (Taji and Seow 2010). Other conditions that can lead to gastric regurgitation in children are oesophageal strictures, chronic respiratory disease, biliary diseases, feeding problems, rumination and intellectual disability (Kilpatrick and Welbury 2005). GORD is known to be more common in people with Cerebral Palsy (Shaw *et al* 1998). Gastric acid in the oral cavity resulting in dental erosion is also seen in people who have repeated or self-induced vomiting as seen in eating disorders such as anorexia and bulimia, (Milosevic and Slade 1989, Bartlett 2005). These conditions are more commonly seen in adolescents and young adults (Kilpatrick and Welbury2005). Repeated vomiting

can also occur in Cyclic Vomiting Syndrome which is thought to be linked to migraine and epilepsy. This condition can begin in the preschool years and continue throughout childhood development (O'Sullivan and Milosevic 2008).

2.6.1.2: Extrinsic causes

Acid arising from extrinsic causes leading to erosion, has been identified as coming from diet, environmental factors, orally-taken liquid medicine and chewable tablets. Excessive consumption of acidic drinks and foods is considered an important cause of extrinsic erosion (Lussi *et al* 2004, Bartlett 2005) and more prevalent among younger people (O'Sullivan and Milosevic 2008). Population studies have shown a direct correlation between erosion and the consumption of carbonated drinks and fruit juices (Lussi *et al* 2004). These increasingly popular drinks are believed to be the leading cause of erosion in children and adolescents.

Watt *et al* (2000), in their investigation of drinking patterns of preschool children based on data from the UK national diet and nutrition survey 1992/93 reported that soft drinks were the most commonly consumed drinks among this age group with over half having them more than once a day. Some baby fruit juices have been shown to have greater acidity than carbonated drinks (Smith and Shaw 1987) along with a high erosive potential (Hunter, *et al* 2009, Lussi 1995). Non-carbonated fruit drinks requiring dilution are also a highly acidic (Ten Cate *et al* 2004). Erosion of deciduous enamel has been shown to be more marked than that of permanent enamel when exposed to frequent intake of a low pH orange drink (Hunter *et al* 2000), suggesting the primary teeth are at increased risk from erosion by these types of drinks.

There has been debate regarding the actual mechanism of dental erosion from these soft drinks. This debate centres on whether erosion is due to initial pH of the drink (Seow *et al* 2005, Cochrane *et al* 2009) or the 'titratable acidity' (Zero 1996). Titratable acidity is the total amount of alkali needed to neutralize the pH of a liquid. For instance cola drinks and orange juice have a pH of 2.5 and 3.8 respectively but have titratable acidity of 0.1 and 4.5 respectively, suggesting that orange juice has greater erosive potential (Shaw 2004). Erosive potential also depends on type of acid (phosphoric or citric), chelating agents (citrate and phosphate) and host factors (Taji and Seow 2010). Fresh fruits, in particular citrus, have a high erosive potential along with pickled and vinegar-based snacks (O'Sullivan and Milosevic 2008).

The most significant host factor that can provide protection against erosion is saliva (Young 2005), due to its buffering capacity from phosphate and bicarbonate ions, flow rate, clearance rates from different parts of the mouth, and enamel remineralisation potential from dissolved calcium (Young *et al* 2002). Other protective host factors include tooth anatomy, soft tissue movements and swallowing, all of which may affect acid clearance time (Lussi *et al* 2004).

Along with these host factors, behavioural factors that can influence the consumption of acidic foods and drinks, are also believed to be important in relation to prevalence and severity of erosion (Young 2005, Taji and Seow 2010) Current dietary practices in Western countries have for many people moved away from eating and drinking at regular mealtimes to all-day 'grazing and snacking' accompanied by greater soft drink and fruit juice consumption (Shaw 2004). Other important behavioural factors would include frequency of intake, time of day and duration, consumption along with foods or drinks that can neutralize acid or increase clearance and method of intake (gulping or sipping, use of straw) (Lussi, *et al* Bartlett 2005). Brushing teeth immediately after and acidic meal or beverage is also believed to increase erosion (O'Sullivan and Milosevic 2008). These dietary behavioural factors take on particular significance in relation to infants and preschool children where extreme erosive destruction has been reported from misuse of fruit juices given in feeding bottles (Smith and Shaw 1987). As these are often given at night or to get the child to sleep (AL-Malik *et al* 2001) there is likely to be longer exposure times to the acid environment along with reduced salivary flow rate and clearance.

Of relevance to the aetiology of erosion in young children is the frequent use of acidic liquid medicines and effervescent tablets commonly used to improve patient compliance (Taji and Seow 2010). Neves *et al* (2010) tested 26 paediatric medicines available in Brazil for titratable acidity and found that most had values of 2.6 to 5.7.

Children given chewable vitamin tablets have been shown to have a significantly increased risk of erosion (Al-Malik *et al* 2001).

Some research has shown an association between dental erosion and asthma. This has been in relation to the erosive potential of asthmatic medications, in particular beta-2 agonists in drugs such as salbutamol which can cause xerostomia and as a result of bronchodilation increase the likelihood of acid reflux potentiating any erosive effect (Drugmore and Rock 2003, O'Sullivan and Milosevic 2008).

2.6.1.3: Clinical presentation

Clinical progression of erosion is usually slow, with periods of activity and inactivity but if prolonged can present as a recognisable clinical lesion. Erosion from dietary sources or gastric acids usually form smooth lesions which have a typical concave appearance on buccal or facial aspects of the teeth and a cupped appearance on the occlusal aspects (Young 2002, Taji and Seow 2010). The lesions may be yellowish in colour due to reduced thickness of the enamel causing greater translucency (Barlett 2005). Along with this there may be chipping of the incisal edges (Taji and Seow 2010). Also as enamel becomes thinner, ridges resembling the chamfered margin of a crown preparation, can be seen or felt with a probe near the cervical margins (O'Sullivan and Milosevic 2008, O' Sullivan 2000). In primary teeth the common site are occlusal aspects of the molars and the palatal surfaces of the maxillary incisors (Taji and Seow 2010). Cupped shaped lesions of exposed dentine often appear symmetrically on the molars due to erosion of cuspal inclines, differing from attrition which produces flat, glossy lesions with well-defined margins (Kilpatrick and Welbury 2005). However, in the later stages the effects of erosion may be added to be the effects of attrition and abrasion particularly if there is exposed dentine and this can alter the clinical appearance.

2.6.1.4: Prevalence in preschool children

Internationally, erosion studies have looked mainly at the permanent dentition in older children, adolescents and adults. There are relatively few studies on erosion in young children, with some regions of the world yet to report any data. The range of indices and methodologies used for measuring dental erosion makes comparisons within and between these studies somewhat difficult (Bardsley 2008). Differences include varying diagnostic criteria, use of full mouth or partial recording and the age group selected.

In the UK, prevalence data on erosion in young children has been available since the early 1990's with data reported in the 1992/3 National Diet and Nutrition Survey NDNS) (Hinds and Gregory 1995) and the 1993 UK Children's Dental Health Survey (CDHS) (O'Brien 1994). Both these surveys used the modified version of the Tooth Wear Index (Smith and Knight 1984). In this modification scores range from 0-3 with 1 =loss of enamel, 2=loss of enamel and exposure of dentine and 3=loss of enamel and dentine exposing pulp. In the NDNS 1992/93, the prevalence of erosion in the 1

½ - 4 ½ age groups was 20% and 52% for 4-6 year olds in the CDHS 1993. Using the similar methodology a prevalence of 29% was reported for 3 year-olds in Cumbria, north England (Jones and Nunn 1995).

Longitudinal comparison of UK data was made possible by the second NDNS in 1996/7 (Walker 2000) that also used the Modified TWI. In the 4-6 year-old age groups, between 1992/3 and 1996/7, overall prevalence of erosion increased to 62% with an increase on the primary incisors from 18% to 38% (Shaw 2003).

Further comparison of these cross-sectional studies over time revealed a trend towards a higher prevalence of erosion in older children and those who consumed carbonated drinks on most days compared with infants and toddlers, who were reported to consume them less often (Nunn *et al* 2003). Higher prevalence of erosion was also associated with drinks given during the night and among children who reported symptoms of GORD. Regression analysis revealed location to be the strongest independent variable, suggesting an influence of socio-environmental factors and SES (Nunn *et al* 2003).

There are no specific prevalence data on dental erosion in children for the US as researchers there have appeared to focus more on other elements of tooth wear (Moazzez and Bartlett 2007), however several studies around the world have shown considerable differences in prevalence rates for the primary dentition (Table 2.11). For instance data from Ireland and Germany show similar rates to the UK suggesting commonalities in food and drink consumption. Data from the Middles-East and Asia also shows considerable variation. A very high prevalence of 82% was reported in Saudi Arabia (Al-Majid *et al* 2002) but this figure contrasts sharply to another study in the same country that reported a prevalence d 32% (Al-Malik 2002), comparable to data for 5-year-olds in India (29%). Some of the differences between prevalence rates may be due to differences in age ranges, as erosive lesions become more pronounced with longer exposure to acids an may be easier to detect in older children. Again confirming the complex nature of this condition some of the variation between populations may also be explained by cultural differences influencing family food and drink choices for their children (Taji and Seow 2010) For instance, in stark contrast to other parts of the world, a very low prevalence was reported among 3-5 year-olds in China (5.7%) (Lou *et al* 2005) and an even lower value of (0.6%), among 4-6 of year-olds in Brazil (Moimaz *et al* 2013).

Table 2.11: Prevalence studies of erosion in the primary dentition

Authors	Year	Country	No of subjects	Age group (years)	Measure of erosion	Prevalence of erosion (any)
O'Brien	1994	UK	17061	4-6	Modified TWI	52%
Jones and Nunn	1995	UK	135	3	Modified TWI	29%
Hinds and Gregory	1995	UK	1658	$1^{1/2} - 4^{1/2}$	Modified TWI	20%
Walker *et al.*	2000	UK	363	4-6	Modified TWI	65%
Al-Malik *et al.*	2002	Saudi Arabia	987	2-5	Modified TWI	31%
Al-Majid *et al.*	2002	Saudi Arabia	354	5-6	Modified TWI	82%
Harding *et al.*	2003	Ireland	202	5	Modified TWI	47%
Lou *et al.*	2005	China	1949	3-5	Modified TWI	5.7%
Nayak *et al*	2010	India	1,100	5	Modified TWI	29%
Moimaz *et al*	2013	Brazil	7058	4-6	Modified TWI	0.6%

2.6.1.5: Relationship between erosion with ECC and enamel developmental defects

The caries process and dental erosion show some similarities with respect to the dissolution of enamel and dentine by acids being an essential element and the conditions usually being chronic in nature and taking a period of time to develop. Differences in relation to the source of the acid are clear, as are site specificity, with erosion generally occurring on plaque free, smooth surfaces and caries more common at sites of plaque accumulation such as pit and fissures and interproximal areas

However, both conditions may share common risk factors with respect to diet and socio-environmental factors (Taji and Seow 2010, Al-Malik *et al* 2001).

Studies have shown that erosion was more common in children who had ECC than those who were caries-free (Al-Malik, Holt and Bedi 2002). The most likely explanation for this being the higher erosive potential of cariogenic drinks such as colas and sweetened juices and their consumption at times of greater tooth susceptibility (i.e. at night-time in feeding bottles). Carious teeth may also be more susceptible to erosion with both processes sometimes occurring on the same surfaces (Al-Malik *et al* 2002).

Enamel defects may also be a risk factor for erosion, and enamel hypoplasia has been shown to be strongly associated with caries experience in the primary dentition (Kazoullis *et al* 2007). One theory for this being the altered mineralization associated with hypoplasia and other enamel defects may predispose to easier dissolution by acids (Taji and Seow 2010).

Summary

Although there is presently no universally accepted, definitive index of dental erosion (Berg-Beckhoff, *et al* 2008, Ganss Young and Lussi 2011), the available data on preschool children suggests the condition may be a public health concern in some populations, particularly as erosion in the primary dentition may be predictive of erosion in the permanent dentition (Ganss, Young and Lussi 2011, Sales-Peres *et al* 2011).

2.6.2: Traumatic Dental Injury (TDI)

Trauma to the teeth can results in fractures of the hard tissues of the crown and or root, displacement or loss of the whole tooth, sometimes associated with bone and soft tissue injury (Welbury and Whitworth 2005). In young children traumatic dental injury (TDI) is considered to be of public health importance due to potential physical, psychological and economic impact (Andersson 2013). Specifically, public health implications of TDI relate to the cost of care, organising emergency dental services and the need for health education programs to aid prevention and management (Andersson 2013)

2.6.2.1: Classification and aetiology

There are several classification systems for TDI's and though broadly similar they have some significant differences. The World Health Organisation (WHO) classification describes injuries to the tooth and root structure along with soft tissue injury but not does not include injury to the socket or fractures to the mandible or maxilla. In this classification system, luxation injuries are grouped together and not divided into sub-categories (Bastone *et al* 2000).

Two modifications of the WHO classification are the Ellis and the Garcia-Godoy classifications. The former is a simplified system which groups many of the injuries and employs broad terms such as *simple* or *extensive*, whereas the latter separates dental fractures based on cementum involvement (Bastone *et al* 2000). One of the

most widely used methods is the Andreasen classification that includes the following main injury categories: *Crown Discoloration, enamel fracture, enamel/dentine facture, (with / without pulp exposure), Subluxation, lateral luxation, intrusive luxation* and *Avlusion* Although in essence a modification of the WHO system, the Andreason classification is more comprehensive, as it includes injuries to the supporting structures of the teeth (Bastone *et al* 2000).

2.6.2.2: Prevalence and risk factors for TDI in preschool children

In preschool children, it is estimated that oral injuries account for 17% of all injuries compared to 5% across all ages (Andersson 2013). Aetiological factors vary between and within age groups, in contrast to sport or being hit by / colliding with another person being the more common causes in school age children, falls are the most common cause of TDI in preschool children (Andersson 2013). The maxillary incisors are the teeth most frequently involved in TDI, with uncomplicated crown factures being the most common injury in the permanent dentition and subluxation is more common in the primary dentition (Bastone *et al* 2000). Increased risk for TDI is also associated with increased overjet and /or incomplete lip coverage (Bastone *et al* 2000). Most prevalence studies on TDI in children have reported data for the permanent teeth in school-aged children. While taking into account differences in survey methods, age-ranges and criteria, prevalence studies on preschool children from around the world suggest that rates are generally higher in developing countries (Andersson 2013). For instance, a very high rate of over 70% was reported in recent study from India (Bhayya and Shyagali 2013) and several studies conducted in Brazil (Kramer *et al* 2003, Jorge *et al* 2009, and Feldens *et al* 2010), suggest a prevalence there generally in the range 30-40%, similar to that reported in Cuba (Rodriquez 2007) (Table 2.12). Data from the Middle-East (Tumen *et al* 2011, Hasan *et al* 2010, Avsar and Topuloju 2009,) suggest rates similar to the UK (Walker *et al* 2000, Rhuoama *et al* 2013) (Table 2.7).

Where gender differences have been reported, boys have higher risk of TDI (Avsar and Topulaju 2009, Tumen *et al* 2011, Rodriguez et al (2007), Bhayya and Shyagali 2013). Also, similar to studies in the permanent dentition, some of these studies reported an increased risk of dental trauma associated with increased overjet (Tumen *et al* 2011), increased overjet and open bite (Feldens *et al* 2010), and increased overjet and incomplete lip coverage (de Vaconceles Cunha Bonini *et al* 2009) (Table

2.7). Few studies have a found a clear relationship between TDI in preschool children and SES (based on for example household income, area of residence, educational levels of parent (Interestingly studies have found risk of TDI to be both directly related (Feldens *et al* 2010) and inversely related (Jorge *et al* 2009), to the educational level of the mother (proxy variable SES), confirming the relationship is likely to complex (Table 2.7).

Summary

The prevalence of TDI in preschool children shows considerable variation across countries and world regions, being regarded as a public health in some populations while having negligible prevalence in others. Some of these differences could be due to methodological approaches to sampling and measurement but could also be related to socio-cultural factors that influence child rearing practices, early childhood activities, supervision of play, type of environment and activities. Higher risk for TDI in boys and children with increased overjet was also a recurring finding among preschool populations.

Table 2.12: Prevalence of TDI in preschool children

Country	Author/ year	Age	N	Prevalence	Criteria	Main injury	Gender difference / Risk factors
England	Jones and Nunn (1993)	3	135	12.6%	(O'Brien 1994)	enamel and dentine fracture	not reported
UK	Walker *et al* (2000) NDNS	4-6	1701	4%	Modified Andreason	not reported	No gender difference
Scotland	Rhouma *et al* (2013)	5	68,354	5%	Hospital records	not reported	No gender difference
Kuwait	Hasan *et al* (2010)	2-6	500	11.2%	Andreason	enamel / dentine fracture	No gender difference
Turkey	Avsar and Topaloju (2009)	0-3	563	17.4 %	Andreason	Periodontal tissue injury	Male gender
Turkey	Tumen *et al* (2011)	2-5	727	8%	Ellis	enamel fracture	Male gender. Overjet >5mmm Anterior Openbite
Cuba	Rodriguez (2007)	2-5	543	34.2%	Andreason	enamel /dentine fracture	male gender
Brazil	Kramer *et al* (2003)	3-4	1545	35.5%	Andreason	enamel fracture	No gender differences
Brazil	Feldens *et al* (2010)	3-5	888	36.4 %	Andreason	not reported	Higher maternal educational level. Overjet >2mm
Brazil	De Vaconcels *et al* (2009)	0-5		13.9%	Ellis	not reported	Increased overjet, incomplete lip coverage,
Brazil	Jorge *et al* (2009)	1-3	519	41.6%	Andreason	enamel/dentine fracture	No gender differences. Lower maternal education
India	Bhayya and Shyaglai (2013	4-6	1500	76.1%	Garcia-Goody	crown fracture involving enamel	Male gender

2.7: Concepts of health

This section describes the relationship between early childhood oral health and the health and well-being of preschool children and their families in Trinidad, in particular the impact of early childhood caries.

Until the middle of the last century the traditional view of health was of an essentially physical state determined by the outcome of disease or pathology and measurable using objective clinical criteria. The limitations of this *biomedical model* were recognised by the WHO in their definition of health as 'a complete state of physical, mental and social well-being and not just the absence of disease or infirmity' (WHO 1948). Subsequent research expanded the understanding that disease is influenced not only by the underlying physiological processes but also by an individual's perception, personality and emotional states (Allen 2003). This *biopsychosocial model* views health as multidimensional and influenced by the impact disease may have on physical, and psychological functioning as well as social and emotional well-being (Allen 2003, Sischo and Broder 2011). Health can therefore also be viewed as a positive attribute, being a resource which gives people the ability to manage and enjoy their daily lives. Health however, refers to a much broader, subjective experience and understanding an individual's experience of health and illness now underpins the concept of health related quality of life. Quality of life has been defined as: *'an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns'* (WHO 1997b).

The need to assess the effectiveness of medical interventions in the face of rapidly escalating healthcare expenditure, has also given impetuous to the development of patient-centred outcome measures (Slade 2002) placing quality of life issues at the forefront of public health policy. Health Related Quality of Life in this context considers the impact of disease and its treatment on a person's emotional, physical and social functioning and lifestyle, providing a subjective, patient-led baseline against which the effects of interventions can be measured (Bowling 1999).

2.7.1: The impact of oral diseases

Until relatively recently, the psycho-social consequences of oral conditions had received little attention, being considered rarely life-threatening. The oral cavity has

also historically been disassociated from the rest of the body when considering the health state of an individual (Allen 2003). However, oral diseases and disorders can have significant emotional and psychological outcomes and conditions affecting the mouth can impact upon general health by changing what people eat, affecting their speech and social and psychological well-being (Sheiham 2005).

This was most dramatically illustrated in research by Reisine *et al* (1984), where analysis of data from the US National Health Interview Survey showed that 8.87 million dental conditions occurred in 1981, resulting in 17 million days of restricted activity, 6 million days of bed disability and 7 million days of work loss. Similar findings, of oral problems leading to substantial work loss were also reported by Gift *et al* (1992) and pain, difficulty with eating and communication, were the oral problems most frequently reported among working adults in the UK (Cushing *et al* 1986).

Oral health has been described as '*a state of the oral and related structures that enable an individual to eat speak and socialize without active disease, discomfort or embarrassment* (Department of Health 1994). Good oral health enables people to communicate effectively and enjoy a variety of foods and is important to self-esteem, self-confidence and overall quality of life (Department of Health 2005). However, traditional measures of oral diseases such as caries, periodontal disease and oral malignancy only reflect the end-point in clinical disease and give no indication of their social and psychological impact (Allen 2003). Locker (1989) states " from the point of view of contemporary definitions of health, clinical outcomes measures have serious limitations as they tell us nothing about the functioning of either the oral cavity of the person as a whole and nothing about perceived symptoms or discomfort".

2.7.2: Development of measures of oral health related quality of life (OHRQoL)

Quality of life is now viewed as a valid health indicator in many areas of healthcare (Sischo and Broder 2011). Consistent with this, a range of specific measures have also been developed to assess Oral Health Related Quality of Life (OHRQoL), which is defined as '*a person's comfort when eating, sleeping, engaging in social interaction, their level of self-esteem and their satisfaction with respect to their oral health'* (Department of Health and Human Services 2000).

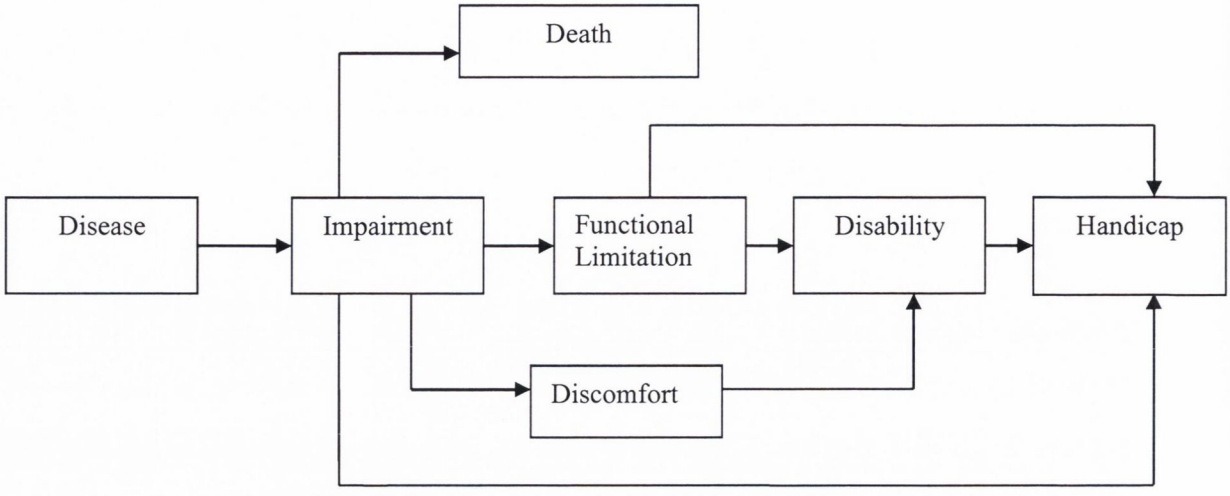
Early attempts to measure OHRQoL used generic measures adapted for those used in general health surveys, such as the Sickness Impact Profile. However, these

instruments were found to lack sensitivity for oral conditions (McGrath and Bedi 2003). Subsequent research on the social impact of disease by Cohen and Jago (1976) and Cushing *et al* (1986) led to the development of oral health specific instruments termed *'sociodental indicators'* i.e. 'measures of the extent to which dental and oral disorders disrupt normal social role functioning and bring about major changes to behaviour' (Locker 1989).

2.7.3: Conceptual models

Derived from the WHO (1980) International Classification of Disease Disability and Handicap (ICDH), Locker (1988) developed a conceptual framework for health related quality of life. This model proposed that 'disease' could be linked directly and indirectly to health outcomes i.e. *impairment*, *disability* and *handicap*. Impairment was described as 'any anatomical loss, structural abnormality or disturbance in physical or psychological processes either present at birth or arising out of disease or injury', disability as 'any limitation in or lack of ability to perform the activities of daily living and handicap as 'the disadvantage experienced by impaired and disabled people through not conforming to the expectation of society or the social group to which they belong (Locker 1989). Locker's model links these outcomes together in a dynamic continuum (Fig 2.2).

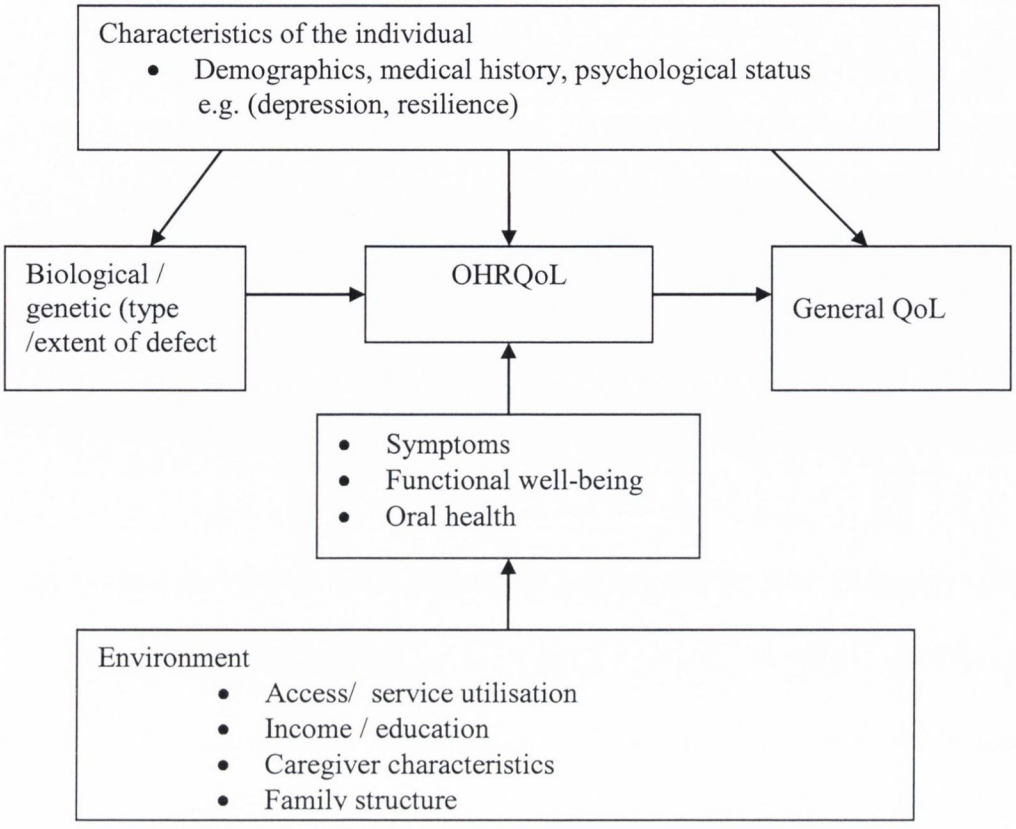
Fig 2.2: Locker's conceptual model (Locker 1988)



A dental example of this model could be tooth loss /becoming edentulous, causing suffering and anatomical loss (impairment), leading to reduced eating and chewing, and speaking (disability) effecting social contact and well-being (handicap) i.e. negative impact on OHRQoL (Allen 2003).

Sischo and Broder (2011) suggest that theoretically, OHRQoL is a function of various symptoms and effects, representing a person's overall subjective experience. Using psychological, social science theory and epidemiology, they propose a model of OHRQoL that incorporates biological, social, psychological and cultural factors. The framework links clinical variables (e.g. type/extent of defect, functional status (e.g. speech), oral-facial appearance, psychological status to OHRQoL and overall QoL. (Fig 2.3)

Fig 2.3: OHRQoL conceptual model by Sischo and Broder (2011)



2.7.4: Summary of main OHRQoL measures

Several measures of OHRQoL have been developed and validated. Some of these instruments capture content related to just a few domains, for example. The oral impacts on daily performance (OIDP) (Adulyanon and Sheiham (1997) or from multiple domains such as the OH-Qol UK (McGrath and Bedi 2001). The majority use a range of questions relating multiple domains with the aim of being able to capture maximum variation within responses categories and a fuller understanding of the impacts in each domain (Slade 2002). Most ask only about negative impacts of oral conditions on quality of life, an exceptions being Oral Health Quality of Life Inventory and the Dental Impact Profile, which include both adverse and beneficial impacts (Slade 2002). Data from most of the instruments can be summarized as numeric scores with some allowing analysis of subscales e.g. The Oral Health Impact Scale (OHIP) (Slade and Spencer 1994), where each of the seven subscales measures a unique theoretical dimension such as functional limitation or disability. A summary of the main measures of OHRQoL are described in Table 2.13.

With the burden of oral disease in later life acknowledged as important in aging (McGrath and Bedi 2003), many of these instruments have been used in cross-sectional studies of community dwelling older adults (Slade 2002). Some instruments have also been used in large scale/ national oral health surveys such as a study of 2338 older adults in Australia, Canada and the US that used the 49-item OHIP (Slade *et al* 1996).

The UK Adult Dental Health Survey 1998 used a short version of the OHIP-14, (Nuttall *et al* 2001) and reported that most people experienced one or more impacts during the previous year. Among dentate people, the most common of these was pain (40%), 27% having had psychological discomfort (self-consciousness/felt tense) and 14% psychological disability (difficult to relax / embarrassment). The OHIP was again used along with the OIDP in the 2009 UK Adult Dental Health Survey with 17% reporting that their oral health had negatively affected their daily lives, mainly with respect to eating, avoiding smiling and cleaning their teeth (White *et al* 20012). These results appear to support the model proposed by Locker (1988). A relationship between clinical oral health status and perceived impacts was indicated by those who reported impacts, on average with more decayed teeth and less sound teeth than those who did not report impacts in 1998 (Nuttall *et al* 2001) and people with 21 or more teeth having better quality of life than those with less natural teeth, in 2009 (White *et al* 2012). In another national study, involving 2,667 households in the UK, it was found that 73% of people claimed their oral health did affect their quality of life, mostly in physical rather than social or psychological aspects (McGrath and Bedi 2003).

Despite some methodological differences between these measures, common themes to emerge from their findings in adult populations have been poorer OHRQoL associated with having fewer teeth, unmet treatment needs, irregular dental care and lower socio-economic status (SES) (Slade 2002).

Table 2.13: Summary of main OHRQoL measures

Authors	Name of measures	Dimensions	No of Questions
Cushing et al (1986)	Social Impacts of Dental Disease	Chewing, talking, laughing, smiling, pain, appearance	14
Atchison and Dolan (1990)	Geriatric Oral Health Assessment Index (GOHAI)	Chewing, eating, social contacts, appearance, pain, worry, self-consciousness	12
Slade and Spencer (1994)	Oral Health Impact Profile (OHIP)	Function, pain, physical, psychological disability, social disability, handicap	49
Locker and Miller (1994)	Subjective Oral Health Status Indicators	Chewing, speaking, symptoms, eating, communication, social relations	42
Leao and Sheiham (1996)	Dental Impacts on Daily Living (DIDL)	Comfort, appearance, pain, daily activities, eating	36
Adulyanon and Sheiham (1997)	Oral Impacts on Daily Performances (OIDP)	Performance in eating, speaking, oral hygiene, sleeping, appearance, emotion	9
McGrath and Bedi (2003)	OH-Qol UK	Eating, appearance, speech, general health, comfort, breath odor, social life, relationships, smiling or laughing, working, sleep, carefree manner, mood, personality	16

Despite variation in dimensions, domains and number of questions items, it is generally accepted that no single measure is significantly better than any other (Slade 2002, McGrath and Bedi (2003).

2.7.5: Uses of OHRQoL information

The information derived from measures of OHRQoL has several important uses within the context of oral health services research and delivery of oral healthcare such as:

- Estimating oral health needs
- Clinical decision making
- Evaluating oral health promotion strategies
- Describing oral health inequalities

2.7.5.1: Estimating oral health needs.

Measures of oral disease are commonly used for health needs assessment to plan and prioritize and evaluate oral health care services (Sheiham *et al* 1982). These professionally defined oral health measures have been criticized for poor reliability, lack of a psychosocial aspect, little consideration of health behaviour, neglect of consumer rights and providing unrealistic estimates for treatment planning (Sheiham and Tsakos 2007). OHRQoL outcome measures can complement clinical data in provide information to dental public health decision making (Rozier and Pahel 2008).

2.7.5.2: Clinical decision making.

In the face off diverse treatment options, measures of OHRQoL incorporated into clinical trials can measure changes in scores from base-line to post-treatment and can therefore provide data on the persons well-being over the course of treatment (WHO 1997b, Sischo and Broder 2011). This enables a more holistic assessment of treatment effects Establishing the effectiveness of interventions using OHRQoL as outcome measures also enables the development of evidence-based clinical guidelines (McGrath *et al* 2004) and also aid communication between professionals and patients (Piovesan *et al* 2009).

2.7.5.3: Evaluating oral health promotion strategies.

By measuring oral health as a positive variable that affects daily functioning, health behaviour and overall well-being, data on OHRQoL can aid the assessment of preventive strategies and oral health promotion interventions, complementing other qualitative information and clinical disease data.

2.7.5.4: Describing and understanding inequalities in oral health.

By focusing on impacts and health outcomes, OHRQoL can be useful in informing public health policy to address oral health disparities, including appropriate allocation of resources. OHRQoL data can help to indentify at-risk populations and help in developing appropriate interventions as well as adjunctive services for example, including psychological support services along with frontline treatment if this has impacted negatively on well-being (Sischo and Broder 2011).

2.7.6: Impact of oral diseases in children

Dental caries remains a major oral health problem among children in most regions of the world, with dental pain and symptoms highly prevalent in younger age groups (WHO 2003). However, traditional 'normative' assessments of oral health provide only a limited, uni-dimensional view of child oral health (McGrath, *et al* 2004).

OHRQoL measures validated for use with adults have been found to be inappropriate for children (Wogelis *et al* 2009, McGrath *et al* 2004). The initial absence of paediatric OHRQoL measures was due in part to the complex conceptual and methodological issues involved in construction of self-report. However, work on childhood asthma demonstrated that instruments designed for children could be valid and reliable (Jokovic *et al* 2002)

Children perceive the world and themselves differently from adults (Piovesan *et al* 2009), therefore communicating with them about their healthcare and QoL requires instruments uniquely tailored toward their developmental age (Inglehart 2002). Children's health cognition is also influenced by their stage of emotional, and social development and their understanding of feelings, relationships and ability to communicate (Jokovic *et al* 2002).

Some key developmental stages that can influence design of such instruments are:

- Age 6 = beginning of abstract thinking and self-concept
- Age 8 = Concept of time
- Age 6-10 = ability to evaluate their appearance, quality of friendships and understand other peoples thoughts and emotions.

Cognitive development varies such that the wording of question items and their relevance needs adapting over time, therefore it is important to define the age group under study be they infants, children or adolescents (McGrath *et al* 2004).

2.7.7: Impact on parents and caregivers

Due to the difficulty of developing OHRQoL instruments for children, parents and caregivers have usually been be asked to provide information on their child's health and well-being. Although this use of 'proxy ratings' has been criticised for not being a true measure of impact experienced by the child, some argue that this actually reduces the cognitive issues encountered when using such instruments on children (Inglehart *et al* 2002). Furthermore, parents and caregivers have a significant role to

play in their child's decision-making and in connecting them with dental /medical care (Inglehart *et al* 2002).

Barbosa and Gaviao (2008), in their systematic review of QoL measures in children, reported that children and parents do not necessarily share similar views about OHRQoL. However, understanding parent perspectives is important as, along with having to manage issues of work-loss and expenditure on dental health care, concerns about their child's oral health, may compromise family well-being (Piovesan *et al* 2009).

2.7.8: Psychometric properties and validation of OHRQoL measures

Use of a measure of OHRQoL requires that its psychometric properties are assessed with respect to its validity and reliability in relation to the population under investigation. Validity, in this context, is an assessment of whether an instrument measures what it aims to measure and should have the following qualities: face, content, criterion, concurrent, construct and predictive validity (Bowling 1999). Reliability refers to reproducibility and consistency and the degree to which it is free from random error.

2.7.8.1: Face validity

This is the appropriateness with which question items support the underlying theory or construct and how the measure appears with respect to its intended subject area (Guyatt *et al* 1993), i.e. do the questions appear to be relevant, reasonable, unambiguous (Bowling 1999).

2.7.8.2: Content validity

The extent to which question items adequately cover all of the domains that they intend to assess (Guyatt *et al* 1993)

2.7.8.3: Criterion validity

The correlation of the measure with a pre-existing criterion measure (i.e. a gold standard). As there is presently no agreed gold standard instrument for OHRQoL this is usually replaced with a proxy measure such as a Global Health Rating (Bowling 1999). This also includes two distinct aspects, these being *concurrent* (independent

corroboration with observable criteria) and *predictive* validity (ability to predict future changes in key variables in the expected directions).

2.7.8.4: Construct validity

Relates to whether the instrument measures the stated theoretical construct and hypothesis it is measuring (Jenny and Campbell 1997) and the logical relations that should exist between the measure and characteristics of the intended respondents (Guyatt 1993). This consists of two parts (*convergent* and *discriminant* validity):

- Convergent validity - Correlation between different measures of the same concept i.e. the scale should correlate with related variables.
- Discriminant validity - The measure should be able to discriminate between different groups and therefore not correlate with dissimilar variables

Other aspects of validity include the features of *Precision and responsiveness to change.* Precision is the ability of the instrument to detect small changes and responsiveness to change is a measure of the association between the change in the observed scores and change in the true value of the construct (Bowling 1999).

Reliability refers to the reproducibility of the instrument during repeated administering. This aspect includes *test-retest reliability*, this being the degree of agreement between two measures taken at different points in time using the same scale (Altman 1997), *internal consistency* which is the extent to which the items are addressing the same concept and *inter-item correlation* which is the extent to which items within each domain are correlated with each other and the total domain score (Bowling 1999).

2.8: Measures of OHRQoL in children

The following sections describe main measures for OHRQoL in children.

2.8.1: Child Oral Health Quality of Life (COHQoL)

Based on the belief that parents/caregivers are intimately involved in the healthcare needs of their children and that treatment of oral health problems is likely to be influenced by parental perceptions, Jokovic *et al* (2003) designed analogous parental/caregiver and child components when constructing the Child Oral Health Quality of Life questionnaire (COHQoL) for children aged 6-14-years old. These

components are the Child Perception Questionnaire (CPQ) and Parental-Caregiver Perceptions Questionnaire (P-CPQ). The CPQ was based on the conceptual model proposed by Locker and contains 37 questions items based on 4 domains (oral symptoms, functional limitation, emotional well-being and social well-being (Piovesen *et al* 2009). The frequency of impacts in each of these domains over the last three months are recorded on a five-point Likert scale (Jokovic *et al* 2002).

The P-CPQ contains The Family Impact Scale was developed by Locker *et al* (2002) and has three domains, each with several questions items: Parental / family activity (5 items), Parental emotion (4 items), Family conflicts (4 items). Although both the C-CPQ and P-CPQ contain items that address oral symptoms, functional limitation, emotional and social well-being, because of the emotional content of the questions, the Family Impact Scale was only included in the P-CPQ (Jokovic *et al* 2003

The COHQoL instrument confirmed that children experience substantial impacts on functional and psychosocial well-being, caused by a variety of oro-facial conditions and that children of this age were able to give psychometrically valid accounts of that impact (Jokovic *et al* 2002). Importantly, their data also showed that three- quarters of parents and caregivers reported frequent family impacts in the previous three months, with the most common impacts on the parent being child requiring attention, financial difficulty, taking time off work and feeling guilty or upset about the child's dental condition. These authors concluded that child oral conditions can cause family distress and that gaining the views of both the child and parents can provide complementary information and deeper insight (Jokovic *et al* 2002).

Marshman *et al* (2005) used the CPQ 11-14 in a study of UK children, also collecting clinical oral health data, along with a global oral health rating. They reported that the summary measures correlated with the global oral health rating, indicating acceptable criterion validity but that, although the number of impacts correlated with the number of missing teeth, the overall relationship between the CPQ and clinical variables was weak. This instrument and its version for use with younger children (CPQ 8-10), was also found to have good cross-cultural adaptation when used among children in non-English-speaking countries (Torres *et al* 2009, Wogelis *et al* 2009).

2.8.2: Child OIDP

The CHILD-OIDP was adapted by Ghuerunpong *et al* (2004a), from The Oral Impact of Daily Performances (OIDP) (Adulyanon and Sheiham 1997). Again, based on the

model proposed by the WHO (1980) and Locker (1988), this was found to be valid and reliable measure for adults, being brief, easy to use, and useful for oral health needs assessment. Therefore the OIDP was considered for use with children ((Piovesen *et al* 2009, Gherungong *et al* 2004a). The process of adapting it involved modifying the instrument to account for the childs' capability in relation to their intellectual, cognitive and language development and memory ability (Gherungong *et al* 2004a).

The CHILD-OIDP records the severity and frequency of oral health problems on the child's ability to perform eight (8) daily activities over the previous three month period: (*eating food, speaking, cleaning mouth, sleeping, emotional state, smiling, studying, social contact*) (Castro *et al* 2008). The CHILD-OIDP was found to be valid and reliable in 12-year-old Thai children (Gherungong *et al* 2004b). This measure has also shown significant associations with self-rated oral health and perceived dental treatment needs (Castro *et al* 2008). Being amenable to cross-cultural adaptation, the instrument has also been used in other child populations in France, The UK, Tanzania, Peru, Brazil, Italy, Spain and Sudan (Nurelhuda *et al* 2010). In these studies the performance with highest impacts have been in eating, cleaning and emotional states due most commonly to sensitive teeth, mouth ulcers and bleeding gums (Nurelhuda *et al* 2010). Showing how needs assessments can differ, using the Child OIDP, Gherungpong *et al* (2006) found that, based on a sociodental approach, only a third of the children described as having normative needs actually required invasive treatment, the remainder only needing preventive care.

2.8.3: Child OHIP

The Child Oral Health Impact Profile (COHIP) developed by Broder *et al* (2005) was designed to assess oro-facial well-being in school-aged children as reported by the child and via proxy report by parent or main caregiver (Broder *et al* 2007). Based on the same theoretical construct as the Child Perception Questionnaire, the COHIP differs from this and other instruments that assess OHRQoL in children, in that it includes items related to positive aspects of oral health (Slade and Reisine 2007). The inclusion of positive oral health outcomes was believed important due to more children presenting as 'orally healthy' resulting in measures of disease and impairment not capturing the full range of experience (McGrath and Broder 2004). COHIP includes 37 items and relating 5 subscales (*oral symptoms, functional well-*

being, social-emotional well-being, self-image and school environment) (Border and Wilson-Genderson 2007).

With respect to its inclusion of both child and caregiver perspective, COHIP was found to have generally good levels of agreement (Wilson-Genderson *et al* 2007). Interestingly, some children undergoing regular paediatric dental treatment or orthodontics rated their oral health similar to or lower than their caregivers rating. This supports the value of including both child and caregivers in the assessment of OHRQol in school aged children. COHIP has been translated into other languages and appears to have good cross-cultural adaptation (Slade and Reisine 2007). The main OHRQoL measures for school-age children are summarizd in Table 2.14.

Table 2.14: Summary of main OHRQOL measures for school-aged children

Study	Country	Instrument	Age range	Composition	Main outcomes
Broder *et al* (2005)	USA	C-OHIP	8-14	34-items	oral symptoms, functional well-being, social /emotional, self image, school environment
Gherunpong *et al* (2004)	Thailand	Child-OIDP	11-12	8-items	Daily activities related to psychosocial and physical performances
Jokovic *et al* (2002)	Canada	COHQOL P-CPQ (FIS) C-CPQ	6-14 (CPQ_{6-7}), (CPQ_{8-10}), CPQ_{11-14})	37 items (8 and 16 item versions)	oral symptoms, functional limitation, emotional well-being, social well-being

2.8.4: OHRQoL in early childhood

Beyond the immediate distress caused by toothache, early childhood caries (ECC) can also have longer term negative health outcomes. Untreated decay in infancy and early childhood is believed to affect weight gain and overall growth and development (Shieham 2006). Proposed mechanisms for this include toothache leading to poor eating/ nutrition, and sleep disturbance, affecting glucorticoid metabolism. Chronic inflammation arising from pulpitis release cytokines that can inhibit red blood cell formation, resulting in reduced haemoglobin levels and anaemia (Sheiham 2006).

Early childhood caries can also affect growth and development. For instance, children with ECC have been shown to weigh less than 80% of ideal body weight (Inglehart 2002) and 3-year-old children with ECC were found to weigh 1kg less than caries-free controls (Acs *et al* 1999). ECC has also been associated with Failure to Thrive (FTT) (Elice 1990).

Along with these patho-physiological affects, ECC can have significant effects on well-being and quality of life of the child and family (Abanto *et al* 2011, Pahel *et al* 2007). Also, as parents and caregivers have the main responsibility for their preschool aged children, ECC can affect them indirectly, for example work-loss due to having to stay at home and take care of the child (Gift *et al* 1992).

The affect of treatment has also confirmed the impact of ECC as Low (1999) found a significant change in the well-being of children aged 3-6, who had their severe ECC treated, as reported by their parents, with respect to pain, eating preferences, amount of food eaten and sleeping habits. Similar findings were reported by (Thomas and Primosch 2002, Filstrup *et al* 2003, Klaassen *et al* 2011). A significant improvement in weight gain and OHRQoL was reported in a cluster randomized trial of Filipino preschool children with severe ECC, four months after their pulpally involved teeth were extracted (Dujister *et al* 2013).

2.8.5: Measures of OHRQoL in early childhood

Children below the age of 6 years are not usually capable of abstract thinking and their recall of events beyond 24 hours is not reliable (Pahel *et al* 2007, Rebok 2001). The instruments described earlier (CPQ, Child-ODIP, C-OHIP) are therefore not appropriate as they include child self-report data.

Attempts have been made to ask preschool age children to assess their oral health related quality of life. Filstrup *et al* (2003) adapted the Michigan OHRQoL Scale for their investigation of the effects of ECC and asked parents of preschool children to agree or disagree with statements about various aspects of their child's OHRQoL (e.g. whether the child was currently experiencing pain, limiting of play because of dental problems).

Cunnion *et al* (2010) also developed an instrument to assess OHRQoL in early childhood, the Parent-reported Oral Health Quality of Life (POQL). This instrument was based on a literature review and data from focus groups with mothers. This measure provides a summary score for 13 items across 5 domains *physical*

functioning, *social functioning*, *mental functioning* (including interpersonal relationships and concerns with aesthetics), *Impairment* due to pain or other 'parent-reported' symptoms. For each symptom parents are asked to report their frequency over the last 3 months. For each item, respondents are asked how 'bothered' the child was by the problem (very bothered, somewhat bothered, bothered a little bit, did not happen). Three versions have been developed: Preschool 2-8, Elementary 8-12 and Pre-teen (12-14). For preschoolers, no self-report measure was developed due to the inability of children in this age group to accurately report their health (Cunnion *et al* 2010). In their study of children aged 2-8, those with ECC were rated as having worse OHRQoL than those who were caries-free. In this longitudinal study on the effects of dental treatment, the authors reported that, despite overall improvements in parent-reported QoL, differences between ECC and caries-free children persisted (Cunnion *et al* 2010).

2.8.6: The Early Childhood Oral Health Impact Scale (ECOHIS)

In response to the paucity of instruments available for measuring OHRQoL in preschool aged children, Pahel *et al* (2007) developed a short condition- specific tool, to be completed by the child's parent or primary caregiver, the Early Childhood Oral Health Impact Scale (ECOHIS). This instrument was designed for use in epidemiological surveys to discriminate between children with and without disease. Unlike several other QoL instruments, for the ECHOHIS the parent is asked to consider lifetime experience rather than the previous 3 months to take account of lower disease levels in some populations. No child self-report section was included as the validity of this method has been questioned, based on the issues of cognition and recall in children below the age of 6 years (Pahel *et al* 2007)

The theoretical construct underpinning the instrument was again that of Locker 1988, as developed by Jokovic *et al* (2002) for their P-CPQ, hence the instruments have several common items. Furthermore, the ECOHIS has items relating to child and family impacts with the frequency recorded on a five-point scale (Never to Very Often). Preliminary data from Pahel *et al* (2007) showed the instrument had good construct, convergent and discriminant validity and test-retest reliability.

The ECOHIS has subsequently been validated in studies in France, Iran and Hong Kong, Brazil and Turkey, where both the English language and translated versions have shown good psychometric properties (Li *et al* 2008, Jabafari *et al* 2010, Wong,

Scarpelli *et al* 2011, Peker *et al* 2011). The instruments responsiveness to change was evaluated among 101 parents of children aged 0-5-years two weeks after completing a course of routine dental treatment, 51% of respondents reported an improvement in their child's OHRQoL (Li *et al* 2008). ECOHIS data were also used to assess the effectiveness of dental treatment under GA in a randomised controlled trial of 4-year-old children, with the finding of improved OHRQoL among children having received this treatment (Klassen *et al* 2011).

Lee *et al* (2010) compared the ECOHIS to generic QoL measure for early childhood, the Paediatric Quality of Life Inventory (PedsQL.4.0). In their study of 111 children of mean age 49 months, ECOHIS scores were significantly higher for children with S-ECC, compared to those not in that category. However, the PedsQL4.0 was not able to detect this difference suggesting that the ECOHIS is a more sensitive condition-specific measure for caries in early childhood. The two most frequent impacts reported in these ECOHIS studies are show in Table 2.15.

Table 2.15: Common findings from studies that have used the ECOHIS.

	Most frequent ECOHIS impacts	
Country / Study	**Child**	**Family**
USA (Pahel *et al* 2007)	*Pain in the teeth, mouth and jaws.* *Been irritable or frustrated*	*Been upset* *Felt guilty*
Canada (Li *et al* 2008)	*Pain in the teeth, mouth and jaws.* *Difficulty eating some foods*	*Been upset* *Felt guilty, Time off work*
Brazil (Scarpelli *et al* 2011)	*Pain in the teeth, mouth and jaws.* *Difficulty eating some foods*	*Been upset* *Felt guilty*
Turkey (Peker *et al* 2011)	*Been irritable or frustrated* *Difficulty eating some foods*	*Financial impact* *Time off work*
China (Wong *et al* 2011)	*Difficulty eating some foods* *Difficulty drinking hot or cold beverages*	*Been upset* *Felt guilty*
Brazil *(Kramer et al* 2013)	*pain in teeth mouth and jaws* *Difficulty eating some foods*	—

No association was found between ECOHIS scores and traumatic dental injuries or malocclusion in a study of 260 children aged 2-5 years-old in Brazil, (Abanto *et al* 2011). However, this study reported higher ECOHIS scores and hence lower OHRQol,

related to having caries and being from a family of low income and greater household crowding (Abanto *et al* 2011), consistent with the known relationship of oral health and SES in children,

In a population-based study of Chinese preschool children, those children with S-ECC had the highest ECOHIS impact scores (Wong *et al* 2011). Symptom domain scores varied, based on parent's educational level and household income in that parents who had lower levels of formal education and lower income reported lower OHRQoL. Furthermore, in their multiple regression model, with child and family impact and overall ECOHIS scores as dependent variables, both filled teeth and decayed teeth had a significant association. The authors state that use of parent/caregiver assessments as proxy assessments of child OHRQoL, while not ideal is acceptable, given the cognitive and linguistic issue of early childhood (Wong *et al* 2011).

2.9: Rationale for present research

The preceding review of the literature has shown that ECC is common oral condition in early childhood. Despite some variation due to differences in case-definitions, internationally, the prevalence of ECC has been reported to range from 6-90%, with most developed countries in the lower end, and most developing countries, in the middle to higher end of this range (O'Mullane and Parnell 2011). Similar to other health conditions, the prevalence of ECC reflects a social gradient (Watt, Williams and Sheiham 2014) and within-country disparities are also common, with preschool children from disadvantaged communities generally experiencing higher levels of disease than the general population (Pine *et al* 2004, Seow 2012).

Due to its high prevalence, the potential for negative health impacts if left untreated, increased risk for caries in the permanent dentition and contribution to oral health inequalities, ECC is recognised as a serious public health problem (O'Mullane and Parnell 2011, Seow 2012).

Socio-economic, socio-cultural and socio-behavioural determinants are believed to influence specific risk factors for ECC such as dietary and feeding practices, oral hygiene and dental attendance patterns (Tinianoff and Resine 2009). As proposed by Fisher-Owens *et al* (2007) these risk factors can have influence at the child, family and community level and are likely to have a complex interplay (Seow 2012).

Very little is known about the oral health of very young children in the Caribbean. The few studies that have been undertaken in the English-speaking Caribbean suggest that caries prevalence among infants and preschool children in the region is high (Vignarajah and Williams 1992, Adewakun and Beltran-Aguilar 2002). No data exists for the preschool age group in Trinidad and Tobago, although national data from schoolchildren indicates a high severity of caries in the primary dentition, with almost two-thirds of 6-8 year-olds affected (Naidu *et al* 2006b). Decayed teeth presenting in primary school children indicate that such children were likely to have been at risk for caries in their primary dentition during their preschool years (Holbrook *et al* 1993, Tinanoff and Reisine 2009). Furthermore, pain and infection arising from decayed primary teeth was the most frequent cause of emergency dental visits in a dental school clinic in Trinidad (Naidu *et al* 2005). Apart from ECC, there are also no data for Trinidad and Tobago with respect to other important oral conditions in early childhood such as dental erosion, developmental defects, dental trauma or the impact of oral problems on quality of life.

There is also a paucity of data on parental knowledge, attitudes and practice in relation to the dental health of preschool children in Trinidad and Tobago and the wider Caribbean. A preliminary Trinidad based study among a sample of parents and caregivers attending a dental hospital clinic, found confusion and lack of accurate information and low awareness of preventive dental care for preschool children (Naidu and Davis 2008). These issues therefore require further investigation.

Determination of clinical disease levels and the of influence social and behavioural risk factors on disease outcomes and treatment need, can help inform development of effective health policy for prevention and management of ECC and other oral conditions in early childhood, in Trinidad and Tobago.

Aim:

The aims of this research were to describe the oral health of preschool children in Trinidad, in particular the prevalence and severity of ECC and explore relationships with social behavioural determinants. Additional aims were to evaluate the effectiveness and acceptability of a community-based oral health promotion intervention and to develop a preventive strategy for ECC, appropriate for this preschool population.

Objectives:

1. Describe prevalence and severity of ECC.
2. Describe levels of treatment need.
3. Describe prevalence of developmental defects of enamel, dental erosion and traumatic dental injury.
4. Describe oral health knowledge of parents and caregivers.
5. Describe the influence of social and behavioural factors on ECC and the impact of ECC on child and caregivers oral health related quality of life (OHRQoL).
6. Explore oral health attitudes and beliefs of parents and caregivers.
7. Describe parent and caregiver and experiences in accessing dental care and identify opportunities for oral health promotion.
8. Assess the effectiveness of an oral health promotion intervention on the oral health attitudes and behaviours of parents and caregivers.
9. Develop oral health promotion Strategy for ECC in Trindad and Tobago

Methodologies employed:

Objectives 1-7

Quantitative study: Cross sectional, descriptive survey from a random sample of preschools in Trinidad.

Objectives 8-9

Qualitative study: Focus group discussions with a sub-sample of parents and caregivers from the descriptive epidemiological study.

Objectives 10

Interventional study: Community-based randomized controlled trial - Oral health promotion intervention using Motivational Interviewing (MI) for parents and caregivers, comparing MI with traditional Dental Health Education (DHE) delivered in preschools.

CHAPTER THREE: MATERIALS AND METHODS

This chapter reports the methods employed for objectives 1-4 of this research (listed below). Methods relating to objective 5 are reported in chapter six, objectives 6&7 in chapter seven and objective 8 in chapter eight.

3.1: Aim

The aims of this research were to describe the oral health of preschool children in Trinidad, in particular the prevalence and severity of ECC and explore relationships with social behavioural determinants. Additional aims were to evaluate the effectiveness and acceptability of a community-based oral health promotion intervention and to develop a preventive strategy for ECC, appropriate for this preschool population.

3.2: Objectives

1. Describe prevalence and severity of ECC.
2. Describe levels of treatment need.
3. Describe prevalence of developmental defects of enamel, dental erosion and traumatic dental injury.
4. Describe oral health knowledge of parents and caregivers.
5. Describe the influence of social and behavioural factors on ECC and the impact of ECC on child and caregivers oral health related quality of life (OHRQoL).
6. Explore oral health attitudes and beliefs of parents and caregivers.
7. Describe parent and caregiver and experiences in accessing dental care and identify opportunities for oral health promotion.
8. Assess the effectiveness of an oral health promotion intervention on the oral health attitudes and behaviours of parents and caregivers.
9. Collate findings from descriptive and interventional studies to develop oral health promotion Strategy for ECC.

3.3: Study design

The following sections describe the methodology and protocol employed in this study.

3.3.1: Overview

This is primarily a cross-sectional oral health survey using a clinical assessment and questionnaire -based approach for children and parents, respectively.

3.3.2: Target population

The target population were children of preschool age in Trinidad.

3.3.3: Accessible population

The accessible population were children attending preschools in the Caroni Education District of Central Trinidad, registered with the Ministry of Education.

3.3.4: Exclusion and inclusion

Children aged 3 to 5 years, attending government / government assisted and private preschools, were included in the sample. Younger children (i.e. under 3 years of age) attending the preschools were excluded.

3.3.5: Sampling size and sampling frame

Sample size was calculated using an estimated caries prevalence of 30% and a preschool population of 3,800. A sample size of 250 was calculated based on a 6% level of precision. Assuming a 20% non–response rate the target population size was 294. With an estimate of 30 children per preschool, this required 10 preschools in the sample. For the random selection very small schools (<15) and very large schools (>60) and those without enrolment size were omitted. This was done to include preschools of similar sizes and to assist data collection by a single examiner. From the remaining preschools in the sampling frame, the final random sample resulted in 3 government/government assisted and 7 non-government preschools.

3.3.6: Permission and Liaison

Ethical approval for the study protocol was obtained from the University of the West Indies Faculty of Medical Sciences Research Ethics Committee (**Appendix 3.1**).

For preschools that agreed to be in the study, packages were sent to each school head teacher / administrator that included letters for individual parents and caregivers inviting them to take part in the study and complete a self-administered questionnaire **(Appendix 3.2)** as well a consent form for oral examination of their child / children **(Appendix 3.3)**.

3.3.7: Recruitment

Preschools were recruited from a list of government/ government assisted and non-government preschools in the Caroni Education District registered with the Trinidad and Tobago Ministry of Education. Based on this list there were 27 government and 57 non-government preschool in the District at the time of the survey. Letters of request to participate in the survey were sent to each preschool in the sample addressed to the head teachers/administrators

3.3.8: Variables summary

The following questionnaire and clinical variables were selected for inclusion in the study.

3.3.8.1: Questionnaire variables

(a) Parent /caregiver:

- Age, sex, ethnicity, occupation of head of household, level of education.
- Oral health rating.
- Dental attendance.
- Oral health knowledge, beliefs and practices (related to young children)
- Health literacy (Morris *et al* 2006).
- Oral health self-efficacy (Finlayson *et al* 2007a).
- Stress and social support (Finlayson *et al* 2007b).

(a) Child:

- Age, sex, general health, preschool type.
- Parental rating of oral health.
- Dental attendance.
- Oral related quality of life (OHRQol) (Pahel *et al* 2007).
- Dental behaviour management problems (DBMP) (Frankl *et al* 1962).

3.3.8.2: Clinical variables

- Individual tooth status and treatment need (WHO 1997).
- Need for urgent dental care (WHO 1997).
- Enamel developmental defects (WHO 1997).
- Oral hygiene and gingival health (Walker *et al* 2000).
- Dental anomalies (WHO 1997).
- Dental erosion (Walker *et al* 2000).
- Traumatic dental injury (WHO 1997).

3.3.9: Development of questionnaire instrument and selection of measures

This section provides a rationale for selecting the study variables and the choice of measures and indices.

3.3.9.1: Age, sex, ethnicity

The independent variables of age, sex and ethnicity were recorded to explore their influence on the clinical and behavioural variables and to consider possible confounding effects. A confounder is a factor associated with the both the exposure and outcome and which can distort their relationship but remains extraneous to them (Datta 1993). A confounder can also be seen as an *intervening variable* or intermediate step in a causal pathway through which the independent (explanatory) variable affects the dependent (outcome) variable and may therefore introduce bias into research findings if not accounted for (Bowling 1999).

Race and ethnicity

The recording of race and ethnicity data in health research is common however there has been inconsistency in terminology and use of *ad hoc* categories, leading to over simplification of a complex socio-demographic variable (Sheldon and Parker 1992). Ethnicity can be considered distinct from race. Race can be seen as a construct based on phenotypical / biological differences whereas ethnicity refers to social groups who share a cultural heritage with a common language, values, religion, customs and attitudes (Hillier 1997).

Marked differences in caries levels, oral hygiene and dietary practices and dental visiting patterns have been reported in studies of children from various ethnic

minorities in the UK, even after controlling for SES (Prendergast *et al* 1997, Gray, *et at* 2000).

Again, after matching for age and social class some studies have shown higher caries experience among preschool children from minority ethnic groups (Watt and Sheiham 1999). Recent data from an ethnically diverse area of inner London found caries rates were significantly higher among preschool children of White Eastern European, Bangladeshi, and Pakistani origin compared to African, White and Black British children in the same area (Marcenes *et al* 2013). These authors suggest these differences may be due to infant feeding and weaning practice, language barriers, cultural beliefs about oral health and dentist perceptions about treating children from ethnic minorities (Marcenes *et al* 2013).

Ethnicity in the Caribbean

The last national census in Trinidad and Tobago stated "ethnicity pertains to people of the same race sharing history and distinctive cultural characteristics" (Central Statistical Office 2012). Hillier (1997) states culture refers to habits of thoughts and beliefs, diet, dress, music and art. Most of the English-speaking Caribbean islands are populated mainly by people of African ancestry but some countries e.g. Guyana and Trinidad, have a significant proportion of people of Indian origin. Although people in the region identify with being 'Caribbean' or 'West-Indian' from having a shared cultural history resulting in common modes of speech, food, festivals and leisure activities, many still consider themselves to have distinct cultural / ethnic differences unique to their specific African, Indian or European heritage. These ethnic differences, though subtle, may also be reflected in differences their health / oral health beliefs and practices.

- Ethnic groupings chosen for this research were based on previous published research in Trinidad and Tobago (Singh *et al* 1996) and national census groupings. The ethnic groups being: African, Indian, Mixed, White and Other.

3.3.9.2: Socioeconomic status

In the Fisher-Owens model, socioeconomic status (SES) is included as a family level influence on children's oral health (Fisher-Owens *et al* 2007) and on application to this model to US data national child oral health data, Fisher-Owens *et al* (2013) found that disparities in oral health could not be attributed to racial/ethnic differences alone but were influenced significantly by SES (represented by family income). Edelstein

(2002) reported that among US children, ECC was 2.5 times higher among preschool children whose parents had less than high school education. Similarly, in the UK, poorer dental health was found among preschool children from more deprived areas (McMahon *et al* 2010).

The use of SES as a variable to define social stratification has largely replaced the use of 'social class', which was based on sociological theory of economic productivity (Leon and Walt 2001). SES is now also the characteristic most commonly used in the analysis of inequalities / disparities in health (Locker 1989, Shavers 2007) as SES is known to influence health beliefs, attitudes and behaviour (Newton and Bower 2005, Locker 2000, Watt and Sheiham 1999).

There is no single universally agreed measure of SES but most developed countries use either *Compositional* (proxy measures) that focus on SES and behavioural characteristics of individuals and their health outcomes e.g. household income, social class, employment category, educational level, or *Composite* measures that are constructed by combining information about SES from several measures e.g. Geographic / area-based deprivation scores (Shavers 2007):

Table 3.1: Classification of measures of SES

Compositional measures	Composite (area-based) measures
Occupation	**Material and social deprivation**
Employment status Specific occupational group Aggregate occupation groups	Carstairs Index Townsend Index Jarman Underprivileged Area Index
Education	**Social standing and prestige**
Years of education Highest level of education Credentials / qualifications	Hollingshead index of social prestige Duncan's Socioeconomic index
Income	
Individual annual income Annual household income Family income	

3.3.9.3: Occupation

Occupation is believed to position individuals within the social structure, influencing access to resources and exposure to hazardous environments (physical and psychological). These effects may be from the actual physical work environment or indirect e.g. lifestyle choices and health behaviour. Occupation therefore generally measures social class and societal prestige. Problems with this approach to measuring SES include the following: (a) occupational classes comprise heterogeneous groups with variation in education and income, (b) lack of precision, (c) problem with retirees and homemakers (d) does not account for ethnic and gender differences in employment status, (e) most measure having been validated on working men (Shavers 2007). This approach has however been widely used in public health research and policy.

In the UK occupation has been used to classify populations into classes or strata that were believed to reflect SES as occupations can influence income levels, social prestige and living standards. The UK Registrar General Classification used six categories which identified segments of the population sharing broadly similar lifestyles and incomes (Locker 1989).

(I) Professional (doctor, dentist, lawyer)

(II) Managerial and lower professional (manager, nurse, schoolteacher)

(III) Non-manual skilled (clerk, cashier)

(IV) Skilled manual (carpenter, bricklayer, miner)

(V) Semi-skilled manual (postman, agricultural worker)

(VI) Unskilled manual (porter, general labourer)

More recently these strata have been replaced by the National Statistics Socio-economic Classification (NS-SEC) (Office for National Statistics 2010). The NS-SEC is an occupationally based classification that was designed to measure employment and conditions that reflect SES position in modern societies. Though not designed to offer better statistical associations than classification based on social strata or socio-economic group, the NS-SEC is believed to offer the possibility of explaining them.

- As the social structure in Trinidad and Tobago developed from a British colonial system, modified versions of the original Registrar General Classification have been used in local health research, such as that developed by Singh *et al* (1996):

Professional/managerial

Middle professional

Lower non-manual

Skilled manual

Unskilled manual

Housewife,

Unemployed

Retired old-age pensioner

In the present research, this classification was chosen as the classification for 'occupation of head of household', one of the proxy variables for SES.

3.3.9.4: Level of education

Educational level can influence income and SES through attainment of higher paid employment, societal position and degree of autonomy, and has therefore been considered a fundamental component of SES (Adler and Newman 2002).

People with higher education may be more socialized to health-promoting behaviour and lifestyles (Morris *et al*, 2006, Shavers 2007). Higher education may also influence their level of health literacy and hence their interaction with the health professionals, health information and health services. Shavers (2007) describes the advantages of this method of measuring SES as (a) being easy to measure (b) few people excluded from the measure (c) less likely to be influenced by disease in the adult population than income or occupation (d) predictive of better jobs, housing, neighbourhoods, income (e) stable beyond early adulthood (f) measurement is practical and easy (g) likely to capture lifestyle and behaviour relevant to health.

Some limitations of this approach include (a) different meaning and importance of education among different cultures, (b) ethnicity and gender may affect economic outcome of educational level (c) not directly linked to years / time in education, (d) may vary significantly over the life course.

- In view of the advantages listed above and for comparability to international research, highest educational level (of head of household) was used as one of the measures of SES for the present study. The educational categories used in this study were :

  None

  Primary

Secondary

Technical College

University

Other

3.3.9.5: Income

It has been argued that better income status may be characterized by better health status in a linear manner. This is in relation to higher income enabling greater access to material goods and services that can influence health. However, this likely to be an oversimplification (Shaver 2007) and is subject to several limitations when using this approach in health research: (a) more unstable than occupational level, (b) higher non-response (c) does not include health insurance aspect or state benefits etc, (d) may be affected by ethnic differences and discriminations, (e) often unavailable or difficult to access these data and (f) age dependent.

Questions on individual or household income were felt to be too intrusive for this study population and thought likely to affect participation and response rates.

3.3.9.6: Composite measures

Composite measure combine data on SES e.g. education, employment, home ownership, income based on regions or geographic areas. These measures do not rely on individual income or social class but assume that small areas are likely to be socially homogenous and therefore allow comparison between socioeconomic or behavioural characteristics between groups which can identify more variation in health outcomes than conventional measures (Locker 2000). Examples of area based measures used in the UK include the Townsend Index (Townsend *et al* 1988), the Carstairs index (Carstairs and Morris 1991) and the Jarman Underprivileged Area Index (UIA) (Jarman 1983).

There is a distinction between material and social forms of deprivation, the former referring to lack of access to good and services and the latter to 'non participation' in societal roles such as education, employment and social relationships resulting in social exclusion (Locker 2000). More recently some of these elements have been included in the concept of *social capital* which refers to resources available to people that are embedded wthin social networks (e.g. family, neighbourhoods, workplaces, school etc) and related to issues of trust, sharing and social cohesion (Leon and Walt 2001, Muryama *et al* 2012).

- Area-based deprivation information is not available in Trinidad and Tobago and was therefore not used in the present study as a measure of SES.

3.3.10: Question domains

The self-administered questionnaire (**Appendix 3.4**) was based on an instrument previously used among parents of preschool children attending a hospital-based paediatric dental clinic in Trinidad (Naidu and Davis 2008). This instrument was further developed based on the literature on early childhood oral health and on the conceptual model proposed by Fisher-Owens *et al* (2007) that considers individual, family and societal level influences on children's oral health. Questions addressed parental knowledge, attitudes, beliefs and practices towards dental health of young children, along with dental service use and demographic information. The final 31-item self-reported questionnaire included the following domains:

- Parent rating of child's dental health.
- Parent beliefs and attitudes towards dental health and oral health fatalism
- Parent dental health knowledge
- Parent oral health practices and self-efficacy
- Health literacy
- Dental service utilisation and access
- Parent stress

3.3.10.1: Parent rating of child oral health

With respect to dental care, a parent's role as a primary caregiver may be influenced by awareness of the condition their child's teeth and mouth (Sohn *et al* 2008). Instruments involving a parent rating of their children's oral health have been found to have good reliability, be related to clinical caries experience (Pahel *et al* 2005, Sohn *et al* 2008) and have shown good consistency over time (Skaret *et al* 2008).

- A five-point Likert scale was used to assess parent and child dental health, based on the question 'how would you rate your child's dental health': The categories being: *Excellent, Very Good, Good, Fair,* and *Poor.*

3.3.10.2: Parent beliefs and attitudes and oral health fatalism

- Parental attitudes can impact on the establishment of habits favourable to oral health (Adair *et al* 2004). Parental attitude towards the importance of the primary teeth was assessed by an item on preferred treatment for a decayed non-painful primary tooth (Blinkhorn 2001, Naidu and Davies 2008). Based on research by Finlayson *et al* (2005) a question item was included relating to a belief in the inevitability of dental caries (oral health fatalism): agreement / disagreement with the statement '*tooth decay runs in families*'.

3.3.10.3: Parent and caregiver knowledge about oral health

- Questions on oral health knowledge about how soon to start and the importance of brushing children's teeth, the role of bacteria in tooth decay, effect of fluoride, use of sweetened baby bottles and time for child's first dental visit based on items used in UK National Diet and Nutrition Survey (Walker *et al* 2000).

3.3.10.4: Parent and caregiver oral health behaviour and self-efficacy

- These variables were assessed using questions on brushing frequency, supervision of brushing, types of brush, method of brushing, use of toothpaste, fluoride use, frequency of sweetened snack and drinks and fruit intake (Blinkhorn 2001, Finlayson *et al* 2007a, Naidu and Davies 2008).

3.3.10.5: Health literacy

Reading skills can influence access to health information, managing personal health, those cared for and utilisation of health services (Kutner *et al* 2003, Morris *et al* 2006).

- Based on the Single Item Literacy Scale (SILS) (Morris *et al* 2006), a question item was included to determine if help is needed with reading health related information, *'How often do you need to have someone help you with reading instructions*, leaflets or other written material from the doctor or pharmacy. Answers on five-point Likert scale, 'never' to 'always'.

3.3.10.6: Dental service access and utilisation

Inequalities in preschool children's oral health have been shown to be related to issues of access to dental care, with children who have irregular dental visits having higher levels of decayed teeth and greater need for emergency care (Edelstein 2002).

- Dental service questions items were included in the questionnaire relation to: frequency of dental attendance of the parent, difficulty in finding dental care for themselves and questions on whether they had taken their child to a dentist or dental nurse and had difficulty in finding dental care for their child.

3.3.10.7: Parent and caregiver stress

Psychosocial factors such as parental stress, social support and coping may be related to oral health behaviours that impact on preschool children's oral health (Finlayson *et al* 2007, Tinanoff and Reisine 2009).

- One question from the 6-item instrument developed by Finlayson *et al* (2007b) to measure parental stress was included to determine level of stress, '*How often do you feel your child is making too many demands on you?*'

3.3.11: Oral health related quality of life

The concept of Oral Health Related Quality of Life (OHRQL) measures the persons' subjective experience of oral problems and its impact on daily life (Allen 2003). In very young children, measuring the impact of oral problems is challenging as the parent or caregiver have to interpret the child's subjective experience. However, more recently, instruments to measure OHRQL in young children have been developed and used successfully (Pahel *et al* 2007, Kramer *et al* 2013).

- The Early Childhood Oral Health Impact Scale (ECOHIS) was developed to assess the impact of oral health problems and related treatment experiences on the quality of life of preschool children aged 3 to 5 years-old and therefore selected for use in the present study. The instrument has child and family impact sections, with the parent as the informant. The ECOHIS was developed in the US Pahel *et al* 2007), and has also been validated in non-English-speaking populations (Shanshan *et al* 2008, Wong *et al* 2011, Peker *et al* 2011, Kramer *et al* 2013). This parent (self-reported) 13-item instrument is based on the theoretical model proposed by Jokovic *et al* (2002). It includes

four descriptive domains for items included in the *child impact section* (symptoms, functional, psychological, self-image/ social interaction) and two domains for the *family impact section* (parent distress, family function). The ECOHIS instrument is described in more detail in Chapter 6)

3.3.12: Child behaviour rating

Dental examinations and treatments are demanding for some children and Dental Behaviour Management Problems (DBMP) are common (Brogardh *et al* 2007). DBMP in preschool children can have implications for service provision with respect to choice of treatment, need for specialist referral and additional clinical resources. A measure of DBMP should therefore be part of the oral health assessment of young children.

DBMP is also linked to anxiety and in young children undergoing / have undergone dental treatment and avoidance of 'treatment-induced anxiety' while effectively managing caries in a young child requires a careful consideration. (Scottish Dental Clinical Effectiveness Programme 2010)

Several instruments have been developed for assessing dental anxiety in children such as the Child Fear Survey Schedule (CFSS) (Carson and Freeman 1997) and the Venham picture test (VPT), (Buchanan and Niven 2002). However, these scales measure anxiety and fear in response to, or anticipation of, dental treatment but do not measure the child's actual behaviour during treatment.

Behaviour rating scales measure situational fear and are reported to be reliable but difficult to validate in different clinical settings (Folayan and Kolawhole 2004; Aartman *et al* 1996). The Melamed Behaviour Rating Scale (Melamed *et al* 1975) consists of 27 child-related behaviours indicative of dental fear. These factors are weighted by a number that reflects 'degree of disruptiveness'. However this scale is complex and time consuming and not suitable for epidemiological studies.

The Frankl behaviour rating scale (Frankl *et al* 1962), rates children's reaction to dental treatment on a four point scale, ranging from definitely negative to definitely positive and has been used in epidemiological studies.

Table 3.2: Frankl behaviour scale (Frankl *et al* 1962)

Rating	Attitude	Definition
1	Definitely negative	Refusal of treatment, crying forcefully or any other overt evidence of extreme negativism]
2	Negative	Reluctant to accept treatment, uncooperative, some evidence of negative attitude but not pronounced
3	Positive	Acceptance of treatment at times cautious, willingness to comply with the dentist at times with reservation but patient follows the dentists directions cooperatively
4	Definitely positive	Good rapport with the dentist, interested in the dental procedure, laughing and enjoying the situation

- Due to its simplicity and ease of use and this scale was included to measure DBMP in this survey, specifically to measure likely disruptive behaviour during dental care.

3.3.13: Selection and development of clinical measures and indices

A dental index is a means of converting a clinical diagnosis into a measurable statistic (Downer 1994). An ideal dental index should be: simple, objective, valid, reliable, acceptable, precise and amenable to statistical analysis (Robinson 1996)

3.3.14: Indices for measuring dental caries

This section reviews measure and indices for recording dental caries

3.3.14.1: The DMFT/dmft index

The most widely used index for caries is the DMFT index (D=decayed, M=missing, F=filled teeth), developed by Klein *et al* (1938). The index measures individual caries experience i.e. the number of decayed, missing and filled primary or permanent teeth or teeth surfaces and therefore describes lifetime caries attack and treatment at the time of observation (Downer 1994). In the primary dentition this is denoted as dmft/dmfs. Whereas caries prevalence is the proportion of people affected by caries at a give time, caries experience is the proportion of people with a DMFT /dmft sore of one or more (Downer 1994). Caries experience can be averaged over small groups or

whole populations and expressed as the mean number of decayed, missing and filled teeth (i.e. mean DMFT /dfmt) or mean tooth surface DMFS /dmfs.

3.3.14.2 Limitations of the DMFT /dmft index

The DMFT index has been used successfully in descriptive epidemiology for many years. It is however subject to several limitations. The M component can be unreliable as subjective assessments of why teeth are missing is difficult, particularly in adult populations. Although extractions due to caries continue into adult life, periodontal disease and other non-caries related reasons for tooth loss becomes a factor (Pitts *et al* 2004). In some developed countries with better access to secondary services, orthodontic extractions may affect the missing component in children (Downer 1994). The objectivity of the index is affected by assigning a score of 1 to all components i.e. the D, M, F particular DMFT score can be associated with very different patterns of caries presentation/treatment. The score also reflects individual diagnostic and treatment decisions of dentists, whom research indicates have widely differing ethos in the clinical treatment of caries (Elderton and Nuttall (1983). In countries where dental services are well established the DMFT may in fact represent the dental care system and not disease prevalence (Pitts *et al* 2004).

Low caries prevalence in many industrialised countries has affected the DMFT frequency distribution making mean scores less meaningful (Whelton and O'Mullane 2007) , with mean caries experience showing compression to zero scores and the associated skewness of the data increasing the variability, decreasing differences between group means and percentage of subjects who are caries- free. Larger sample sizes are therefore required in caries prevalence studies to avoid Type 2 errors (Spencer 1997).

Greater use of fissure sealants and tooth coloured restorations, particularly in children, present difficulty in scoring teeth as sound or filled as it difficult for examiners in the field to distinguish between the two situations leading to an underestimate of the prevalence of dental caries (Downer 1994, Whelton and O'Mullane 2007)

3.3.14.3: Diagnostic threshold for caries

The caries process is an interaction between the tooth surface and biofilm, with the caries lesion being the manifestation at a particular stage in time. It is a dynamic

process which in its very early stages is reversible, presents very differently at various stages of its development (Pitts *et al* 2004).

The diagnostic threshold for caries determines whether a tooth is recorded as diseased or sound. These authors propose the grading of clinically detectable lesions from D1 to D4:

D1= clinically detectable enamel lesion with intact surface

D2= clinically detectable cavity limited to enamel

D3= clinically detectable lesion in dentine

D4= clinically detectable lesion into pulp

For most caries prevalence studies the diagnostic threshold for caries has been set at the D3 / d3 (denoting caries in primary teeth) level and above, with caries recorded when there has been an obvious break in the tooth surface (macroscopic cavitation). A criticism of using this threshold has been that by only reporting the existence of decay at this late stage suggests people below the D3 level are caries-free and have no disease.

Confirmation of cavitation at D3 has been achieved by use of sharp and more recently blunt explorers. The use of the former has been more prevalent in the US and the latter more common among European researchers (Whelton and O'Mullane 2007). In the early nineties the British Society for Community Dentistry (BASCD) discontinued the use of an explorer, relying on purely visual inspection for diagnosis at D3 on teeth surfaces clear of debris. However, the 1998 UK Adult Dental Health Survey recorded as carious, teeth with a clinically changed colour to dentine seen through intact enamel ('visual caries') (Kelly *et al* 2000). In this national survey it was felt important to include carious lesions that showed dentine involvement without cavitation as this stage of the caries process is an important marker of disease requiring restorative treatment, particularly in younger populations (Nunn *et al* 2001). This type of lesion is not to be confused with 'hidden caries' which implies caries in dentine, visible only on radiograph.

DMFT data in the above-mentioned survey were recorded using both criteria. The impact of the use of the newer criteria was greatest in the younger age groups (16-24 years) where the number of decayed teeth doubled as compared to the number reported using the traditional D3 criteria (Kelly *et al* 2000).

Diagnosis of caries before dentine involvement has also been reported in caries prevalence studies. The work of Backer Dirks *et al* (1951) has lead to D1 and D2

lesions also being used as diagnostic thresholds in some surveys but until recently these methods has been found to have greater utility in clinical practice based research rather than epidemiological studies (Pitts *et al* 2004).

3.3.14.4: ICDAS

To take into account current presentation and population distribution of caries along with a better understanding of the caries process, a new international criteria for caries diagnosis has been developed, the International Caries Detection and Assessment System (ICDAS). The ICDAS was developed to provide clinicians, epidemiologists and researchers with an evidence-based system to permit standardized caries detection and diagnosis in different situations (Pitt 2004). The ICDAS and ICDAS II are predominantly visual scoring systems using criteria that diagnose caries at the D1 to D3 level (Pitts and Topping 2007) In this system teeth are examined following removal of plaque and when wet and after drying, with six codes for each tooth surface, including visual changes in enamel, enamel breakdown, shadowing in dentine and distinct cavity in dentine (Pitts and Topping 2007, Ismail *et al* 2007).

- Despite some limitations related to current caries presentation and diagnosis, the DMFT / dmft index is still widely used for caries epidemiology. Its long and widespread use as a measure of caries prevalence has enabled international comparison of data sets from cross-sectional and longitudinal studies over many decades. It has satisfactory reliability when used by trained and calibrated examiners. Good acceptability and is amenable to statistical analysis. Though it lacks some validity as an absolute measure of caries especially in older people and some sensitivity at the D3 /d3 level, it is a satisfactory index for descriptive epidemiology. For these reasons the dmft index was chosen for use in the survey.

3.3.15: Treatment need

Assessment of dental treatment needs is required in order to plan, prioritize and evaluate dental services to compare treatment needs in different populations and sub-populations, and enables targeting of appropriate resources to those in greatest need (Sheiham and Tsakos 2007).

Assessments involving professionally defined need for dental care (i.e. normative need) have been attempted using various methods, most commonly by using information from DMFT/dmft survey data. Although the DMFT/dmft index was designed to measure caries experience it has been used in the 'condition to need approach' where treatment needs are assessed on the basis of the nature and distribution of the oral health of a sample of the population (Sheiham and Spencer 1997). Problems with using the DMFT / for treatment needs arise from using the D /d or M /m components as a proxy for overall need for care, as these codes do not implicitly indicate what type of care is required (i.e. extraction, restorative, preventive care) or the level of severity of need (routine / urgent). In addition, with the changing patterns of caries experience, skewed distributions and varying treatment decisions by dentists, DMFT/ dmft data can have quite different implications depending on the population investigated. For instance, in developed countries the F/f may be the higher component as compared to a developing country where the D /d might likely be higher (Peterson 2003). DMFT /dmft data is therefore not sensitive or reliable enough for direct treatment needs assessment and hence inadequate to assess dental treatment needs in a community (Mann *et al* 1993).

To improve the utility of DMFT/dmft data for treatment needs assessment / service planning, Bratthall (2000) developed the Significant Caries Index (ScI). This index focuses on data from those with the highest caries scores and reports the DMFT/dmft score for the one third with the highest caries. Aleksejuniene and Bruliene 2009 state that although the ScI may be more sensitive for setting targets in relation to prevention (i.e. identify high risk groups) it does not eliminate easy comparison for normative need. Pioveson *et al* (2013) reported data for preschool children using the ScI and ICDAS, which was helpful in differentiating between those with children the greatest disease burden and greater unmet need.

A Treatment Need Index (TNI) developed by Mann *et al* (1993) attempted to assess severity of damage to the teeth and complexity of treatment required. It described several levels of treatment need: *none, preventive, fissure sealant, initial restorations, moderate restorations, advanced restorations, radical treatment/pulp therapy, prosthetics, and extractions.* Although found to record a more accurate picture of caries extent and severity than the DMFT index, these treatment categories may be more prone to subjective interpretation, with examiners requiring more extensive calibration.

Another index designed to describe severity of oral problems in relation to caries is the PUFA / pufa index (Figueirdo *et al* 2011). This index assess the prevalence and severity of caries by coding untreated lesions as having: 'p' (*pulpal involvement*), 'u' (*ulceration*), 'f' (*fistulae*), 'a' (*abscess*). The authors propose that this index can reflect a population's 'real needs' which is imperative in developing countries where oral health services are a low Government priority. In studies reported from Brazil and the Philippines the 'p' code was the most prevalent component of the index (75% and 85%, respectively) indicating a severity of caries that would otherwise be reported as 'd' in the dmft index along all carious teeth. Reporting PUFA/ pufa data along with caries experience can therefore portray the reality of oral health in a community (Figueirdo *et al* 2011) and may aid policy development.

Another alternate epidemiological index for evaluating summative dental treatment need was proposed by Aleksejuniene and Bruklene 2009): the 'Quantitative Summative Dental Treatment Needs Index (QSDTNI). The QSDTNI attempts to evaluate both individual treatment need and total burden of disease. In this assessment the normative dental treatment need is based on the WHO criteria with the QSDTNI calculated for each subject. This calculation for each treatment modality relative to the cost of a fissure sealant (based on the Canadian Dental Association fees guide. In this way the relative treatment costs are presented for preventive, one, two and three surface fillings, root treatment, crowns, partial and complete dentures and surgery. This index will need further evaluation as to its utility in different countries and populations.

3.3.15.1: WHO dental treatment need assessment

This index developed by the WHO for oral health surveys (WHO 1997), has been widely used and allows a summation of individual procedures ranging from preventive care, simple to complex restorative care, to extractions. These data are derived directly from the individual tooth status information gathered at the time of the oral examination and has been described as the '*direct treatment plan approach'*. This has the advantage of clearly quantifying specific treatment needs (McGuire 1992). However, some have argued that, data based on WHO criteria, are generally not analyzed in a consistent way, making comparison between studies difficult (Aleksejuniene and Bruklene 2009). Furthermore, collapsing several different

treatment needs into one or two treatment categories reduces the ability to determine differences in treatment among individuals.

- Overall, the WHO index has simple criteria and good speed of use in the field and is amenable to statistical analysis. This index of treatment need was therefore selected for use in this present study.

3.3.16: Developmental enamel defects

Defects of enamel have a complex aetiology and some cannot be assigned to a specific cause. They can be broadly classified however as (a) genetic, (b) systemic (metabolic, ingestion of toxic substances e.g. fluoride, Tetracycline or 1 (c) localised (e.g. trauma, infection) (Cutress *et al* 2007).

3.3.16.1: Metabolic factors

This includes childhood illnesses such as mumps and measles. Poor nutrition during early childhood has been implicated for primary teeth (Sweeney *et al* 1971) and permanent (Rugg-Gunn and Nunn 1999) *Linear enamel hypoplasia* in the primary has been reported as common where the prevalence of malnutrition among children is high, which in turn has been associated with low socio-economic status.

Dental Fluorosis is caused by the chronic ingestion of high amounts of fluoride during the time of amelogenesis and can present in a wide range of clinical presentations. (Cutress *et al* 2007).

3.3.16.2: Local factors

Enamel defects of the permanent teeth are a common sequelae of trauma to the primary successor, particularly in the anterior region and the type and severity of disturbance is closely related to the age of the child at time of injury and stage of tooth development Where infection occurs around the tooth germ this can present as a well demarcated hypomineralised area or hypoplasia in the permanent tooth (Turner tooth) Cutress *et al* 2007)

3.3.16.3: Classification:

Nearly all defects can be classified by their macroscopic appearance as either

demarcated opacities, diffuse opacities or *hyoplasia.* Although differing in aetiology the appearance is related to stage of ameloblast activity and disruption of amelogenesis.

- Fluorosis specific indices
- Indices developed to measure enamel defects and opacities fall under: Descriptive indices

Fluorosis specific indices have been developed based on Deans Index (Dean 1942), which records enamel as ranging from 'normal' to 'severe.' Dean index lacks specificity at the lower end of the scale as the criteria include 'questionable' and 'very mild' and lacks discrimination at the higher, severe end of the scale (Cutress *et al* 2007). Sensitivity has been improved by later indices such as the TF index (Thylstrup and Fejerskov 1978), Tooth Surface Loss Index (TSIF) (Horowitiz *et al* 1984) and the Flourosis Risk Index (Pendrys 1990).

Unlike Dean Index, descriptive indices classify enamel based on appearance and not aetiology. This includes the Developmental Defects of Enamel – DDE (FDI 1992), J-A index (Al-Alousi *et al* 1975) and the M-S index (Murray and Shaw 1979).

- Based on its validity as an epidemiological tool and for ease of use in a preschool population the modified DDE index, as described by the WHO (1997) was selected for the present study. This index has three broad categories for enamel abnormalities: 'Demarcated Opacity', 'Diffuse opacity" and 'Hypoplasia' with further categories are combinations of these three. The WHO criteria were further adapted for use with the primary dentition, with the index being the upper right first primary molar to the upper left first primary molar (8 teeth), as opposed to the 10 permanent teeth described by the WHO.

3.3.17: Dental Erosion

Dental erosion has been defined as the irreversible loss of tooth substance caused by a chemical process that does not involve bacteria (Kilpatrick and Welbury 2005). Non carious tooth surface loss (sometimes referred to as 'tooth wear') can also occur from attrition and abrasion where tooth substance is lost by mechanical action. Erosive lesions do not always have a clear aetiology and may include an element of

mechanical tooth loss as it is understood that tooth surface loss is usually due to a combination all three processes with perhaps one predominating (Shaw 2004). Data from UK national surveys as indicated a trend of high prevalence of erosion in children aged 3 to 4 compared to older children (Nunn *et al* 2003).

3.3.18: Measures of tooth wear and dental erosion in children

An ideal index to measure erosion should include definitive parameters to assess differing extents of the erosion, easily distinguish erosion from other types of tooth wear and be able to monitor changes in severity over time (Taji and Seow 2010). Several indices have been developed to measure tooth wear for use on both permanent and primary dentitions.

To measure dental erosion of 'non-industrial origin', Eccles (1979) designed an index using very detailed qualitative criteria, in this index, erosion was categorized into three classes based on the type of lesion, and tooth surfaces affected (Bardsley 2008). The extensive criteria however make this index unwieldy, limiting its use for large surveys.

Smith and Knight (1984) developed Eccles concept into a visual, 'aetiology non-specific' index for measuring tooth wear (The Tooth Wear Index TWI). The TWI which has subsequently been widely used in dental surveys (Moazzez and Barlett 2007). In this index, tooth wear from any cause is scored on all tooth surfaces: cervical, buccal/labial, incisal/occlusal and palatal/lingual with scores ranging from 0-4, with 0 (no tooth wear), 1 (enamel wear), 2 (exposure of dentine less than 1/3), 3 (exposure of dentine greater then 1/3), 4 (exposure of pulpal dentine or secondary dentine). This score combing extent and severity was based on maximum acceptable tooth wear scores that were proposed for each decade of life (Taji and Seow 2010). The use of age-related reference scores makes the index more applicable for adults.

A modified version of the TWI was used measure erosion in the 1993 UK national child dental health survey (O'Brien 1994). Codes in this instrument were: 0=no wear, 1=enamel wear, 2=dentine exposure, 3=pulp exposure (Moazzez and Barlett 2007). To improve ease of use in a large survey situation a partial-recording system using 'index teeth' were scored rather than measuring wear on the whole dentition (Bardsley 2008). In children, these index teeth were the upper anteriors with measurements on the buccal and palatal surfaces. Incisal wear was excluded in an attempt to gain a more accurate measure of tooth wear caused by erosion rather than

attrition or abrasion (Taji and Seow 2010). Aine *et al* (1993) developed an index for measuring erosion in primary and permanent teeth caused by GORD with lesions classified based on dentine exposure but lack of site specificity and lesion extent are thought to limit its utility (Taji and Seow 2010).

Although less widely used, Lussi (1996) proposed an index for recording only lesions 'definitely' due to erosion based on the TWI. These lesion are scored using the following categories on the labial surfaces: 1=loss of enamel, 2=involvement of dentine for less than half of the surface, 3 involvement of dentine on over half the surface. On the occlusal surfaces these grades being 1=slight erosion with no dentine involvement and 3= severe erosion with dentine involvement.

O'Sullivan (2000) developed an index for erosion specifically for use in children. This index scores tooth surfaces affected, severity of the erosion and the area of the surface affected. This was to address that fact that the modified TWI index used in other child dental health surveys employed partial recording and summary scores, measuring overall loss of tissue exposing enamel, dentine or pulp but not the more subtle changes that aid follow-up and monitoring (O'Sullivan 2000). All teeth were examined and assigned a three digit score based on 5 sites, area affected (less than/ more than half surface affected) and severity (graded 0-5) (Bardsley 2008). The index was reported to have good ease of use and reproducibility (O'Sullivan 2000).

- For ease of use in young children and comparability, the modified version of the TWI as used in the UK National Diet and Nutrition Surveys 1997 (Walker *et al* 2000), was selected for use in the present study

3.3.19: Plaque and gingival health

When measuring oral health, an assessment of oral hygiene is considered important as effective plaque removal reduces exposure to the main risk factor for gingivitis and periodontal disease. Indices to measure plaque have considered the presentation of plaque on a tooth in terms of its *weight*, *extent* or *thickness*. Measurements of plaque weight (Grant *et al* 1998) and extent (Green and Vermillion 1960; Quigley and Hein 1962, Green and Vermillion 1964; Ramfjord 1967) and thickness (Silness and Loe 1964) have been applied to experimental and descriptive epidemiological studies. Indices with high precision, although useful for experimental studies e.g. clinical trials,

are usually very detailed and time consuming, reducing simplicity and ease of use in population surveys.

Gingivitis and much of periodontal disease is very closely related to oral hygiene levels and sustained plaque control by individuals could impact significantly on disease prevalence (Corbet 2007). In the permanent dentition gingival inflammation may remain as a contained gingivitis indefinitely or progress to periodontitis depending on the equilibrium between bacterial challenge and host defences (Page 1986). Indices measuring gingivitis therefore, generally seek to assess the classic signs of inflammation i.e. colour change, change of contour and consistency and bleeding on probing, Ramfjord (1959), Muhlemann and Sohn (1971), Loe and Silness (1963).

In young children the gingival epithelium is thinner and less keratinzed giving the appearance of increased redness that may be interpreted as mild inflammation (Heasman and Waterhouse 2005) and hence an overestimation of prevalence.

- Although visual scoring methods for oral hygiene and gingival health lack some sensitivity and precision, they are simple and acceptable and have been used in national dental health surveys of young children (Walker 2000). Visual recording of presence / absence of plaque and gingivitis, without the use of a probe, was selected for use in this survey.

Details of the oral examination indices (codes and criteria) are described in **Appendix 3.5.**

3.3.20: Oral health related quality of life (OHRQoL) and the early childhood oral health inmpact scale (ECOHIS)

The ECOHIS instrument was included as part of a self-administered oral health questionnaire (**Appendix 3.4**) given to parents and caregivers from nine randomly selected preschools in the Caroni Education District in central Trinidad (*sample selection described in Chapter 3).* Along with the ECOHIS instrument, the oral health questionnaire also contained socio-demographic and socio-behavioural variables relating to the oral health of preschool children. Parents who participated in the study were also requested to give consent for an oral examination of their child/children.

To test face and content validity, the ECOHIS instrument was piloted among parents and caregivers of young children attending a dental hospital clinic in Trinidad and found to be acceptable.

3.3.20.1: The ECOHIS instrument

The Early Childhood Oral Health Impact Scale (ECOHIS) was constructed as follows.

Opening statement:

"Problems with the teeth, mouth, or jaws and their treatment can often affect the well-being of children and their families. For each of the following questions please tick the number next to the response that best describes your child's experience or your own. Consider the child's entire life from birth until now when answering each question". Response options: Never, Hardly ever, Occasionally, Often, Very often & (Don't know).

Both sections of the instrument address quality of life 'domains':

Child impact section

1. *How often has your child had **pain** in the teeth, mouth or jaws?* (Child symptoms domain)

How often has you child....because of dental problems or dental treatment? (Child function domain)

2. had **difficulty drinking hot or cold drinks**
3. had **difficulty eating some foods**
4. had **difficulty pronouncing any words**
5. **missed preschool, day-care or school**

How often has your child....because of dental problems or dental treatments? (Child psychological domain)

6. had **trouble sleeping**
7. **been irritable or frustrated**

How often has your child....because of dental problems or dental treatment? (Child self-image related domain)

8. **avoided smiling or laughing** when around other children.
9. **avoided talking** with other children

Family impact section

How often have you or another family member....because of your child's dental problems or dental treatments? (Parent distress domain)

10. been **upset**

11. felt **guilty**

How often... have you or another family member. .because of your child's dental problems or dental treatments? (Family function domain)

12. **taken time off from work** ....because of your child's dental problems or dental treatments.

13. that had a **financial impact** on your family?

3.3.20.2: Scoring the ECOHIS:

ECOHIS scores are calculated from the sum of the responses for the child (0-36) and family sections (0-16) and reported as mean impacts per item/ section.

3.3.21: Conduct of the study

The following sections describe the conduct of field-work, examination protocols and data handling.

3.3.21.1: Pilot study

The self-administered questionnaire was piloted among parents and caregivers of one preschool (not used in final sample) to assess with oral examinations of children for whom consent was obtained. Face and content validity for the questionnaire were found to be acceptable with no need for wording changes and no further modifications were necessary for the oral examination protocol

3.3.21.2: Equipment and resources

The personnel involved in the field-work for this survey were a single examiner (RN) and two assistants.

Equipment required included the following:

Disposable mouth mirrors

Disposable facemasks

Cotton rolls

2 x 2 gauze squares

Hand sanitizer

Plastic garbage bags

Data forms for oral examinations

Dental health education materials (tooth puppets and large brushes and dental themed giveaways and tokens for the child participants, (stickers and bravery certificates)

3.3.21.3: Training and calibration

The single examiner was previously trained and calibrated in use of the WHO 1997 criteria. Further training was achieved through the use of training slides on CD ROM (assessment of gingival health, enamel hypoplasia and dental erosion). The Kappa statistic was used for intra-examiner reliability (caries diagnosis / dmft).

3.3.21.4: Protocol for clinical examination

Before the oral examinations a dental health presentation was given in each preschool using puppets (by the research assistant) and all children were given colouring books/ stickers and a toothbrush after their examinations. Children were examined in the preschool classroom using natural light in a seated position in a small chair /bench with the examiner positioned behind. The child's head was tipped slightly back to aid vision. Teeth were assessed visually with use of disposable mouth mirror with examiner wearing disposable gloves and facemask. New gloves and mouth mirror were used for each child. Teeth were not air dried but soft debris on tooth surfaces was removed with a cotton roll or gauze square.

The teeth were examined from child's right to left across upper arch and left to right for the lower arch with clinical variables recorded in following sequence: *1/Enamel hypoplasia, 2/oral hygiene, 3/gingival inflammation, 4/cleft lip/palate or other dental anomaly, 5/dentition status and treatment need, 6/erosion,7/ need for urgent care and referral.* A second attempt was made to examine children who initially refused; (this second attempt followed completion of examinations on compliant children whom the previously non-compliant children were able to observe.

3.3.21.5: Data recording and processing

Oral examination data was entered onto data record sheet (**Appendix 3.6)** by a research assistant in the field. This information was subsequently entered into a

computer database (SPSS v 16) for storage and processing. Data were cleaned and checked for errors before processing using SPSS, STATA and the R statistical package.

3.3.21.6: Analytical strategy

Descriptive statistics were applied to questionnaire and clinical variables.

Specific codes from dentition status were used to calculate the dmft index score to describe visual caries experience: for the (d) component this included dentition codes for 'decayed' and 'filled and decayed', for the (f) component this included 'filled no decay' and for the (m) component 'missing due to caries'. Means, standard deviations and 95% confidence intervals were calculated for continuous variables.

3.3.21.7: Summary of statistics

Results for visual caries experience and treatment need were reported as:

- Mean decayed, missing and filled teeth (dmft), for all children, standard deviation and 95% confidence limits.
- Mean decayed teeth (dt), standard deviation and 95% confidence limits.
- Mean missing teeth (ft), standard deviation and 95% confidence limits.
- Mean filled teeth (ft), standard deviation and 95% confidence limits.
- Mean dmft for the children with some caries experience (dmft > 0).
- Mean dmft by gender, ethnicity and school type.
- Proportions of children with some caries experience (dmft >0).
- Proportion of children with untreated decayed teeth (dt>0).
- Proportion with severe early childhood caries S-ECC.
- Proportion of children with treatment need / treatment need categories
- Proportion of children with caries experience by gender.
- Proportion of children with plaque and gingivitis,
- Proportion of children with dental erosion
- Proportion of children with enamel developmental defects,
- Proportion of children with a dental anomaly.

Associations between socio-behavioural variables from the questionnaire and clinical variables from the oral examinations (in particular 'visual caries experience'), were

explored using bivariate (Wilcoxon rank sum test, Kruskal Wallis test, Pearson Chi square test) and multi-variate analyses (logistic regression and general linear mixed models (GLMM).

CHAPTER FOUR: RESULTS OF THE ORAL HEALTH SURVEY

This chapter describes the results of the oral health survey including results from the parent/caregiver questionnaire and clinical findings from the child oral health examinations and for the oral health related quality of life instrument (ECOHIS).

4.1: Response to the survey

Ten preschools were randomly selected from the final sampling frame of preschools in the Caroni Education District. Of these, three were government / government assisted and seven non-government run. One preschool (Grells day care) was subsequently excluded as all children were under three years old and thus did not fit the inclusion criteria. Of the 9 remaining preschools, all agreed to participate in the study.

From the 340 enrolled children, 309 parents and caregivers responded to the invitation to participate in the survey and completed the dental health questionnaire (Response rate 91 %). Of the 314 parents and caregivers that gave consent for the oral examination (Response rate 92%), examinations were completed for 251 children. The overall response to the survey is shown in Table 4.1.

4.1.1: Study Power

Based on a sample size achieved of 251, the power of the study was 99%.

Delta =1 (able to detect a difference of 1 decayed, missing or filled tooth).

Standard deviation: 3. Significance level: 0.05

Table 4.1: Response to survey

Preschool	enrolment	Questionnaire completed	No Consent	Absent	Refused oral exam	Completed oral exam
HanifaAziz[1]	40	40	0	3	9	28
Montrose Nursery2	36	35	1	4	7	24
ASJA[1]	51	49	4	12	0	35
Heavens Gift[2]	14	12	0	0	0	14
Orchard[2]	30	27	1	3	0	26
Kids World[1]	47	38	9	2	4	32
Mennonite[2]	42	37	5	4	4	29
Caroni[2]	28	25	0	3	3	22
Flaming word[2]	52	46	6	5	0	41
Total	**340**	**309**	**26**	**36**	**27**	**251**

[1] Government / Government Assisted

[2] Non- Government

4.2: Results from parent / caregiver questionnaire

The following sections describe results for the parent / caregiver questionnaire with respect to socio-demographic information, oral health knowledge, attitudes and practices and experience of dental care.

4.2.1: Age of participants

The majority of parents and caregivers were in the 25 to 44 year range. Two hundred and seventy one (88%) were female and 38 (12%) male (Table 4.2). The largest ethnic group were those of Indian descent (74.4%) followed by Mixed (13.7%) and African (11.3%) (Table 4.3). The participant's children were in the following ages ranges: 3 years (38.5%), 4 years (51.5%) and 5 years (10%).

Table 4.2: Age of participants (N=309)

Age group	n	%
18-24	17	5.5
25-34	183	59.2
35-44	95	30.7
45-54	8	2.6
55-64	2	0.7
65+	1	0.3
Missing	3	1.0
total	309	100

Table 4.3: Ethnicity of participants (N=309)

Ethnic group	n	%
African	35	11.3
Indian	230	74.4
Mixed	41	13.3
White	1	0.3
Other	2	0.7
total	309	100

4.2.2: Occupation of head-of-household

Half the participants (50.5%) had a manual head-of-household and a third (33.3%), were from non-manual households (Table 4.4).

Table 4.4: Occupation of head-of-household (N=309)

Occupation	n	%
Professional	11	3.6
managerial/lower professional	48	15.5
non-manual	44	14.2
manual -skilled	107	34.6
manual- semi-skilled	6	1.9
manual –unskilled	43	13.9
housewife/ unemployed	15	4.9
Retired/ old-age pensioner	7	2.3
missing	28	9.1
total	309	100

4.2.3: Highest level of education

The majority of participants (59.9%) were educated to at least secondary level. One third of participants had tertiary level education (Table 4.5).

Table 4.5: Highest level of education (N=309)

Education	n	%
none	1	0.3
primary	29	9.4
secondary	255	50.2
technical college	54	17.5
university	49	15.9
other	15	4.9
missing (not given)	6	1.9
total	309	100

4.2.4: Oral health knowledge, attitudes and practices

Most participants were aware of the causes of caries and the role of fluoride. Almost 15% disagreed with or did not know if baby teeth should be brushed as soon as they come into the mouth. Almost 10% did not know if putting a child to bed with juice could cause cavities and 13% either did not know or agreed that 'tooth decay ran in families' (Table 4.6).

Table 4.6: Oral health knowledge (n=309)

Statement	Agree n (%)	Disagree n (%)	Don't know n (%)	Missing n (%)	Total N
(a) Parents should start cleaning their child's teeth as soon as they first baby tooth comes out	259 (83.8)	28 (9.1)	17 (5.5)	5 (1.6)	309
(b) Germs in the mouth can cause tooth decay	302 (97.7)	1 (0.3)	4 (1.3)	1 (0.3)	309
(c) Fluoride helps to prevent tooth decay	269 (87.1)	6 (1.9)	17 (5.5)	17 (5.5)	309
(d) Putting a child to bed with a bottle containing juice can cause cavities in the their teeth	271 (87.7)	6 (1.9)	29 (9.4)	3 (1.0)	309
(e) Tooth decay runs in families	40 (12.9)	190 (61.5)	55 (17.8)	24 (7.8)	309

4.2.5: Timing of the first dental visit

Most participants (60%) felt that the first dental visit for a child should be when all the primary teeth have erupted. Twenty four per cent thought this should be when

they get their first adult teeth. Over a fifth (22%) were unsure of when the first visit should be (Table 4.7)

Table 4.7: The first dental visit (N=309)

Time for first dental visit	n	%
When they get their first tooth	18	5.8
When they have all their baby teeth	185	59.1
When they get their first adult tooth	24	7.8
Only when they get pain or have a problem	11	3.6
Not sure	68	22.0
Missing	3	1.0
Total	309	100

4.2.6: Child oral health rating

Most participants rated their child's oral health as good or better (81.6%) and 17% as fair or poor (Table 4.8).

Table 4.8: Parent / caregiver rating of child's dental health (N=309)

Oral Health Rating	n	%
Excellent	58	18.8
Very Good	92	29.8
Good	102	33.0
Fair	38	12.3
Poor	15	4.9
missing	4	1.3
total	309	100

4.2.7: Previous dental visit (child)

Almost two thirds of participant's children (64%) had not had a dental visit.

4.2.8: Difficulty finding dental care for child

Ten per cent of participants had experienced difficulty in finding dental care for their child.

4.2.9: Preferred treatment for asymptomatic decayed primary tooth

Over a third of participants (37%) were unsure of what to do about a symptomless decayed primary tooth. Over a quarter (28%) would want it taken out rather than filled (22%). Thirteen per cent would want no treatment (Table 4.9)

Table 4.9: Treatment preferences for decayed primary teeth (N=309)

Preferred treatment for decayed baby tooth that was not causing pain	n	%
Nothing	41	13.3
Have it filled	67	21.7
Take it out	86	27.8
Not sure	113	36.6
missing	2	0.7
total	309	100

4.2.10 Frequency of child tooth brushing

The majority of participants reported that their child had their teeth brushed at least twice a day and just under a third, at least once a day (Table 4.10).

Table 4.10: Frequency of child tooth brushing (N=309)

How often does child brush their teeth	n	%
Never	-	-
Once a day	99	32.0
Twice a day	189	61.2
More than twice	18	5.8
Missing	3	5.8
Total	309	100

4.2.11: Supervision of child's tooth brushing

Over half the participants (53%) always helped their child brush their teeth and 46% reported doing this 'sometimes' (Table 4.11).

Table 4.11: Supervision of child tooth brushing (N=309)

How often do you help your child brush their teeth	n	%
Sometimes	143	46.3
All the time	163	52.8
Never	3	1.0
Total	309	100

4.2.12: Tooth brushing position

Most participants (62%) help brushed their child's teeth from in front of the child and 15% from one side (Table 4.12).

Table 4.12: Position for supervised tooth brushing (N=309)

Position when supervising brushing	n	%
In front	193	62.5
Behind	44	14.2
At one side	48	15.5
Missing	24	7.8
Total	309	100

4.2.13: Size of toothbrush

Most participants (88%) used a small toothbrush for their child and 11% a medium brush size (Table 4.13).

Table 4.13: Size of toothbrush (N=309)

size of toothbrush	n	%
Small	273	88.4
Medium	35	11.3
Large	0	0
Missing	1	0.3
Total	309	100

4.2.14 Toothpaste use

Nearly all participants let their child use toothpaste when brushing.

4.2.15: Quantity of toothpaste

Over half of the participants (56%) use a quantity of toothpaste that would cover half or all of the brush head of their child's toothbrush. Forty-four per cent of participants were using a pea-size amount (Table 4.14)>

Table 4.14: Amount of toothpaste on tooth brush (N=309)

Amount of toothpaste	n	%
Enough to cover the whole brush head	99	32.0
Enough to cover half the brush head	73	23.6
pea size	135	43.7
don't know	2	0.7
total	309	100

4.2.16 Fluoride toothpaste

Over 80% participants were using fluoride toothpaste for their child (Table 4.15).

Table 4.15: Fluoride toothpaste (309)

Child's toothpaste contains fluoride	n	%
Yes	273	88.4
No	11	3.6
Don't know	15	4.9
Missing	10	3.2
Total	309	100

4.2.17: Other fluoride vehicles

Most participants had not used any other fluoride vehicles for their child (58.7%). Less than a tenth of participants reported fluoride varnish having been used on their child (Table 4.16).

Table 4.16: Other fluoride vehicles used on child (N=309)

Fluoride use	n	%
fluoride tablets /drops	1	0.3
fluoride varnish or gel applied by a dentist or dental nurse	29	9.4
fluoride mouthwash	97	31.4
No other fluoride	182	58.9
Total	309	100

4.2.18: Breastfeeding

Over three quarters of participants (76.7%) reported that their child was breast-fed.

4.2.19: Duration of breastfeeding

A third of participants breastfed their child up to 6 months of age and one fifth up to a year. Over a fifth of children (22%) were breastfed past one year of age (Table 4.18). Eight children (3%) with a mean age 3.1 years were still being breastfed at the time of the study (4.17).

Table 4.17: Child age when stopped breastfeeding (N=309)

Age stopped breastfeeding	n	%
<3 month	16	5.2
3-6 months	87	28.2
6-12 months	61	19.7
>12 months	68	22.0
not breast fed / missing	77	24.9
total	309	100

4.2.20: Use of a sweetened baby bottle at night

Over a quarter had reported giving a sweetened baby bottle or feeder to their child at bedtime.

4.2.21: Frequency of sweet foods and drinks

Over half of participants (58%) gave sweet drinks to their child twice a day or more than twice a day and a third 33% reported giving sweet snacks twice or more than twice. A fifth reported that their child ate fruits more than twice day (Table 4.18).

Table 4.18: Frequency of sweet drinks, snacks and fruits (N=309)

Food / drink	Never n (%)	Rarely	Once a day	Twice a day	More than twice a day	Missing	Total
Sweet drinks	0	47 (15.2)	77 (24.9)	86 (27.8)	93 (30.1)	6 (1.9)	309 (100)
Sweet snacks	3 (1.0)	72 (23.3)	125 (40.5)	53 (17.1)	50 (16.2)	6 (1.9)	309 (100)
Fruits	2 (0.7)	20 (6.5)	142 (45.6)	78 (25.2)	64 (20.7)	3 (1.0)	309 (100)

4.2.22: Parent/ caregiver dental attendance

Thirty per cent of participants attended the dentist once a year. Over a quarter (26%) reported attending for dental care very six months and 14% only attended when in pain (Table 4.19). A significantly greater proportion of children had visited a dentist or dental nurse among parents and caregivers who were regular attenders (6 monthly or yearly (Chi square $p<0.03$)

Table 4.19: Parent / caregiver dental attendance (N=309)

Frequency of dental visits	n	%
never been	51	16.5
only when in pain	43	13.9
every six months	80	25.9
once a year	93	30.1
other	37	11.1
missing	5	1.6
total	309	100

4.2.23: Parent / caregiver difficulty in finding dental care

Seventeen per cent reported having difficulty in finding dental care for themselves (Table 4.20).

Table 4.20: Difficulty finding dental care for self (N=309)

Difficulty in finding dental care	n	%
Yes	55	17.8
No	244	79.0
Missing	10	3.2
Total	309	100

4.2.24: Parent/caregiver self-rating of dental health

Most (71%) participants rated their dental health as good to excellent and over a quarter (27%) rated it as fair to poor (Table 2.21).

Table 4.21: Parent /caregiver self-rating of dental health (N=309)

dental health self-rating	n	%
Excellent	22	7.1
very good	70	22.7
good	126	40.9
fair	65	21.0
poor	21	6.8
missing	5	1.6
total	309	100

4.2.25 Parent / caregiver stress

Over half (56%) of participants reported that their child made too many demands on them from occasionally to all the time (4.22).

Table 4.22: Parent/caregiver stress (N=309)

"How often do you feel your child is making too many demands on you?"	**n**	**%**
All the time	12	3.9
Often	17	5.5
Sometimes	70	22.7
Occasionally	73	23.6
Never	126	40.8
missing	11	3.6
total	309	100

4.2.26: Health literacy

Eighteen per cent of participants reported needing help with reading health information, 'occasionally' to 'all the time' (4.23).

Table 4.23: Parent/caregiver health literacy (N=309)

"How often do need help to read information from leaflets or written material from a doctor or pharmacy?"	**n**	**%**
All the time	4	1.3
Often	4	1.3
Sometimes	25	8.1
Occasionally	22	7.1
Never	253	81.9
missing	1	0.3
total	309	100

4.3: Results for oral examinations

This section of the results reports findings from the clinical examinations.

Parental consent for the oral examination was received for 314 children. Thirty-six children were absent on the day on the data collection For those for whom consent

was given and who were present, two attempts were made to exam all children who initially refused, (the second following completion of examinations on the other children). Following this process 27 could still not be examined ('definitely negative behaviour'). The 251 children who completed the oral exam showed 'positive' or 'definitely positive' behaviour using the Frankl scale, while undergoing oral examination (Table 4.24)

Table 4.24: Child behaviour rating - Frankl Scale (N=278)

Behaviour rating	n	%
Definitely negative	27	9.7
Positive	14	5.0
Definitely positive	237	85.3

4.3.1: Examiner reliability

The assessment for intra-observer reproducibility involved re-examination children at one preschool (25 children). Re-examination took place on the same day as data collection after a short interval, having examined all the children once. The Kappa statistic for intra-examiner reliability (visible caries experience) was 0.9 indicating very good agreement.

4.3.2: Demographic profile of children examined

The age range of the children examined was 3 to 5 years with a mean age of 3.7 years (sd 0.67). One hundred and twenty five were female (49.8%) and 126 were male (50.2%). Most of the children (70.5%) were of Indian ethnicity followed by 18% of mixed ethnicity (Table 4.25).

Table 4.25: Child demographics (N=251)

Gender	**n**	**%**
male	126	50.2
female	125	49.8
Ethnicity		
African	24	9.6
Indian	177	70.5
Mixed	46	18.3
Other	2	0.8
missing	2	0.8

4.3.3 Health and development

The majority of children (86%) had no specific health or development concerns as reported by their parent/ guardian. Issues regarding general health were the most commonly reported concern (8.4%) followed by problems with hearing and eyesight (Table 4.26).

Table 4.26: Child health and development (N=251)

Health/ development concern	**n**	**%**
Sight	3	1.2
Hearing	1	0.4
Movement	0	0.0
Speech	7	2.8
Learning	3	1.2
General health	21	8.4
No problems	216	86.0
Total	251	100

4.3.4 Prevalence of visible caries experience

Seventy three children (29.1%) of children had some caries experience (dmft>0) with similar proportions in male and female children (Table 4.27.). As the proportions by gender were so close, these data are combined for the remainder of this report

Table 4.27: Proportion of children with visible caries experience by gender (N=251)

Gender	No visible caries experience n (%)	Visible caries experience n (%)
Male	89 (70.6)	37 (29.4)
Female	89 (71.2)	36 (28.8)
Total	178 (70.9)	73 (29.1)

4.3.5: Severity of visible caries experience

The mean number of decayed, missing and filled teeth for the whole sample was 1.40 (sd 3.01) with a range 0 – 13 (Table 4.28).

Table 4.28: Visible caries experience for whole sample (N=251)

Decayed teeth (d) Mean (sd)	Missing teeth (t) mean (sd)	Filled teeth (f) mean (sd)	dmft mean (sd)	95% CI
1.37 (2.96)	0.20 (0.21)	0.12 (0.14)	1.40 (3.01)	1.03-1.78

As ECC was only observed in a minority of the children examined the frequency distribution for visible caries experience was highly positively skewed. This is demonstrated by histogram and boxplot (Figures 4.1 and 4.2).

Figure 4.1: frequency distribution for visible caries experience (dmft)

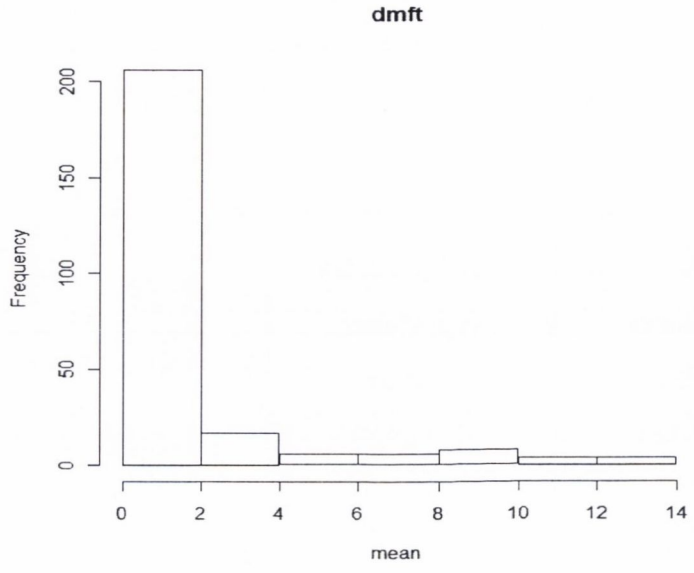
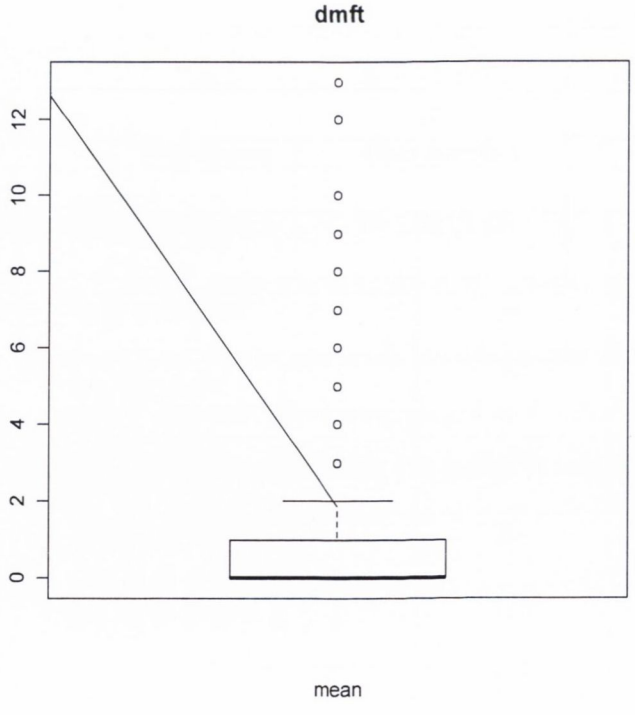


Figure: 4.2: Box-plot for visible caries experience (dmft)



4.3.6: Children with some visible caries experience

When children with no visible caries were excluded from the analysis, the mean dmft for those children with some visible caries experience (dmft>0) was 4.82 (sd 3.83), (95% CI: 3.93 -5.72) (Table 4.29), median 4, interquartile range 7. For those children with untreated decay (dt>0), the mean number of decayed teeth was 4.71 sd 3.80 (95% CI: 3.82-5.60).

Table 4.29: children with visible caries experience (dmft>0) (N=73)

	mean	**sd**
d	4.72	3.80
m	0.07	0.38
f	0.04	0.26
dmft	4.82	3.83

4.3.7: Visible caries experience and demographic profile

Table 4.30 describes visible caries experience was similar for male and female children, different ethnic groups and whether attending a government or privately run preschools.

Table 4.30: Visible caries experience by gender, ethnicity and school type (N=251)

	N	dmft	sd	95%CI
Gender				
Male	126	1.39	2.90	0.89-1.91
Female	125	1.34	3.03	0.81-1.88
Ethnicity				
African	24	0.71	1.33	0.14 -1.27
Indian	177	1.63	3.30	1.15 – 2.12
Mixed	46	0.98	2.46	0.25 – 1.71
Other	2	0	-	-
School Type				
Government / Government Assisted	172	1.49	3.09	1.02-1.95
Non government	79	1.22	2.82	0.58-1.84

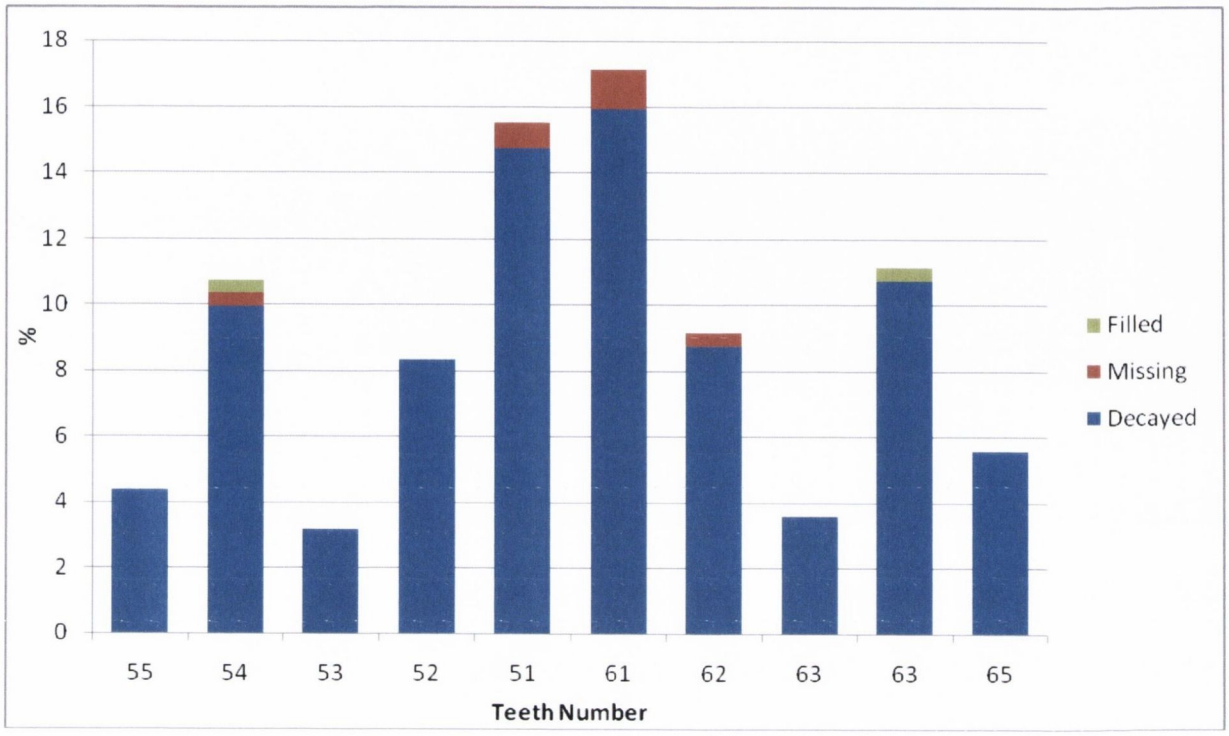
4.3.8: Severe Early Childhood Caries (S-ECC)

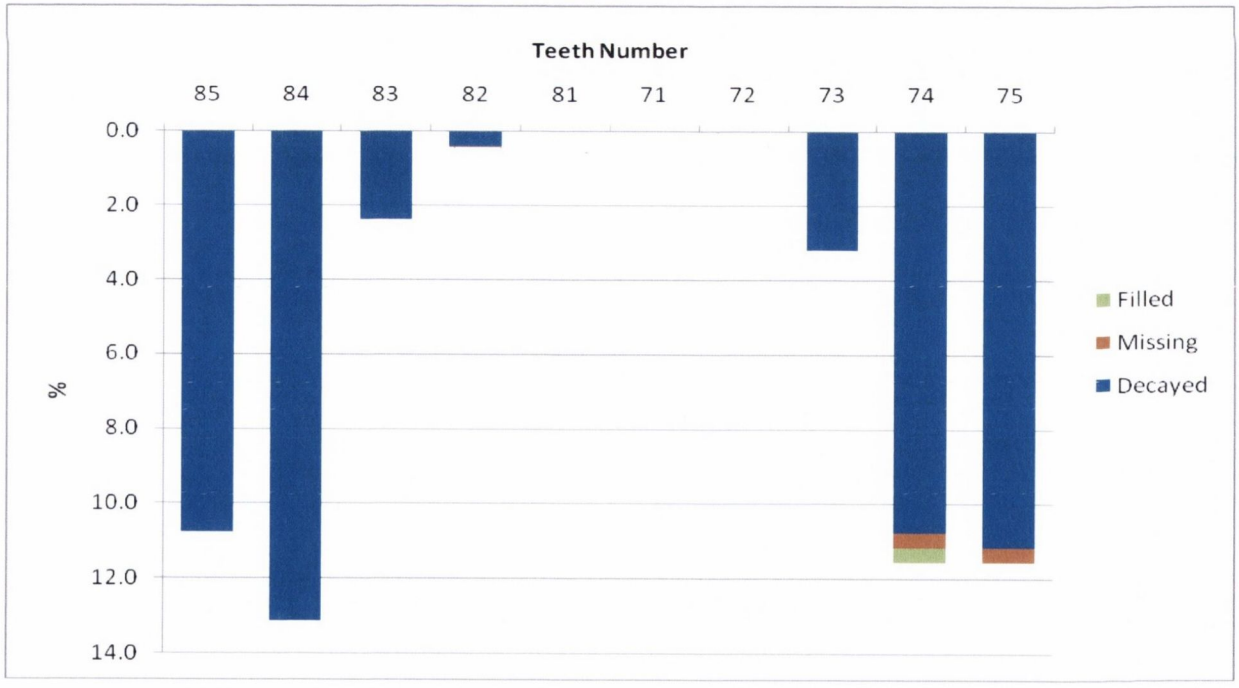
Forty four children (17.5%) had evidence of severe early childhood caries i.e. one or more decayed, missing due to caries or filled primary maxillary anterior tooth. This definition was adapted from the AAPD/AAP definition to account for use of whole tooth score rather than surface score.

4.3.8.1: Visible caries experience site distribution

Among the dentition of individual children, most caries experience was found in the upper anterior and lower posterior primary teeth (Figure 4.3).

Figure 4.3: Proportion of decayed, missing and filled teeth by individual teeth upper and lower arch (N=251)





4.3.9: Treatment need

Based on WHO criteria, 75 children (29.9%) had some treatment need beyond routine preventive care (children could have required more than one treatment type therefore total percentages do not total 100). The majority of this need was for one-surface restorative care (Table 4.31)

Table 4.31: Treatment need (N=251)

Treatment type required N=75	n	%
one surface restoration	66	88.0
two surface restoration	40	53.3
pulp care	14	18.7
extraction	13	17.3
No need	176	70.1%

4.3.10: Need for urgent care and referral

Thirty children (12%) were in need of urgent care, mostly due to caries and its sequelae (pulp infection and need for extraction).

4.3.11 Oral Hygiene

Thirty five children (14%) had visible plaque. The distribution of plaque was most prevalent on the upper anterior teeth (Table 4.32).

Table 4.32: Visible plaque by sextant (N=251)

Sextant	No visible plaque n (%)	Visible plaque n (%)	Not recorded n (%)
Upper right	242 (96.4%)	9 (3.6%)	0
Upper anterior	219 (87.3)	32 (12.6)	0
Upper left	242 (96.41)	9 (3.6)	0
Lower right	243 (96.8)	8 (3.2)	0
Lower anterior	239 (95.2)	12 (4.8)	0
Lower left	243 (96.8)	8 (3.2)	0

4.3.12: Gingival health

Fifty five children (21.9%) had visible gingivitis, mainly in the upper and lower anterior sextants (Table 4.33).

Table 4.33: Gingivitis by sextant

Sextant	Healthy n (%)	Gingivitis n (%)	Not recorded n (%)
Upper right	236 (94.0)	15 (5.6)	0
Upper anterior	204 (81.3)	47 (18.7)	0
Upper left	235 (93.6)	15 (5.6)	1
Lower right	242 (96.4)	8 (3.19)	1
Lower anterior	230 (91.6)	19 (7.57)	2
Lower left	243 (96.8)	8 (3.19)	0

4.3.13 Enamel developmental defects

Sixty three children (25.1%) had some type of developmental enamel defect in the recorded index teeth (54-64). Among the defects the most common lesions were diffuse opacity (42%) and demarcated opacity (30%) (Table 4.34).

Table 4.34: Developmental enamel defects (N=251)

Enamel condition	n	%
Demarcated opacity	19	30
Diffuse opacity	27	42.9
Hypoplasia	7	11.1
Demarcated and diffuse	9	14.3
Demarcated and hypoplasia	5	7.9
Diffuse and hypoplasia	10	15.9
All three	5	7.9
None	188	74.9

4.3.14: Dental Erosion

Seventy two (28.7%) of children examined had some degree of dental erosion on one or more teeth. Twenty one had evidence of dentine involvement (8.4%) but no lesions involved the pulp (Table 4.35). In bivariate analyses (Chi square) no association was found between the proportion of children with erosion and SES indicators (occupation of head-of household or parents/ caregiver highest level of education) or with dietary factors (frequency of intake of fruits or sweet snack and drinks).

Table 4.35: Dental erosion (N=251)

Severity of Erosion	n	%
Any	72	28.7
Dentine involvement	21	8.4
None	179	71.3

4.3.15: Dental Trauma

Twelve children (5%) had signs of trauma to their dentition as evidenced by fracture of enamel / dentine.

4.3.16: Dental Anomalies

One child had evidence of a cleft lip/palate. Eighteen children (7.1%) had some other form of dental anomaly such as a peg shaped incisor.

4.4: Visible caries experience and socio-behavioural factors (Bivariate analyses)

The following sections describe possible relationships between ECC (based on visible caries experience) and socio-behavioural factors explored, using bivariate analyses. The results include analyses for severity and prevalence of visible caries experience followed by statistical modelling based on Logistic and Poisson regression General Linear Mixed Model (GLMM).

4.4.1. Severity of visible caries experience and socio-demographic factors

Based on the frequency distribution of the dmft, this variable was highly positively skewed with comparison groups showing several outliers and unequal variances (Figures 4.1 & 4.2). In these analyses this variable is therefore reported in terms of

median values and for comparison to the international dental literature, means and standard deviations are also reported. No significant associations were found for socio-demographic factors and visible caries experience (Table 4.36).

Table 4.36: Severity of visible caries experience and socio-demographic factors (N=251)

Socio-demographic factors	n	dmft mean (sd)	dmft Median	(*p*-value)
Gender				
male	126	1.42 (2.93)	0.00	
female	125	1.38 (2.77)	0.00	0.88[a]
Ethnicity				
African	24	0.78 (1.33)	0.00	
Indian	177	1.64 (3.30)	0.00	
Mixed	46	0.98 (2.46)	0.00	
Other	2	0	0.00	0.21[b]
Occupation (head of household)				
Professional / managerial	46	0.61 (1.58)	0.00	
Non-manual	37	0.70 (1.76)	0.00	
Skilled manual	87	1.98(3.51)	0.00	
Un-skilled Manual	38	1.27 (3.08)	0.00	
Housewife/ unemployed/pensioner	19	3.21 (4.79)	0.00	0.08[b]
Highest level of education				
Primary	23	3.30 (4.93)	0.00	
Secondary	125	1.48 (3.01)	0.00	
Technical/ training college	44	1.05 (2.28)	0.00	
University	41	0.88 (2.43)	0.00	
Other	13	0.38 (1.12)	0.00	0.24[b]

[a] Wilcoxon rank sum test
[b] Kruskal Wallis test

To account for small numbers in some categories, socio-demographic factors were aggregated into fewer categories for further analyses (non-Indian / Indian, manual / non-manual, secondary education and below/ tertiary education) Based on these categories children from manual households had significantly greater caries severity (Table 4.37).

Table 4.37: Severity of visible caries experience with regrouped socio-demographic variables (N=251)

Socio-demographic variables	n	dmft mean (sd)	95% CI	*p*-value (Wilcoxcon rank sum)
Ethnicity				
Non Indian	72	0.86 (2.11)	0.36 - 1.36	0.06
Indian	177	1.63 (3.30)	1.14 – 2.13	
Occupation of head-of-household				
Non-Manual	83	0.65 (1.66)	0.29 – 1.01	0.02
Manual	147	1.93 (3.61)	1.35 – 2.53	
Highest level of Education				
Secondary and below	149	1.75 (3.41)	1.19 – 2.30	0.07
Tertiary	98	0.88 (2.22)	0.44 – 1.33	

4.4.2: Severity of visible caries experience and oral health knowledge, attitudes and practices

No significant associations were found for visible caries experience and age at which the child started brushing, parent/ caregiver beliefs about role of bacteria in tooth decay, effects of fluoride, putting a child to bed with a bottle, and best time for the first dental visit (Table 4.38).

Table 4.38: Visible caries experience and beliefs, attitudes and oral health practices of parents/ caregivers (N=251).

Factor	n	dmft mean (sd)	dmft Median	(*p*-value)
Parents should start brushing their child's teeth as soon as first teeth appear				
agree	213	1.37 (2.92)	0.00	
disagree	20	1.05 (2.74)	0.00	
don't know	14	1.92 (3.51)	0.00	
				0.70[b]
Bacteria in the mouth cause cavities				
agree	245	1.43 (3.04)	0.00	
disagree	1	0 (0)	0.00	
don't know	4	0.50 (1.00)	0.00	
				0.78[b]
Fluoride helps prevent tooth decay				
agree	221	1.48 (3.10)		
disagree	4	1.50 (3.00)		
don't know	12	0.58 (1.00)		
				0.99[b]
Putting a child to bed with a juice bottle can cause cavities				
agree	220	1.50 (3.14)	0.00	
disagree	5	1.00 (1.73)	0.00	
don't know	24	0.75 (1.70)	0.00	
				0.76[b]
Tooth decay runs in families				
agree	32	2.97 (4.37)	0.00	
disagree	156	1.15 (2.70)	0.00	
don't know	43	1.70 (3.13)	0.00	
				0.03[b]*
When should you take your child to the dentist for the first time				
When they get their first teeth	14	0.64 (1.28)	0.00	
When they get all their baby teeth	148	1.55 (3.15)	0.00	
When they get all their adult teeth		0.91 (2.82)	0.00	
Only when they get pain or a problem	22	1.33 (1.80)	0.00	
Not sure	55	1.31 (3.02)	0.00	
				0.55[b]

[a] Wilcoxon rank sum test
[b] Kruskal Wallis test
* significant *p*-value

Greater severity of visible caries experience was found in children whose parents and caregivers rated their child's oral health as fair or poor, if they had visited the dentist or dental nurse or had difficulty finding dental care (Table 4.39).

Table 4.39: Visible caries experience and beliefs, attitudes and oral health practices of parents/ caregivers (dental attendance) (N=251).

Factor	n	dmft Mean (sd)	dmft Median	(*p*-value)
How would you rate your child's dental health				
Excellent	48	0.50 (1.71)	0.00	
Very good	78	0.44 (1.12)	0.00	
Good	79	0.78 (1.90)	0.00	
Fair	31	4.03 (4.23)	0.00	
Poor	12	7.75 (4.59)	0.00	
				< 0.001[b]*
Has your child ever visited a dentist or dental nurse				
Yes	87	2.18 (3.46)	0.00	
No	159	1.01 (2.69)	0.00	
				<0.001[a]*
Have you ever had difficulty in finding dental care for your child				
Yes	28	2.96 (4.19)	0.00	
No	206	1.20 (2.75)	0.00	
				<0.01[a]*
If your child had decay in a baby tooth that was not causing pain what treatment would you want				
None	32	0.934 (2.00)	0.00	
Have it filled	54	2.24 (3.80)	0.00	
Have it taken out	71	1.42 (3.37)	0.00	
Not sure	92	0.95 (2.03)	0.00	
				0.23[b]
How often does your child brush their teeth				
Once a day	77	0.99 (2.16)		
Twice a day	156	1.65 (3.42)		
More than twice a day	15	0.93 (1.98)		
Never	-	-	-	
				0.70[b]

[a] Wilcoxon rank sum test
[b] Kruskal Wallis test
* significant *p*-value

No significant differences were found with respect to frequency of tooth brushing, supervision of brushing, brushing position, brush size or type and amount of toothpaste and fluoride use (Table 4.40).

Table 4.40: Visible caries experience (dmft) and beliefs, attitudes and oral health practices of parents/ caregivers (tooth brushing) (N=251).

Factor	n	dmft Mean (sd)	dmft Median	(*p*-value)
How often do you help your child to brush their teeth				
Sometimes	118	1.41 (2.83)	0.00	
All the time	132	1.37 (3.17)	0.00	
Never	1	5.00 (0)	0.00	
				0.59[b]
In what position do you brush from				
In front of them	159	1.17 (2.83)	0.00	
Behind them	35	1.66 (3.31)	0.00	
At one side	40	1.98 (3.37)	0.00	
				0.07[b]
What size toothbrush does your child use				
Large	-	-	-	
Medium		1.00 (2.38)	0.00	
Small		1.46 (3.08)	0.00	
				0.37[b]
Does your child use toothpaste				
Yes	249	1.40 (3.01)	0.00	
No	1	0.00 (0)	0.00	
Don't know	1	0.00 (0)	0.00	
				0.25[b]
How much toothpaste do you place on the brush				
Enough to cover the entire brush head	81	1.68 (2.96)	0.00	
Enough to cover half the brush head	60	1.75 (3.47)	0.00	
Pea size	108	1.03 (2.76)	0.00	
Don't know	-	-	-	
				0.07[b]
Does the toothpaste contain fluoride				
Yes	225	1.45 (3.10)		
No	9	0.22 (0.66)		
Don't know	10	1.30(2.36)		
				0.39[b]
Has your child used any other form of fluoride				
Fluoride tablets	-	-	-	
Fluoride varnish applied by a dentist or dental nurse	26	2.96 (4.26)		
Fluoride mouthwash	73	1.47 (2.60)		
				0.20[b]

[a]Wilcoxon rank sum test
[b]Kruskal Wallis test
* significant *p*-value

Children who ate fruits and sweet snacks more frequently had a greater severity of visible caries experience (Table 4.41).

Table 4.41: Visible caries experience (dmft) and beliefs, attitudes and oral health practices of parents/ caregivers (feeding and diet) (N=251).

Factor	n	dmft Mean (sd)	dmft Median	*p*-value
Was you child breast fed				
Yes	195	1.41 (3.09)	0.00	
No	53	1.41 (2.77)	0.00	
				0.62[a]
Duration of breastfeeding				
<3 months	14	2.14 (4.52)	0.00	
3-6 months	72	0.79 (2.19)	0.00	
6-12 months	52	1.25 (3.06)	0.00	
>12 months	54	1.93(3.28)	0.00	
				0.086[b]
Has your child ever used a sweetened baby bottle or infant feeder at night				
Yes	61	2.08 (3.79)	0.00	
No	183	1.22 (2.72)	0.00	
				0.21[a]
How often does your child have sweet drinks				
More than twice a day	75	1.63 (3.07)	0.00	
Twice a day	74	1.54 (3.47)	0.00	
Once a day	63	1.00 (2.61)	0.00	
Rarely	34	1.47 (2.62)	0.00	
Never	-	-	-	
Don't know	-	-	-	
				0.27[b]
How often does your child eat fruits				
More than twice a day	55	2.12 (3.51)	0.00	
Twice a day	62	1.35 (2.86)	0.00	
Once a day	115	1.17 (2.94)	0.00	
Rarely	16	1.00 (2.09)	0.00	
Never	2	0 (0)	-	
Don't know	-	-	-	
				0.01[b]*
How often does your child eat sweet snacks				
More than twice a day	41	2.37 (3.00)	0.00	
Twice a day	40	2.13 (4.20)	0.00	
Once a day	106	1.02 (2.64)	0.00	
Rarely	58	0.72 (2.11)	0.00	
Never	3	1.33 (2.31	0.00	
Don't know	1	0.0 (0)	0.00	
				<0.001[b]*

[a]Wilcoxon rank sum test
[b]Kruskal Wallis test
* significant *p*-value

No significant associations were found for visible caries experience and parent/caregiver dental attendance, self-rating of oral health, stress and health literacy (Table 4.42)

Table 4.42: Visible caries experience (dmft) and beliefs, attitudes and oral health practices of parents/ caregivers (parent dental attendance) (N=251).

Factor	n	dmft Mean (sd)	dmft Median	(*p*-value)
How often do you visit the dentist				
Never been	46	1.83 (3.61)	0.00	
Only when in pain	37	1.41 (3.26)	0.00	
Every 6 months	63	1.12 (2.37)	0.00	
Once a year	74	1.31 (2.95)	0.00	
Other	30	1.40 (3.18)	0.00	
				0.85[b]
Have you ever had difficulty finding dental care for yourself				
Yes	45	2.40 (4.28)	0.00	
Know	201	1.21 (2.63)	0.00	
				0.12[b]
How would you rate your own dental health				
Excellent	48	1.95 (3.27)	0.00	
Very good	78	0.92 (2.44)	0.00	
Good	79	1.17 (2.70)	0.00	
Fair	31	2.06 (3.74)	0.00	
Poor	12	1.68 (3.58)	0.00	
				0.67[b]
How often do you feel your child is making too many demands on you				
Always	10	2.50 (4.09)	0.00	
Often	10	2.1 (3.35)	0.00	
Sometimes	61	1.49 (3.05)	0.00	
Occasionally	61	1.16 (2.86)	0.00	
Never	104	1.38 (3.00)	0.00	
				0.62[b]
How often do you need someone to help your read written material from the doctor or pharmacy				
Always	4	6.24 (7.23)	0.00	
Often	2	2.00 (2.83)	0.00	
Sometimes	22	1.90 (3.52)	0.00	
Occasionally	18	0.94 (1.83)	0.00	
Never	204	1.25 (2.81)	0.00	
				0.34[b]

[a]Wilcoxon rank sum test
[b]Kruskal Wallis test
* significant *p*-value

4.4.3: Visible caries and enamel developmental defects

Association between severity of visible caries experience and enamel developmental defects are shown in Table 4.43. Greater severity of visible caries experience was associated with diffuse opacities, hypoplasia and when all were defects present, although numbers are small.

Table 4.43: Association between enamel developmental defects and visible caries experience (N=251).

Enamel condition	N	%	dmft	sd	*p-value* (t-test)	*p-value (Wilcoxon rank sum)*
Demarcated opacity						
Not present	232	92.4	1.40	3.03	0.976	0.57
Present	19	7.6	1.42	2.73		
Diffuse opacity						
Not present	224	89.2	1.16	2.71	0.012	<0.01*
Present	27	10.8	3.44	4.35		
Hypoplasia						
Not present	244	97.2	1.35	2.96	0.302	0.02*
Present	7	2.8	3.14	4.18		
Demarcated and diffuse opacity						
Not present	242	96.4	1.33	2.94	0.164	0.05
Present	9	3.6	3.44	4.13		
Demarcated opacity and hypoplasia						
Not present	246	98.0	1.37	2.99	0.453	0.14
Present	5	2.0	2.80	3.83		
Diffuse opacity and hypoplasia						
Not present	241	96.0	1.31	2.91	0.119	0.06
Present	10	4.0	3.70	4.37		
All three						
Not present	246	98.0	1.27	2.85	0.010	<0.001*
Present	5	2.0	8.00	3.39		

4.4.4: Prevalence of visible caries experience and socio-behavioural factors

Associations between social and behavioural factors and prevalence of visible caries experience were also explored using the binary variable: *proportions of children with 'no visible caries experience'* (dmft=0) *versus proportion of children with 'visible caries experience'* (dmft<0). No associations were found for demographic variables (Table 4.44), beliefs about brushing, the causes of tooth decay (Table 4.45) and supervision of brushing, amount of toothpaste, breastfeeding and bottle feeding (Table 4.46).

Table 4.44: Effect of demographic factors on proportions of children with caries (N=251).

	No visible caries experience (dmft=0) n (%)	**Visible caries experience (dmft>0) n (%)**	***p*-value (Chi square)**
Gender (child)			
male	89 (70.6)	37 (29.4)	
female	89 (71.2)	36 (28.8)	
(n=251)			0.92
Ethnicity (child)			
African	18 (75.0)	6 (25.0)	
Indian	119 (67.2)	58 (32.8)	
Mixed	37 (80.4)	9 (19.6)	
Other	2 (100.0)	0	
(n= 249)			0.24
Occupation of head of household			
Professional / managerial	36 (78.3)	10 (21.7)	
non-manual (skilled)	29 (78.4)	8 (21.6)	
Manual (skilled)	56 (64.4)	31 (35.6)	
Manual (un-skilled)	27 (71.1)	11 (28.9)	
Housewife/ unemployed /retired	11 (57.9)	8 (42.1)	
(n=227)			0.32
Parent's highest level of education			
Primary	14 (60.9)	9 (39.1)	
Secondary	85 (68.0)	40 (32.0)	
Technical College	33 (75.0)	11 (25.0)	
University	31 (75.6)	10 (24.4)	
Other	11 (84.6)	2 (15.4)	
(n=246)			0.46

Table 4.45: Effect of social and behavioural factors (oral health beliefs) on proportions of children with caries (N=251).

	No visible caries experience (dmft=0) n (%)	Visible caries expereince (dmft>0) n (%)	*p*-value (Chi square)
Parents should start cleaning the teeth as soon as the first baby tooth appears			
Agree	151 (70.1)	62 (29.1)	
Disagree	15 (75.0)	5 (25.0)	
Don't know	9 (64.3)	5 (35.7)	
(n=247)			0.80
Bacteria and germs in the mouth cause cavities			
Agree	173 (70.6)	72 (29.4)	
Disagree	1 (100.0)	0	
Don't know	3 (75.0)	1 (25.0)	
(n=250)			0.80
Fluoride helps prevent tooth decay			
Agree	155 (70.1)	66 (29.8)	
Disagree	3 (75.0)	1 (25.0)	
Don't know	8 (66.7)	4 (33.3)	
(n=237)			0.95
Putting a child to bed with a bottle containing juice can cause cavities			
Agree	155 (70.5)	65 (29.5)	
Disagree	3 (60.0)	2 (40.0	
Don't know	18 (75.0)	6 (25.0)	
(n=249)			0.78
Tooth decay runs in families			
Agree	18 (56.3)	14 (43.8)	
Disagree	1 16 (74.4)	40 (25.6)	
Don't know	27 (62.8)	16 (37.2)	
(n=231)			0.07

Table 4.46: Effect of social and behavioural factors (denal attendance) on proportions of children with caries (N=251).

	No visible caries experience (dmft=0) n (%)	Visible caries experience (dmft>0) n (%)	*p*-value (Chi square)
When should you take your child to the dentist for the first time			
When they get their first tooth	10 (71.4)	4 (28.6)	
When they have all their baby teeth	101 (68.2)	47 (31.8)	
When they get their first adult teeth	18 (81.8)	4 (18.1)	
Only when they get pain or a problem	5 (55.6)	4 (44.4)	
(n=193)			0.462
How would you rate your child's dental health			
Excellent	41 (85.4)	7 (14.6)	
Very good	63 (80.8)	15 (19.2)	
Good	59 (74.7)	20 (25.3)	
Fair	12 (38.7)	19 (61.3)	
Poor	1 (8.3)	11 (91.7)	
(n=248)			<0.001*
Has your child ever visited a dentist or dental nurse			
Yes	50 (57.5)	37 (42.5)	
No	124 (78.0)	35 (22.0)	
(n=246)			<0.01*
Have you ever had difficulty in finding dental care for your child			
Yes	14 (50.4)	14 (50.0)	
No	151 (73.3)	55 (26.7)	
(n=98)			0.02*
If your child had decay in a baby tooth that was not causing pain what treatment would you want			
None	23 (71.9)	9 (28.1)	
Have it filled	33 (61.1)	21 (38.9)	
Take it out	53 (74.6)	18 (25.4)	
Not sure	68 (73.9)	24 (26.1)	
(n=249)			0.33
How often does your child brush their teeth			
Once a day	57 (74.0)	20 (26.0)	
Twice a day	109 (69.9)	47 (30.1)	
More than twice a day	10 (66.7)	5 (33.3)	
(n=248)			0.75

A significantly greater proportion of children with visible caries experience was associated with lower rating of oral health by parent/ caregiver, having visited a dentist or dental nurse or had difficulty in finding dental care (Table 4.47). Higher daily frequency of fruits and sweet snacks was also significantly associated with visible caries experience (Table 4.48).

Table 4.47: Effect of social and behavioural factors (tooth brushing, breast / bottle feeding) on proportions of children with caries (N=251) (cont.)

	No visible caries experience (dmft=0) n (%)	**Visible caries experience (dmft>0) n (%)**	***p*-value Chi square**
How often do you help your child brush their teeth			
Never	0	1 (100)	
Sometimes	82 (69.5)	36 (30.5)	
All the time	96 (72.7)	36 (27.3)	
(n=251)			0.25
What position do you brush from			
Behind them	24 (68.6)	11 (31.4)	
In front of them	120 (75.5)	39 (24.5)	
At one side	23 (57.5)	17 (42.5)	
(n=234)			0.07
How much toothpaste do you use			
Enough to cover the whole brush head	51 (63.0)	30 (37.0)	
Enough to cover half the brush head	41 (68.3)	19 (31.7)	
Pea size	84 (77.8)	24 (22.2)	
(n=249)			0.08
Was your child breast fed			
Yes	140 (71.8)	55 (28.2)	
No	36 (67.9)	17 (32.1)	
(n=248)			0.58
What age did you stop breastfeeding			
< 3 months	10 (71.4)	4 (28.6)	
3-6 months	56 (77.8)	16 (22.2)	
6-12 months	40 (76.9)	12 (23.1)	
12+ months	32 (59.3)	22 (40.7)	
(n=192)			0.12
Has your child ever used a sweetened baby bottle or infant feeder at night			
Yes	40 (65.6)	21 (34.4)	
No	132 (72.1)	51 (27.9)	
(n=244)			0.33

Table 4.48: Effect of social and behavioural factors (sweet drinks, foods and snacks) on proportions of children with caries (N=251).

	No visible caries experience (dmft=0) n (%)	**Visible caries experience (dmft>0) n (%)**	***p*-value (Chi square)**
How often does your child have sweet drinks			
Never	0	0	
Rarely	23 (67.6)	11 (32.4)	
Once a day	49 (77.8)	14 (22.2)	
Twice a day	55 (74.3)	19 (25.7)	
More than twice a day	47 (62.7)	28 (37.3)	
Don't know	0	0	
(n=246)			0.21
How often does your child have fruits			
Never	2 (100)	0	
Rarely	11 (68.8)	5 (31.3)	
Once a day	93 (80.9)	22 (19.1)	
Twice a day	41 (66.1)	21 (33.9)	
More than twice a day	30 (54.5)	25 (45.5)	
Don't know	0	0	
(n=250)			<0.01*
How often does your child eat sweet snacks			
Never	2 (66.7)	1 (33.3)	
Rarely	48 (82.8)	10 (17.2)	
Once a day	80 (75.5)	26 (24.5)	
Twice a day	29 (72.5)	11 (27.5)	
More than twice a day	18 (43.9)	23 (56.1)	
Don't know	0	100	
(n=248)			<0.01*

4.4.5: Multiple-variate models

Four socio-behavioural variables, identified as being significantly associated with caries experience in the bivariate analysis, were found to have an effect in a multivariate analysis, using logistic regression. In this model, caries experience was treated as a binary variable (dmft=0 / dmft>0) and the predicators of caries experience were: a low parental dental health rating for the child, the child having visited a dentist or dental nurse, having had difficulty in finding dental health care and greater frequency of sweet snacks (Table 4.49)

Table 4.49: Results for logisitic regression* (215 degrees of freedom)

Questionnaire variable	Adjusted Odds Ratio*	95% CI	Wald Statistic	*p* value
How would you rate your child's dental health? Reference value: *Excellent*				
Very good	1.34	0.44 – 4.07	0.602	
Good	2.19	0.73 - 6.56	0.163	
Fair	6.83	1.89 –24.68	0.003	
Poor	46.22	4.55– 469.26	0.001	<0.001
Has your child ever visited a dentist or dental nurse? Reference value: *No*				
Yes	3.34	1.64 – 6.78	0.001	<0.001
Has your child ever had difficulty finding dental care? Reference value: *No*				
Yes	2.72	1.01 – 7.30	0.048	0.05
How often does your child eat sweet snacks? Reference value: *Rarely*				
Once a day	1.20	0.47 – 3.30	0.705	
Twice a day	0.95	0.29 – 3.12	0.930	
More than twice a day	4.35	1.49 – 12.72	0.007	0.01

*dmft <0 = 0, dmft>0 = 1

Visible caries experience (dmft) was also modelled both as a Poisson generalized linear mixed model (GLMM) for actual counts of dmft and a Logistic GLMM for presence and absence of visible caries experience. Children were considered nested within preschools clusters to control for similarities between children attending the same preschools. The analysis was conducted using the package lme4 in R (Bates *et al* 2012). Potential model predictors were recoded as required by collapsing sparsely populated levels. To achieve a parsimonios model, only model terms with confirmed significance at an alpha of 5% were retained in the final model, based on changes in the Akaike Information Criterion (Akaike 1974). However, for comparative purposes, the Logistic model results retained the same set of variables as for the Poisson model. Missing values were assumed to be missing completely at random and so were excluded from the modelling (Tables 4.50 & 4.51).

Table 4.50: Estimated rate of visible caries experience based on Poisson generalized linear model with children nested in preschools.

Term	Estimated rate of visible caries experience (dmft)	95% Confidence Interval	*p*-value
Intercept	2.58	0.95 - 7.00	0.06
Frequency sweet snacks =1 daily (base = rarely or never)	0.98	0.67 - 1.41	0.90
Frequency sweet snacks = 2 > daily (base = rarely or never)	1.85	1.32 - 2.58	<0.001
Dental health rating by parent = average (base = fair or poor)	0.12	0.16 - 0.30	<0.0001
Dental health rating by parent = good (base = fair or poor)	0.22	0.08 - 0.17	<0.0001
Dental health rating by parent = excellent (base = fair or poor)	0.17	0.11 - 0.27	<0.0001
Previous dental visit = no (base = yes)	0.49	0.38 - 0.64	<0.0001
Difficulty finding dental care = no (base = yes)	0.65	0.48 - 0.86	<0.001

Table 4.51: Estimated Odds Ratio for presence versus absence of visible caries experience based on a Logistic generalized linear mixed effects model* with children nested in preschools.

Term	Estimated Odds Ratio	95% Confidence Interval	*p*-value
Intercept	1.40	0.11 – 17.16	0.792
Frequency sweet snacks =1 daily (base = rarely or never)	1.10	0.45 – 2.68	0.840
Frequency sweet snacks = 2 > daily (base = rarely or never)	2.13	0.86 – 5.25	0.102
Dental health rating by parent = average (base = fair or poor)	0.20	0.08 – 0.50	0.001
Dental health rating by parent= good (base = fair or poor)	0.12	0.05 – 0.30	<0.001
Dental health rating by parent = excellent (base = fair or poor)	0.11	0.03 – 0.34	<0.001
Previous dental visit = no (base = yes)	0.13	0.17 – 0.68	0.002
Difficulty finding dental care = no (base = yes)	0.47	0.19 – 1.20	0.115

* dmft <0 = 0, dmft>0 = 1

4.5 Results for the early childhood oral health impact scale (ECOHIS)

From 340 families invited to participate, 309 participants (completed the ECOHIS instrument as part of the oral health questionnaire (response rate 90.1%). Of these families, 251 children completed the oral examination. Full details of the response to the survey are given in Chapter 3, Table 3.1.

The analyses and reporting of the ECOHIS data was based on that recommended by developers of the instrument, Pahel *et al* (2007), in their validation study among families in the USA.

4.5.1 Internal consistency

The instrument showed good internal consistency with a Cronbach alpha reliability coefficient of 0.94. For the child and family sections Cronbach alpha was 0.92 and 0.85, respectively.

Mean Impacts

Table 4.52 shows the mean ECOHIS impacts scores for child, family sections and whole instrument, along with the possible range of scores. Overall mean impacts were low but with standard deviations indicating considerable variation in scores.

Table 4.52: ECOHIS Mean impacts (N=309)

Impacts	No of items	Possible Range	Mean Impacts	sd
Child section	9	0-36	1.49	3.62
Family section	4	0-16	0.80	2.16
(whole ECOHIS	13	0-52	2.29	5.52

4.5.2 Frequency of impacts for whole sample

Table 4.53 shows the distribution of responses across all ECOHIS items. Table 4.54 shows impacts collapsed into three categories (never - hardly ever, occasional - very often) & don't know / missing) to more clearly indicate the more frequent impacts. In the Child Section these were: '*pain in the teeth, mouth or jaw*' (10.4%), followed by '*difficulty eating some foods*' (5.2%), '*being irritable and frustrated*' (4.5%) and '*difficulty with hot or cold drinks*' (4.2%). In the Family Impacts section the most

frequent impacts being experienced because of oral health problems in their child were: *'felt guilty'* (10%), *'been upset'* (5.2%) and *'taken time off work'* (4.9%).

Table 5.53: Frequency of impacts – all responses (N=309)

Impacts	*Never* n (%)	*Hardly ever* n (%)	*Occasionally* n (%)	*Often* n (%)	*Very Often* n (%)	*Don't know* n (%)	*Missing* n *(%)*
Child impacts							
(a) Pain in the teeth mouth of jaws	206 (66.7)	65 (21.04)	27 (8.7)	1 (0.3)	4 (1.3)	3 (1.0)	3 (1.0)
(b) Difficulty drinking hot or cold drinks	265 (85.8)	24 (7.8)	11 (3.6)	1 (0.3)	1 (0.3)	3 (1.0)	4 (1.0)
(c) Difficulty eating some foods	264 (85.4)	27 (8.7)	12 (3.9)	3 (1.0)	1 (0.3)	2 (0.7)	0
(d) Difficulty pronouncing some words	283 (91.6)	11 (3.6)	2 (0.7)	4 (1.3)	1 (0.3)	8 (2.6)	0
(e) Missed preschool	287 (92.9)	14 (4.5)	5 (1.6)	1 (0.3)	1 (0.3)	1 (0.3)	0
(f) Trouble sleeping	279 (90.3)	19 (6.2)	6 (1.9)	1 (0.3)	2 (0.7)	1 (0.3)	1 (0.3)
(g) Been irritable or frustrated	273 (88.4)	19 (6.2)	9 (2.9)	4 (1.3)	1 (0.3)	1 (0.3)	2 (0.7)
(h) Avoided smiling or laughing	286 (92.6)	11 (3.6)	3 (1.0)	3 (1.0)	1 (0.3)	3 (1.0)	2 (0.7)
(i) Avoided talking?	293 (94.8)	9 (2.9)	3 (1.0)	1 (0.3)	1 (0.3)	1 (0.3)	1 (0.3)
Family impacts							
(j) Been upset	273 (88.4)	18 (5.8)	9 (2.9)	2 (0.7)	5 (1.6)	1 (0.3)	1 (0.3)
(k) Felt guilty	258 (83.5)	17 (5.5)	17 (5.5)	7 (2.3)	7 (2.3)	2 (0.7)	1 (0.3)
(l) Taken time off work	275 (89.0)	17 (5.5)	13 (4.2)	0	2 (0.7)	1 (0.3)	1 (0.3)
(m) Had a financial impact on your family	287 (92.9)	14 (4.5)	4 (1.3)	0	3 (1.0)	1 (0.3)	0

Table 4.54: Frequency of impacts – aggregated (N=309)

Impacts	*Never / Hardly ever* n (%)	*Occasionally/ often/ very often* n (%)	*Don't know/ missing* n (%)
Pain in the teeth mouth of jaws	271 (87.7)	32 (10.4)	6 (1.9)
Difficulty drinking hot or cold drinks	289 (93.5)	13 (4.2)	7 (2.3)
Difficulty eating some foods	291 (94.2)	16 (5.2)	2 (0.65)
Difficulty pronouncing some words	294 (95.1)	7 (2.3)	8 (2.6)
Missed preschool	301 (97.4)	7 (2.3)	1 (0.32)
Trouble sleeping	298 (96.4)	9 (2.9)	2 (0.65)
Been irritable or frustrated	292 (94.5)	13 (4.2)	3 (0.97)
Avoided smiling or laughing	297 (96.1)	7 (2.3)	5 (1.6)
Avoided talking?	302 (97.7)	5 (1.6)	2 (0.65)
Been upset	291 (94.2)	16 (5.2)	2 (0.65)
Felt guilty	275 (89.0)	31 (10.0)	3 (0.97)
Taken time off work	292 (94.5)	15 (4.9)	2 (0.65)
Had a financial impact on your family	301 (97.4)	7 (2.3)	1 (0.32)

4.5.3: Frequency of impacts for children with some caries experience

Tables 4.55 and 4.56 show the frequency of oral health impacts for children with some caries experience (dmft > 0) and no caries experience (dmft=0) for the child and family levels, respectively. For both levels, a significantly higher frequency of impacts were reported for children with some caries experience.

Table 4.55: Frequency of child level impacts (aggregated), for children with no caries experience (dmft=0) / some caries experience (dmft>0) (N=251).

Impact	dmft = 0 (n=178)		dmft>0 (n=73)		Chi square
	n	%	n	%	
Pain in the teeth, mouth of jaw					
Never /hardly ever	170	76.9	51	23.1	
Occasionally/ often/ very often	6	22.2	21	77.8	
Don't know / NA	2	66.6	1	33.3	$p< 0.0001$
Difficulty drink hot or cold drinks					
Never /hardly ever	174	73.7	62	26.3	
Occasionally/ often/ very often	2	18.2	9	81.8	
Don't know / NA	2	50.0	2	50.0	$p<0.001$
Difficulty eating some foods					
Never /hardly ever	175	74.5	60	25.5	
Occasionally/ often/ very often	3	20.0	12	80.0	
Don't know / NA	0	0	1	100	$p<0.0001$
Difficulty pronouncing some words					
Never /hardly ever	175	72.6	66	27.4	
Occasionally/ often/ very often	3	42.9	4	57.1	
Don't know / NA	0	0	3	100	$p<0.01$
Missed preschool					
Never /hardly ever	176	72.1	68	27.9	
Occasionally/ often/ very often	1	20.0	4	80.0	
Don't know / NA	1	50.0	1	50.0	$p<0.05$
Trouble sleeping					
Never /hardly ever	175	72.9	65	26.4	
Occasionally/ often/ very often	2	22.2	7	77.8	
Don't know / NA	1	50.0	1	50.0	$p<0.01$
Been irritable or frustrated					
Never /hardly ever	177	74.7	60	25.3	
Occasionally/ often/ very often	1	8.3	11	91.7	
Don't know / NA	0	0	2	100	$p<0.0001$
Avoided smiling or laughing					
Never /hardly ever	176	73.3	64	26.7	
Occasionally/ often/ very often	1	14.3	6	85.7	
Don't know / NA	1	25.0	3	75.0	$p<0.001$
Avoided talking					
Never /hardly ever	176	72.1	68	27.9	
Occasionally/ often/ very often	1	20.0	4	80.0	
Don't know / NA	1	50.0	1	50.0	$p<0.05$

Table 4.56: Frequency of family level impacts (aggregated), for children with no caries experience (dmft=0) / some caries experience (dmft>0) N=251.

Family Impact	dmft = 0 (n=178)		dmft>0 (n=73)		Chi square
	n	%	n	%	
Felt upset					
Never /hardly ever	173	73.3	63	26.7	
Occasionally/ often/ very often	4	30.8	9	69.2	
Don't know / NA	1	50.0	1	50.0	$p<0.01$
Felt guilty					
Never /hardly ever	169	75.1	56	24.9	
Occasionally/ often/ very often	8	33.3	16	66.7	
Don't know / NA	1	50.0	1	50.0	$p<0.0001$
Taken time off work					
Never /hardly ever	175	74.5	60	25.5	
Occasionally/ often/ very often	3	21.4	11	78.6	
Don't know / NA	0	0	1	100	$p<0.0001$
Had a financial impact on your family					
Never /hardly ever	177	72.8	66	27.2	
Occasionally/ often/ very often	1	14.3	6	85.7	
Don't know / NA	0	0	1	100	$p<0.01$

4.5.4 Validity of the ECOHIS.

This section describes the validity of the ECOHIS

4.5.4.1: Criterion validity.

To assess criterion validity, mean ECOHIS scores were correlated with a global oral health rating (i.e. *How would you rate your child's dental health*?) Response categories: 1 = Excellent, 2 = Very good, 3 = Good, 4 = Fair and 5 = Poor. The results of this correlation are shown in Table 4.57. Children with lower oral health ratings had more reported impacts on the ECOHIS ($p<0.001$) although the Spearman rho values for both the child and family sections were low.

Table 4.57: Criterion validity for ECOHIS (using global rating of child dental health) (N =309)

variable	**Child section** *Spearman's rho*	**Family section** *Spearman's rho*
How would you rate your child's dental health?	0.27*	0.36*

*$p < 0.001$

4.5.4.2: Construct validity

Construct validity was assessed for both *convergent* and *discriminant* validity, using caries experience (dmft) versus mean ECOHIS scores.

4.5.4.3: Convergent validity

Convergent validity was tested using clinical data for caries experience (dmft) and mean ECOHIS scores. These two variables were significantly correlated with greater mean impacts related to higher mean caries experience ($p<0.001$) (Table 4.58).

Table 4.58: Convergent validity for the ECOHIS and caries experience (n=251)

variable	**Child section** *Spearman's rho*	**Family section** *Spearman's rho*
Caries experience (dmft>0)	0.41*	0.47*

*$p < 0.001$

4.5.4.4: Discriminant validity

The ECOHIS showed good discriminant validity by being able to show differing impacts when comparing different levels of disease severity for caries experience i.e. none (dmft=0), moderate (dmft 1-3) and high (dmft>4) ($p<0.001$). These levels were compared as: none versus 1-3, none versus >4 and 1-3 versus >4 (Table 4.59).

Table 4.59: Discriminant validity for the ECOHIS: Comparison of mean impacts for different levels of caries severity (n=251)

	Severity of caries experience (ECC)		
	dmft=0	**dmft 1-3**	**dmft >4**
Child section			
n	178	36	37
Mean impacts (sd)	0.56 (1.40)	1.1(1.63)	6.86 (7.79)
Comparison of caries severity	0 vs 1-3 0 vs >4* 1-3 vs >4*		
Family section			
n	178	36	37
Mean impacts (sd)	0.29 (0.97)	0.44 (0.91)	3.84 (4.40)
Comparison of caries severity	0 vs 1-3 0 vs >4* 1-3 vs >4*		

ANOVA *$p< 0.001$

CHAPTER FIVE: DISCUSSION

This chapter present a discussion of the findings from the oral health questionnaire and child oral examinations. The first section discusses findings from the parent/caregiver questionnaire (N=309).

5.1: Parent / caregiver characteristics

A good response rate was achieved from the sample of six randomly selected preschools. As expected the majority of respondents were female, with mothers or other female family members commonly being the main caregivers in the family. Half of the respondents were in the 25 to 34 year age range, indicating a relatively young group, consistent with them having some/all the children they care for at the preschool stage.

Almost three quarters of the sample were of Indian descent, which differs from the national demographic profile of Trinidad and Tobago, where African and Indian ethnicity are in similar proportions (Central Statistical Office 2012). This most likely reflects the ethnic composition of the region where the study took place. The Caroni region is located in the central part of the island of Trinidad and is historically the hub of the sugar cane industry. Indian indentured labourers arrived during British colonial rule to work in the plantations and sugar mills (Brereton 1989). Despite its agricultural past, the area is presently a mixture of urban and rural communities (Anthony 2001). As an indication that the sample contained a greater proportion of people from generally lower SES groups, the majority of respondents were from families with a head of household in manual work and over half the respondents were educated to secondary level.

5.1.1 Limitations of the study

The possibility of selection bias must be considered in this study. Not all children in this age group attend preschools or day-care facilities and their socio-demographic / behavioural characteristics may have differed from those children sampled through preschool enrolment. Caries experience and socio-behavioural factors among children who refused or were not present on the day for the oral examination (almost a fifth of those for whom parental consent was given), may have differed from those who were examined. Bias may also have arisen from exclusion of very small and very large

preschools from the sampling frame. Furthermore, although possibly representative of preschool children in the Caroni education district of central Trinidad, these data may not reflect the oral health of all preschool children across the nation. Associations between caries experience and socio-behavioural factors may have differed if non-cavitated lesions were included.

The use of self-reported questionnaires for a period preceding the last sixth months can be affected by respondent recall (Bowling 1999) and some participants may have been influenced by social desirability for questions such as those on tooth brushing and dental attendance (i.e. a tendency to present one-self in the best possible light) (Fisher 1993).

Being cross-sectional in design the context and temporal effect of the identified risk factors for ECC is not clear. This may have also resulted in apparent paradoxes in the final regression model which included theoretical antecedent events (frequency of sweet snacks), concurrent events (parental assessment of child oral health) and downstream events (dental attendance).

5.2: Oral health knowledge, attitudes, practices and child oral health rating

The majority of respondent had a generally good knowledge about oral health. Nearly all participants agreed that germs in the mouth caused tooth decay and that baby teeth should be cleaned as soon as they appear. Similar knowledge levels were found in mothers of preschool children in Canada who had good knowledge of oral health and generally positive attitudes toward oral care (Schroth *et al* 2007).

Although the majority of respondents believed that fluoride prevents decay and putting a child to bed with a bottle containing juice may cause cavities, some parents and caregivers appeared to still be unsure of the role of fluoride and the negative effects of sweetened bottle use. This is similar to earlier findings among mothers of young children in attending a paediatric dental clinic in Trinidad (Naidu and Davis 2008) and also consistent with mothers of high caries risk preschool children attending dental clinics in the UK, which indicated confusion about these oral health issues (Blinkhorn 1991). Hooley *et al* (2012) in their systematic review, concluded that parental factors such as knowledge, attitudes and beliefs are important in the development of ECC. This is significant because preschool-aged children generally spend much of their time with family members and during this period of 'primary socialization' the earliest childhood routines and habits are acquired, being mostly

learned from caregivers, older siblings and other family members in the home (Blinkhorn 1991). Parents and caregivers therefore, play an important role in decisions regarding their children's oral health (Pahel *et al* 2005, Blinkhorn 1991).

Lack of knowledge about dental caries and how to care for newly erupted teeth may prevent caregivers from meeting their child's oral health needs (Finlayson *et al* 2005). Dental health knowledge and attitudes, and their affect on oral health behaviours, are also mediated by social and cultural beliefs and norms within a community (Pine *et al* 2004, Fisher-Owens 2007).

While oral health knowledge is believed to have some influence on ECC, some previous findings have suggested this could be both positive and negative. For instance, in a review by Reisine and Douglass (1998), dental health knowledge was positively related to caries prevalence that is, higher knowledge was found among parents who's children had ECC. This unexpected relationship may be due to the parents having been recruited from a US Head Start programme and having already received some dental health education. The US Head Start programme was designed to assist children from low income families with access to education, health, and nutrition services, including early intervention and preventive care (Lee 2009), Vargas *et al* (1998) reported that by the time children were enrolled in Head-Start they already had a higher caries prevalence than the general population. Similarly, in the present study, some parents and caregivers may have already received some dental health education.

Over a tenth of respondents agreed with the statement '*tooth decay runs in families*' and almost a quarter did not know or did not answer. Some of these parents and caregivers may therefore believe that caries in the primary teeth of very young children is an inevitability, suggestive of a fatalistic view of their child's oral health. People with fatalistic health beliefs have lower perceived need for care and lower utilization of health services (Hallet and O'Rourke 2003). In a study of low-income African American families with preschool children in the US, the authors found that higher oral health knowledge was protective against ECC but caregivers endorsing a fatalistic beliefs tripled the odds of their children having ECC (Finlayson *et al* 2007).

A recent series of studies from Belgium reported that the favourable oral health behaviours among parent / caregiver were predicted by higher educational level of mothers and a positive attitude and intentions towards dental health (Van de Branden *et al* 2012). In the present study, there were generally positive attitudes about the care

of a carious primary teeth, as measured by the question '*if your child had decay in baby tooth that was not causing pain what treatment would you want*?' However, there was some ambivalence, with over a third of respondents unsure. This is consistent with findings in the UK where few parents of 5-year-old children who were asked a similar question, wanted restoration of carious asymptomatic primary teeth and generally preferred to leave the decision to the dentist (Tickle *et al* 2003). Schroth *et al* (2007) found that preschool children were more likely to have ECC if the caregiver did not believe that the primary teeth are important.

Perceptions that the primary teeth are temporary and of low importance may be influenced by cultural beliefs and attitudes as suggested by the findings of qualitative studies with caregivers of preschool children (Mofidi *et al* 2009, Hilton *et al* 2007, Obeng 2008). Consistent with data from the US NHANES III national survey, which reported data for over three thousand 2–5 years olds (Pahel *et al* 2005), the majority of respondents in this study rated their child's dental health as good to excellent.

5.3: Timing of first dental visit

The majority of respondents indicated that their child had not yet visited a dentist or dental nurse. Similar findings were reported in Canada, Europe and Asia where most preschool aged children had not visited a dentist (Schroth *et al* 2007, Leroy *et al* 2013, and Han *et al* 2013). This is of concern as the likelihood of a child being caries-free in later childhood increases with early dental attendance (Al-Ganim *et al* 1998).

Current best-practice guidelines for the care of infant and preschool children's oral health, is that a child be taken for a dental check-up by 1 year of age, ideally within six months of eruption of the first tooth (AAPD 2011, BSPD 2003). Early dental attendance can also enable the delivery of '*anticipatory guidance*' defined as '"the process of providing practical, developmentally appropriate health information to caregivers in anticipation of significant emotional, physiological milestones" (Nowak and Casamassimo 2009). Anticipatory guidance from a dental or non-dental health professional should include information about the child's dental growth and development, preventive oral care and the importance of the establishment of a '*dental home*' (Nowak and Casamassimo 2009). The dental home has been defined as " the ongoing relationship between the dentist and the patient on all aspects of oral health care delivered in a comprehensive, continuously accessible, coordinated and

family centred way" (AAP 2003). This provides an opportunity to impart preventive dental health advice, tailored to the child's needs through caries risk assessment.

The present findings, therefore, indicate that information on the first dental visit and the importance of early dental attendance should be an important part of oral health promotion messages in Trinidad and for all preschool children to have a dental home.

Early and regular dental attendance for preschool children, may enable clinical intervention through the application of fluoride varnish by a dental professional, which has been shown to be effective in preventing ECC (Marinho *et al* 2013, Twetman 2008). Weintraub *et al* (2006) reported that, when combined with dental health education/counselling for caregivers, fluoride varnish application twice a year reduced caries incidence during a two-year, randomised clinical trial in low income preschool children.

5.4: Access and utilization of dental services

Although almost a fifth of respondents in the present study found reported in finding dental care for themselves, few reported encountering difficulty in accessing dental care for their child. This should be viewed with caution as only a quarter claimed to be regular dental attenders and most may not have attempted to take their child to the dentist.

Based on research in other countries, access to dental care for preschool children is a problem for many families particularly those from minority groups (Harris *et al* 2004). These barriers have included the child's ability to cope with dental treatment (Harris *et al* 2004), community health beliefs, caregiver fear of dental treatment and trust and satisfaction with the dental care system (Tinanoff and Reisine (2009). Affordability of care is considered an important dimension of access to dental care in the five 'a's model proposed by Penchansky and Thomas (1981) however, this may not refer to absolute cost of treatment but also expenses relating to time off work, travel expenses and opportunity costs. Tickle *et al* (2000), in their analysis of UK service uptake, report that families from lower SES communities were more likely to attend if services are free at the point of delivery and provided locally. Edelstein (2000) reported that Head-start preschool children in the US receive comprehensive insurance cover yet have the fewest dental visits and when they do get care, it often does not meet the child's needs and suggests this is due to transport problems, cultural factors and the lack of availability of GA services (Edelstein 2000).

Preschool children in the UK were more likely to visit the dentist if they came from non-manual households with a mother who had at least secondary level education and who themselves were regular attenders (Hind and Gregory 1995). Similarly, the main predictors for routine dental visits in a Brazilian population were higher family SES, mothers with more schooling and those who had received guidance about prevention (Camargo *et al* 2012). Furthermore, as availability and utilization of health care tends to vary inversely with the need (Tudar Hart 1971, Petti and Poliman 2011), focusing on those already receiving support, could exacerbate oral health inequalities.

5.5: Tooth brushing and oral health self-efficacy

Most children were reported to have their teeth brushed at least once a day, with over two thirds brushing twice a day or more. Nearly all the respondents reported helping their child brush some or all of the time. This is encouraging as though some preschool children are happy to brush, they lack the manual dexterity to do so effectively and supervised tooth brushing or assisting with brushing is recommended until children can do this effectively, by around the age of 7 (Levine and Stillman-Lowe 2009). In their systematic review, Hooley *et al* (2012) reported that supervised brushing was associated with less caries experience. Interestingly, the majority of respondents in the present study reported helping to brush their child's teeth from the front or the side of the child. Current advice for effective brushing for young children recommends standing behind the child, with their head tilted slight back and with a gentle scrubbing method, to ensure all surfaces are cleaned (Levine and Stillman-Lowe 2009). Oral health promotion should therefore include advice on positioning as well as supervision of tooth brushing.

Psychosocial factors can influence engagement in, and maintenance of, health promoting behaviour such as supervised tooth brushing and, in particular, a mother's level of 'self efficacy' (Finlayson *et al* 2007a). Derived from Social Cognitive Theory (Bandura 1977), self-efficacy has been defined as an individual's belief in his or her ability to carry out and succeed at a specific task (Miller and Rollnick 2002).

Low caregiver oral health self-efficacy was found to be an important predictor of decay in a longitudinal study of low-income preschool children in a Connecticut Head Start programme (Reisine *et al* 1994, Litt *et al* 1995). In Adair's 17-country investigation of the relationship between ECC with familial and cultural perceptions,

parental self-efficacy was the strongest predictor, based on regression modelling, in the establishing of tooth brushing habits and control of sugar snacking (Adair *et al* 2004). Unsupervised brushing was strongly associated with a higher prevalence of ECC in a study of preschool children (Guido *et al* 2011). Therefore, although improving oral health knowledge may not directly influence oral health behaviour (Kay and Locker 1998), it may exert an indirect influence through developing self-efficacy.

5.6: Stress and coping

Hooley *et al* (2012) report that psychosocial variables, such as depression and anxiety can influence the extent to which parents and caregivers engage in preventive oral care behaviour because lack of perceived power to make a change in their behaviour. Families may also have simultaneous social problems causing psychological distress that may compromise health and health behaviours (Petti and Polimeni 2011).

Over half the respondents in the present study reported that their child sometimes made too many demands on them. Though not a full psychometric measure, this variable was included to consider the influence of parental stress. However, the role of caregiver stress and early childhood oral health however remains somewhat unclear. Some research has shown an association between higher parental stress and ECC (Seow 2009, Quinonez *et al* 2001). This finding as been shown to hold true in bivariate analyses although not in regression models (Tang *et al* 2005, Quinonez et al 2001, Jabbarifar *et al* 2009, Seow 2009). Conversely, Finlayson *et al* (2005) found that higher parental stress was associated with lower levels of ECC and hence may actually be protective. Finlayson postulates that higher parents stress may indicate a more conscientious caregivers who are trying too hard to maintain good oral health in their children. This seems plausible and gives support to the idea of stress being influenced by other factors such as Locus of Control i.e. the extent of an individual's perceived control over health outcomes (Wallston and Wallston 1978). Psychosocial factors such as health locus of control are believed to affect an individual's ability to execute health promoting behaviours. It has been suggested that these factors can also be encompassed by the concept of 'sense of coherence' (SOC), that is, the degree to which a person views life in a comprehensive, manageable and meaningful way (Qui *et al* 2013). Higher SOC enables an individual to perceive the environment as less stressful and facilitates positive health behaviours. However, the role of SOC in oral

health behaviours related to preschool children's oral health is unclear as recent research from China showed no significant association (Qiu *et al* 2013) whereas data from Brazil found that mothers with a lower SOC were more likely to have children with decayed teeth (Bonanto *et al* 2009)

The findings from the present research suggests that interventions aimed at changing oral health behaviour, should also be sensitive to the parent/ caregiver's wider concerns and overall demands of childrearing.

5.7 Fluoride use

A series of Cochrane reviews of randomized controlled trials have established the beneficial effects of topical fluorides (including toothpastes, and varnishes) for the reduction of caries increment in the primary dentition (Marinho 2009, Marinho *et al* 2013).

Nearly all respondents in this study reported using toothpaste that contained fluoride. Of concern is that over half were using enough toothpaste to cover half or all the brush head rather than a pea sized amount. Over-ingestion of toothpaste in preschool children can occur due to their inability to rinse and spit out effectively after brushing. Use of the correct amount of toothpaste is therefore important to reduce the risk of children developing enamel opacities in their permanent teeth as a consequence of early ingestion. Current US and UK guidance recommends the use of a small headed soft toothbrush and a smear of toothpaste up to age 2 and a pea size (0.2mg fluoride) amount for children up to age 5 (AAPD) or 7 (Levine and Stillman-Lowe 2009). Previously, low-dose fluoride toothpastes (600ppm or less), were recommend for children at low-risk of developing caries but as these provide only limited anti-caries benefit, it is now recommended that toothpaste should contain no less than 1000ppm for children up to age 3 and from 3 to 6 years, 1,350-1500ppm (Levine and Stillman-Lowe 2009). As these are the standard concentrations in most adult formula toothpastes, the amount used for children is very important and must be emphasized in health education messages, particularly as labelling of toothpaste fluoride content is generally unsatisfactory (Department of Health 2007).

5.8 Breastfeeding

Three quarters of the respondents reported that their child was breastfed and just over a fifth continued past one year. This is consistent with national data that reports that a fifth of mothers in Trinidad and Tobago were breastfeeding up to 24 months (Ministry of Social Development 2006), most likely influenced by advice from other health practitioners. Breastfeeding has previously been associated with ECC in some case reports and cross-sectional studies (Kramer *et al* 2007) and is believed to be due to prolonged contact of fermentable milk sugars, which pool around the anterior primary teeth. However, more recent longitudinal data have shown a less clear picture (Mohibi *et al* 2008, Kramer *et al* 2007). Feldens *et al* (2010) report that breastfeeding *per se* is not a risk factor for ECC if it occurs once or twice a day, however children breastfed past 12 months and fed several times a day, were more likely to have ECC, even after controlling for other dietary factors.

Masumo *et al* 2012 found that children who weaned earlier presented with higher sugar consumption perhaps indicating a 'protective effect' of breastfeeding on ECC.

Children who fall asleep while breastfeeding have been found to be at greater risk of caries (Johansson *et al* 2010). The AAPD recommend that *ad libitum* / on demand breastfeeding should be avoided after the first tooth erupts and as other carbohydrates are introduced to the child's diet. Breast and bottle feeding should be phased out after 12 months of age as beyond this time such feeding encourages comfort sucking and disturbs the transition to adults swallowing pattern, which is learnt from using a cup (BSPD 2003).

Mothers are likely to find this oral health guidance somewhat in conflict with messages being received from other health professionals, where support for breastfeeding past one year is often encouraged in the context of good nutrition and healthy child development. For example, UNICEF guidelines on breastfeeding are endorsed in Trinidad and Tobago (Ministry of Social Development 2006) and widely disseminated. These recommendations include '*exclusive breastfeeding for the first six months and following introduction of complementary foods at six months to continue breastfeeding for at least two years*'. Dental health advice must therefore be developed with sensitivity to the wider health promotion agenda to avoid causing confusion among mothers and caregivers. This position was highlighted in the UK guidance where the Scottish Intercollegiate Guideline Network stated dental health

professionals should support and promote breastfeeding in accordance with current recommendations (Scottish Intercollegiate Guideline Network 2005).

5.9 Feeding Bottle use

In the present study, over one quarter of caregivers reported their child was given a sweetened baby bottle at night time. There is evidence from case-reports, cross-sectional and longitudinal studies using multivariate analyses, to show that night-time feeding using a sweetened baby bottle or comforter increases the risk for ECC, with the maxillary incisors being most vulnerable (Winter 1980, Holt *et al* 1996, Wendt *et al* 1991, Declerck *et al* 2008, Seow 2009). In view of this, current guidance explicitly advises against this practice (AAPD 2011a), Levine and Stillman-Lowe 2009, BSPD 2003). However, encouraging caregivers to follow this advice is likely to be a challenge as cultural practices and beliefs play a role in bottle and sweetened bottle use (Harrison *et al* 1997). Giving a child a bottle to help them sleep or comfort them appears to be the accepted norm for many caregivers (Mofidi *et al* 2009), therefore, culturally sensitive approaches area required when developing oral health promotion for this client group.

5.10 Sweet snacks and drinks

Frequent intake of sweetened drinks and confectionary are established risk factors for ECC (Tinanoff and Reisine 2009, Alm *et al* 2012, Han *et al* 2013). Sweetened drinks and snacks appear to be given quite frequently to the children in this sample. It also appears that cola-type drinks and juices were consumed more often than confectionary such as chocolates, candies or biscuits. Both sweetened foods and drinks contain NMES and are potential risk factors for ECC. In a study on rural children with high caries prevalence in Mexico, ECC was significantly associated with frequent consumption of sodas, sweetened juice and sweetened milk drinks (Guido *et al* 2011).

Fruit consumption appeared to be quite frequent in this present study with almost half of the children reported to be eating fruits everyday, and a fifth, three times a day. This is encouraging and may reflect the good availability of fresh fruit in the Caribbean.

In tropical climates, including the Caribbean, children need regular hydration, therefore parents and caregivers must be advised on alternative drinks such as water,

milk or unsweetened fruit drinks as dentally safe options, and that sweetened beverages should be confined to mealtimes.

5.11 Oral health literacy

Oral health literacy is 'the degree to which individuals have the capacity to obtain, process and understand basic oral health information and services needed to make appropriate health decisions' (Lee *et al* 2012). Groups with low health literacy have less ability to understand and care for chronic conditions, fewer self-management skills, lower use of preventive health services and increased use of emergency services. (Reardon 2010) and Parker (2000) states that adequate health literacy is essential for primary prevention and health promotion.

The majority of respondents in this study reported never having difficulty reading health information. Although some people may not readily admit to having this difficulty (Reardon 2010). This finding was similar to findings among caregivers of preschool children in Australia, where the majority of participants interviewed did not require help from others to read dental health information leaflets (Arora *et al* 2012a). Brickhouse (2009) suggests that oral health literacy can affect children's oral health outcomes based on the relationship between family caregiver education, the health system and cultural factors. It is therefore important to identify families with low oral health literacy as they are more likely to experience barriers to dental health. Vann *et al* (2010) reported that caregivers of preschool children with higher health literacy had more oral health knowledge and higher rating of self-rated oral health. Lee *et al* (2011) suggest that oral health literacy may be related to oral health self-efficacy.

Results from instruments such as REALD (Rapid Test of Adult Literacy in Dentistry) have been found to correlate with caregiver perceived OHRQoL and child oral health outcomes, so such instruments may be of value to help indentify families in need of more individually tailored dental health education (Richman *et al* 2007). These individualised approaches should include little use of jargon, listening to the caregiver without interruption, using pictures and practical demonstrations, assessing comprehension by asking for feedback (asking them to repeat some points in own words) and using written material as a back-up for oral delivery. As well as the readability, oral health information provided through written media another important consideration must be that of cultural sensitivity, which takes account of social,

cultural, historical environmental, and psychological factors that influence beliefs and healthcare perceptions (Elledge 2012).

5.12 Child clinical oral health

The following sections discuss oral health findings from the oral health examinations (N=251).

5.12.1 Behaviour and compliance

The response rate for the examinations was affected mainly by absence of children on the day of the visit, followed by non-compliance with the oral examination. In anticipation of non compliance with the oral examinations by some children, several methods were used to address this, including modelling (letting non-compliant children watch others be examined), use of a dental puppet to demonstrate the procedure and a 'tell-show-do' approach during the process and use of rewards on completion (stickers and certificates).

Although designed for assessment of child behaviour during dental treatment, the Frankl scale was used in this study to assess compliance with the oral examination. Non compliance (Frankl score 'definitely negative') was considered an indication of Dental Behaviour Management Problems (DBMP). DBMP is a recognised problem among preschool age children reportedly ranging from 8-18% (Klingberg *et al* 1994). In a 17-country study most dentists believed that very young children's coping skills limited their ability to accept dental treatment and this constituted a significant barrier to care (Pine *et al* 2004). DBMP may have implications for service provision with respect to choice of treatment, need for specialist referral and additional clinical resources (Folayan and Kolawole 2004).

Factors related to DBMP include previous experience of toothache and lack of cooperation during prior medical visits (Ramos-Jorge 2006). Having a dentally anxious parent, along with a history of extractions and irregular dental attendance were associated with dentally anxious preschool children in the UK (Milsom *et al* 2003). Xia and Wang (2011) suggest using a pre-treatment interview with the family to help with DBMP, although Blinkhorn (2005) states this may only reduce parental anxiety but not affect the child's behaviour. Nevertheless, one of the challenges of dental care for preschool children is the requirement for the clinician to establish a

working relationship to be able to communicate with both child and parent (Fayle 2005) and a measure of DBMP should form part of the oral health assessment.

5.12.2 Health and development

Very few children were reported to have problems with sight, hearing or general health. It can therefore be assumed the majority of children were in good health with essentially normal growth and development.

5.12.3 Prevalence and severity of visible caries experience (dmft)

Similar to US national survey data, where the minority of children in the sample presented with most of the observed decay (Edelstein 2002), the skewed frequency distribution of visible caries experience in the present study suggests most of the disease burden was concentrated in a minority of children. This was further illustrated by severity of caries experience in children with some visible caries experience being over double that for the entire sample.

Comparison with international caries data for preschool children must take account of methodological differences, such as use of national survey data versus sub-samples, differing age ranges, ECC definitions, and examination criteria. Despite these considerations some overall trends are apparent.

The prevalence and severity of caries experience in this Trinidadian study was similar to neighbouring English-speaking islands i.e. Antigua, (Vignaraja and Williams 1992) and Anguilla (Adewakeun and Beltran-Aguillar 2002).

The ECC prevalence was also similar to data reported from UK studies (Hinds and Gregory 1995, Holt *et al* 1996, McMahon *et al* 2010), the US NHANES III survey (Tinanoff and Reisine 2009) and Australia (Hallet and O'Rourke 2002). The prevalence was, however, much higher than some other Western European countries such as Sweden (Bankel et al 2006), Switzerland (Menghini et al 2008) and Belgium (Declerk *et al* 2008).

Compared to data from other developing regions of the world, caries prevalence in this Trinidadian sample was lower than some countries in the Middle-East and some Asian countries (Al- Mughery *et al* 1991, Janson and Fakhouri 1993, Al-Malik *et al* 2003, Wyen 2008, Sinrativir *et al* 2009) and mainland China (Zeng *et al* 2005).

Interestingly, caries experience was very similar to some countries in the Far-East such as Singapore (Gao *et al* 2009) and Hong Kong 28.5% (Lo *et al* 2009). It should be noted that the city of Hong Kong is fluoridated.

Comparison with data from Latin America is difficult as studies on preschool children shows considerable variation, possibly due to the cultural difference in a very large geographic region and choice of study population (usually urban poor), however, this Trinidadian data did show similarity to some studies from Brazil (Piovesan *et al* 2010, Rosenblatt and Zarzar 2002) but was much lower the prevalence in some other studies from the same country (Dini *et al* 2000, Gradella *et al* 2011)

5.12.4 Caries site distribution

Severity of ECC can also be indicated by the pattern, number and types of primary teeth affected. The caries site distribution in this study showed that visible caries experience was most common in the maxillary incisors and lower molars.

The classic description of ECC involved decay on the smooth surfaces of the maxillary incisors (Fass 1962, Winter et al 1966) and was historically defined by specific high risk feeding and weaning practices (e.g. bottle mouth, baby bottle decay, nursing caries etc). Oral clearance of cariogenic substrate in the mouth, particularly during sleep where salivary flow rates are reduced, may influence site distribution and it has been shown that clearance of sugars is slowest on the labial surfaces of the maxillary teeth and buccal of the mandibular molars (Hakani *et al* 1993). This corresponds to the common presentation of ECC. However, this pattern of caries in the rest of the mouth is likely to have a complex aetiology and indicates the interplay of several other factors that influence risk status.

In a longitudinal study, involving a two-year follow-up of over one thousand children in Belgium, children assessed to be at high risk of caries developed new lesions mainly on the occlusal and distal surfaces of the mandibular first molars by age 3. Those at low risk presented with caries in the occlusal surfaces of the maxillary molars by age 5 (Leroy and Declerk 2013). Tooth and surfaces first affected may therefore indicate level of disease risk and susceptibility to ECC. O'Sullivan and Tinanoff (1993) also reported that children with maxillary anterior caries at age 3 had eight times more posterior caries by age 5 than those who were caries-free at baseline. These findings suggest that anterior caries in preschool children is a predictor of the

extent and severity of future caries in posterior teeth (O'Sullivan and Tinanoff 1996, Ardenghi *et al* 2008).

The caries pattern in this Trinidad-based study is similar to that reported in children of the same age range in Anguilla (Adewakun and Beltran-Aguillar 2003). Although the Anguillan study included precavitated lesions, most caries experience was still from cavitation on the molars, with incisors less affected. This may be related to Anguilla having implemented school-based fluoride schemes, which, together with promotion of fluoride toothpaste use, may have reduced caries susceptibility of smooth surfaces.

5.13: Treatment need and urgency

Consistent with most of this ECC experience attributable to decayed teeth (dt), the majority of children who were in need of treatment in the present study required restorative treatment, with a smaller proportion needing pulp care or extractions. Importantly, over a third of children with unmet need required urgent care to address problems resulting from untreated caries such as dental abscesses.

This situation could indicate delayed care-seeking which can lead to a 'downward-spiral' and symptom-based attendance at emergency dental departments (Pine *et al* 2006). ECC related conditions were the most frequent reason for emergency department presentation in the US (Casamassimo *et al* 2009) and decayed primary molars were one of the most frequent reasons for emergency dental attendance in Trinidad (Naidu *et al* 2006).

5.13.1: Care of decayed primary teeth

Debate has arisen over the most effective and appropriate methods for addressing untreated caries in the primary dentition of young children. Some research has shown that the majority of un-restored carious primary teeth remain symptomless until exfoliation (Levine *et al* 2002) suggesting a less invasive approach may be appropriate. Although it is not possible to accurately predict which teeth with small carious lesions will progress (Duggal 2011). Teeth most likely to progress to large cavities are molars, affected soon after eruption (Milsom *et al* 2003). Untreated caries has been found to impact on child well-being with respect to pain and disrupted eating and sleeping patterns (Low *et al* 1999). As the risk of pain and infection increases with higher caries experience, children at high risk for ECC would benefit most from dental intervention (Pine *at al* 2006).

This sequence of events has been noted in preschool aged children referred for GA treatment by Hunter *et al* (1997), where the authors state " young children often do not receive any restorative care and are frequently among those who require urgent pain relief under general anaesthesia". In their study, decay was already extensive by the time of their fist visit. Edelstein *et al* (2009) state "caring for dental emergencies resulting from ECC can add further stress as parents need to adjust work or other obligations to care for and comfort their child who may be in pain". In a study among low-income caregivers in California, some parents reported losing their jobs because of repeatedly taking their child for dental care (Barker and Horton 2008). This again highlights societal impacts resulting from late dental attendance and the value of establishing a 'dental home' early in the child's life, as recommended by the AAPD and BSPD. Importantly, access to timely and appropriate treatment for ECC can have positive effects such as improved growth trajectories (Acs *et al* 1999), and improved quality of life for the child and the family (Filstrup *et al* 2003, Cassamassimo *et al* 2009).

5.14 Oral hygiene and gingival health

A small proportion of children presented with visible plaque or evidence of gingival changes. Most frequently this was in the upper anterior region. Some under-reporting may have occurred by use of visual assessment, without the use of an explorer. Furthermore, oral hygiene levels on the day of examination may have been better with parents, caregivers and preschool staff knowing that a dental team was visiting the preschool. Visible plaque is considered a risk factor for ECC (Tinanoff and Reisine 2009, Seow *et al* 2009). In a large study of 3-year-old children in Belgium, visible plaque on at least one primary tooth was found to be a significant risk factor for ECC (Leroy *et al* 2012) with the researchers suggesting that visible plaque levels could be used as a risk assessment tool. Interestingly, some prediction models suggest that cariogenic bacterial load rather than absolute oral hygiene levels have been shown to be related to risk of ECC (Holbrook *et al* 1993, Harris *et al* 2004). Twice daily supervised brushing in preschool children is recommended by the AAPD and BSPD (Levine and Stillman-Lowe 2009) and oral hygiene levels may also be seen as a marker for caregiver involvement in the child's tooth brushing (Gibson and Williams 1999).

5.15 Enamel developmental defects

Enamel developmental defects (based on the upper anterior teeth) were found in one quarter of the sample of children examined. This falls within the range reported for primary teeth of 13 to 39% in the review by Tinanoff and Reisine (2009) and very similar to the prevalence of 24% in children aged 3-4 in Antigua, although a different index (FDI, DDE) was used in that study (Vignarajah and Williams 1992). In the present study the most common defects were diffuse or demarcated opacities, followed by combinations of both together and some instances of hypoplasia. This is consistent with the reports in the international literature that have used similar criteria, where opacities are the most prevalent condition, in most of these studies (Lai *et al* 1997, Milgrom *et al* 2000, Montero *et al* 2003, Farsi 2010, Oliveira *et al* 2006, Carvalho *et al* 2011).

The prevalence of defects was higher in pre-term, low-birth weight children (Seow 1998 Seow *et al* 2009), possibly due to inadequate child / mother nutrition during the peri-natal or post-natal period (Tinanoff and Reisine 2009). In the present study data were not collected on birth-weight or prematurity however, National Survey data reported that 20% of children in central Trinidad, which includes the Caroni region, were of low birth weight (less than 2500 grams) (Ministry of Social Development 2006). Quantitative defects such as hypoplasia were less prevalent and this is expected as these defects are more often due to serious systemic disturbance or genetic influences.

The bivariate analysis showed a significant association with severity of visible caries, specifically diffuse opacities, hypoplasia, and demarcated opacities. This is consistent with recent data from preschool children in Kampala, Uganda where children with enamel hypoplasia were twice as likely to have ECC, than those without the condition (Masumo *et al* 2012).

As the present study was cross-sectional in design, a causal relationship between ECC and enamel defects could not be established, however, these findings are consistent with the international literature including recent longitudinal studies (Oliveira *et al* 2006 and Targino *et al* 2011). Defective areas of enamel, in particular hypoplastic areas may be rough and prone to plaque accumulation and higher counts of *Mutans Streptococci* placing the child at greater risk of ECC (Carvalho *et al* 2011, Hong *et al* 2014, Seow *et al* 2009 Caufield *et al* 2012) hence further emphasising the importance of good oral hygiene and need for use of fluoride toothpaste use in early childhood.

Highlighting the importance of this condition, enamel hypoplasia is also now included as a risk factor for ECC in the American Academy of Paediatiric Dentistry caries risk assessment tool (CAT) for dental and non-dental professionals (AAPD 2013). Therefore, where possible the presence (or possibility) of these defects on the anterior teeth of infants and preschool children should be brought to the attention of parents and caregivers during dental visits or counselling by health professional. This should be included in anticipatory guidance to further reinforce good oral habits and home care for these children at high risk of ECC.

5.16 Socio-behavioural factors and ECC

The following sections discuss findings from the bivariate analyses and statistical modelling, using multiple-variate analyses with respect to socio-behavioural factors.

5.16.1 Gender and ethnicity

Consistent with most studies on ECC there were no gender differences identified. Although there was a trend of greater severity of ECC in children of Indian ethnicity, this was not found to be significant compared to the other main groups i.e. Mixed and African. This may have been due to sample size or ethnic / cultural differences not having much influence on these children's diets and oral practice in the home. Research on ethnic differences for caries experience in young children is commonly confounded by socio-economic disadvantage. However, a recent UK study was able to demonstrate a significant association between ECC and preschool children of eastern European, and Asian (Pakistani and Bangladeshi) ethnicity. After controlling for SES, these children had worse oral health than White British children in a deprived inner city area of London (Marcenes *et al* 2013), This suggests that ethnicity and oral health of preschool children is a complex issue and cultural competency must be considered when developing oral health promotion activity and supporting material.

5.16.2 Socioeconomic status

Although in the bivariate analyses severity of ECC was higher in children in families from manual households, this proxy variable for SES did not hold for prevalence of ECC experience and was not significant in the regression models. Similarly, no associations were seen for highest educational level of parent / caregiver for prevalence and severity of ECC. This may have been due the sample size or lack of

sensitivity of these proxy variables for SES. Although use of household income may have been more discriminating, collection of this information was felt to be too intrusive.

The effect of SES may be clearer in longitudinal studies. For instance, a marked social gradient in ECC and oral health behaviours was reported in a recent longitudinal study of preschool children in Europe, with children examined at age 3 and age 5 and educational level used a proxy for SES. Children of low educated mothers were over seven times more likely to present with ECC at age 5 than those from mothers with university level education (Van de Branden *et al* 2103). This has implications for the development of oral health promotion and avoiding widening oral health inequalities, by ensuring that dental services and oral health promotion is appropriate for preschool children and families with higher disease levels and unmet treatment need.

5.16.3: Oral health rating, beliefs, attitudes and practices

In both the bivariate and regression analyses, higher prevalence and severity of ECC was related to lower child oral health ratings. This parental perception of the child's oral health status is consistent with the literature as parental oral health ratings of their children, have been shown to be associated with actual clinical status and need for dental treatment (Pahel *et al* 2005, Locker 2008). Machry *et al* (2013) reported that parents who reported their child's oral health as fair/poor were less likely to have visited the dentist for preventive care.

Oral health rating may therefore have utility in planning of oral health services and preventive strategies as a proxy measure of treatment need, particularly when dental screening of children is not feasible due to issues of cost, access and other logistics.

In the bivariate analysis, ECC was associated with parents who agreed that '*tooth decay runs in families*'. This variable was indicative of oral health fatalism and suggests that negative views of oral healthcare and importance of the primary dentition may be one of the issues to overcome when providing oral health information, particularly when discussing effectiveness of prevention and during anticipatory guidance in early childhood.

Based on the analyses in this study (bivariate and regression models), having difficulty finding dental care and having attended a dentist were related to higher rates of ECC. This was consistent with recent data from China, where higher dmft scores

were found among preschool children who had visited a dentist and was thought to be evidence of "problem-oriented dental care seeking behaviour" (Zhang *et al* 2013). The present findings may therefore suggest problems of access to dental care as well as some children attending due to a caries-related problem. Symptoms such as pain or infection would be more likely in children with a higher rate of caries experience. This would be consistent with the issue of symptom-related attendance (Pine *et al* 2006, Casamassimo *et al* 2009).

Consistent with the literature on dietary practices was the finding of a significantly greater severity and prevalence of ECC among those children who ate sweet snacks more than once a day, this relationship with ECC also being confirmed in the regression models. This was similar to the findings of firstly, Zhang *et al* (2013), who reported that preschool children in China who consumed daily sweet snacks had a greater caries severity and secondly, a case-control study of Indian preschool children, where the risk of ECC was higher in children who were snacking on sweet foods more than three times a day (Mahesh *et al* 2013).

Introducing sugary snacks in early childhood develops a sweet habit that may persist as the child gets older (Hunter *et al* 1997). Children who consumed both a sugary drink and snack in the hour before bed have been found to have a four-fold increase in the caries risk, compared to children who had neither (Levine 2000). The AAPD recommends that carbonated beverages, which are usually heavily sweetened, should be eliminated from the diet of preschool children (AAPD 2011). Furthermore, a national study in Scotland of children aged 3-17 demonstrated that risk of having had dental treatment for caries increased with frequent intake of NMES (Masson *et al* 2010). This risk remained in children who reported brushing their teeth twice a day, suggesting oral hygiene and fluoride use may not be protective when NME sugar consumption is high, highlighting the importance of dietary advice.

An unexpected finding was that of ECC being related to more frequent consumption of fruits since intrinsic sugars in fruits are considered less-cariogenic. This finding might therefore be the result of confounding with some of these children who ate fruits regularly also snacking on confectionary or more likely sweetened juice. Although unsweetened fruit juice has not been reported to cause caries (Weinstein et al 1992, Reisine and Douglass 1998), fruit juices in Trinidad are traditionally very highly sweetened, to suit the local palate. One of the most popular local brands of

fruit juices, marketed under the banner of a 'natural' and healthy drink, contains more sugar than standard carbonated cola drinks.

With both local and imported fruits widely available and generally affordable in Trinidad, these food items could provide a safe option for children's snacks, however, oral health promotion for caregivers must include advice on checking food labels and the preference on un-sweetened juices.

To be effective, oral health promotion should therefore include an understanding of parent and caregiver knowledge and attitudes (Schroth *et al* 2007) and oral health advice must be clear and appropriate (Arora *et al* 2012). In the systematic review by Hooley *et al* (2012), it was concluded that parental oral health behaviour was an intermediary in the development of ECC, being the result of their oral health knowledge, attitudes and beliefs, which in turn are influenced by education, socioeconomic status and culture. This was found to be consistent with the findings of the present study where parent/caregiver oral behaviours, such as dental attendance and dietary habits, were associated with a higher rate of visible caries experience of their children in the Poisson regression model.

Adopting a more client-centred approach, which considers underlying social determinants of health, may help to motivate parents and caregivers to adopt healthier dental health behaviours for their families. One such approach is motivational interviewing (MI), a counselling method that attempts to elicit behaviour change by resolving ambivalence and increasing self-efficacy (Yevlahova *et al* 2009).

5.16.4 Summary

The prevalence and severity of ECC in this sample of preschool children in Trinidad suggest the need for improved access to dental care and more effective oral health promotion for this population group. This should include primary prevention and interventions that offer more practical advice and support for parents and caregivers, including counselling type approaches that consider the social determinants of oral health.

5.17 Dental erosion and dental trauma

Over one quarter of the sample of preschool children had some evidence of dental erosion, less than a tenth with dentine involvement. Despite some methodological differences, broad comparison with international data, suggest that the prevalence in the present study is consistent to that reported in the UK (Jones and Nunn 1993, Hinds and Gregory 1995), The Middle-east (Al Malik *et al* 2002) and India (Nayak 2010). However, the prevalence in this Caribbean island was much lower than recent data from South America (Murakami *et al* 2011) and Greece (Mantonanaki *et al* 2013).

In the present study no association was found between SES and prevalence of erosion which is consistent with the findings of Murakami *et al* (2011) in a large study of Brazilian children. Interestingly, in another recent study from Brazil (Moimaz *et al* 2013) the prevalence of erosion in the primary dentition of preschool children was very low (0.6%), with the authors also stating that the condition could not therefore be considered a public health problem. The same study also reported a positive association between erosion and higher family income, further indicating that the relationship between erosion and SES is less clear than that with ECC (Moimaz *et al* 2013).

Murakami *et al* (2011) reported a significant association with higher frequency of soft drinks, although this was not a finding in the present study. The lack of association with frequency of soft drink consumption and fruits suggests a more subtle interplay between aetiological factors over a period of time which was not detectable in this cross-sectional study.

5.18 Traumtic dental injury (TDI)

Although in the present study recording was standardized during recording of dentition status using WHO criteria, an additional index specifically designed to record degree of dental injury or discolouration was not included. Presence of TDI was indicated by any tooth missing any surface of the crown with their being no evidence of caries.

Comparisons with international data should be viewed with caution since due to differing age ranges and indices these differences highlight probable cultural differences influencing prevalence of injuries such as types of environment, types of play and supervision of preschool children. However the prevalence of TDI in this Trinidadian preschool population was very low, being much less than data from

Brazil, Cuba, India and Turkey. These Caribbean data did show some similarity to data from the UK (Walker *et al* 2000), Kuwait (Hasan *et al* 2010) and recent national data from Scotland (Rhouma, 2013). Similar to the present study, the Scottish national study did not use an index for TDI but recorded teeth with a diagnostic code for dental injury as part of oral examination for caries experience and other conditions. The results did not show an association with SES based on area deprivation scores (Rhouma *et al* 2013).

The low prevalence in this present study may suggest that TDI in these preschool children is not a public health concern. However TDI, when it occurs in young children, can be distressing for the child and family and may have an impact on quality of life (Rhouma *et al* 2013, Kramer *et al* 2013). Furthermore, TDI was one of the most common reasons for attendance for emergency dental care at a Dental Hospital in Trinidad (Naidu *et al* 2006), indicating a problem in later childhood. As part of oral promotion programmes for parents and caregivers of young children it is therefore important to include clear information on the risk and sequelae of TDI, along with aspects of prevention (mouth guards, safer play areas), particularly for young children with malocclusion (Class II incisor relationship with increased overjet). Ensuring adequate access to emergency dental services and evidence-based training for the dental team is essential for providing high quality care for young children presenting with TDI (Andersson 2013).

6.12: OHRQoL

The ECOHIS showed good internal consistency with high Cronbach alpha scores overall and for both the child and family sections (>0.9), indicating that questions items within the instrument were addressing the same concept. The instrument showed good face and content validity as the terms and themes in the instrument appeared to be relevant and understood by the respondent, suggesting the ECOHIS is culturally appropriate for use in this Caribbean population.

Overall, the frequency of oral health impacts for this sample was low for both Child and Family sections of the instrument, which is similar to data from the US (Pahel *et al* 2007). The distribution of scores for the whole sample was was possibly related to the skewed prevalence of ECC in this sample of children, with the majority of the children having has no caries experience. However for those children who had oral examinations, a significantly greater frequency of impacts was found for children with

some caries experience (dmft>0) compared to those with no caries experience (dmft=0). Greater prevalence of impacts was reported in Turkey (Peker *et al* 2011) and Brazil (Scarpelli *et al* 2011) though it should be noted that these studies used convenience samples of children who likely presented with higher caries experience.

The most frequent child impacts in this sample were similar to most other studies that have used the ECOHIS (Li *et al* 2008, Scarpelli *et al* 2011, Wong *et al* 2011, Kramer *et al* 2013). These being pain and difficulty with eating, drinking hot or cold beverages and being irritable. All these are consistent with symptoms from untreated dental caries children and confirms the negative effect on quality of life that ECC can have preschool children. Similarly findings in the family impacts section were consistent with research in other countries with feeling guilty or upset being the most common impact. Interestingly, family impacts in a Turkish study (Peker *et al* 2011) differed from the present study, with most frequent family impacts being financial and having to take time off work, although that study was among a sample of older children (5-6-year-olds) with a higher severity of caries experience.

The issue of feelings of guilt about oral health of their preschool aged child was explored by Carvalho *et al* (2012), who defined guilt as "*a feeling that occurs when one assesses one's specific action as a failure or when the particular action has led to failure*". They suggest that these feelings may be due to some parents having knowledge about prevention and dental care but are unable to act on it effectively, with respect to their child. This again highlights the need to develop oral health promotion strategies that support parents and caregivers that go beyond increasing oral health knowledge. Changing behaviour requires approaches that impart practical advice and enhance motivation, as well as developing coping skills, enabling families to overcome barriers to preventive dental care. In this regard, patient-centred counselling approaches and brief counselling techniques such as motivational interviewing (MI) have been shown to be effective in relation to preschool children's oral health (Weinstein *et al* 2004, Yevlahova and Satur 2009).

Consistent with the theorised direction and with previous studies (Pahel *et al* 2007), a correlation was found between parental oral health ratings of the child and quality of life impacts (i.e. higher impacts associated with lower oral health rating), suggesting that parent/caregivers had a good appreciation of their child's oral health status and were aware of oral health problems.

Importantly, there was also a positive correlation observed between mean ECOHIS impacts and severity of caries experience (dmft). Again, this was in the expected direction and showed that ECOHIS impacts can reflect actual disease burden. This was consistent with recent data from Brazil that reported that an increase in severity of ECC resulted in increased negative impacts on the quality of life of the child (Martins-Junior *et al 2013*). As in earlier validation studies in other countries, the ECOHIS was also able to discriminate between different levels of caries severity in this Trinidadian population (Pahel *et al* 2007, Scarpelli *et al* 2011, Peker *et al* 2011). With disease burden confined to a minority of preschool children, the ECOHIS may therefore be able to inform management strategies by helping to prioritise children for preventive dental care and different treatment modalities (routine restorative care, emergency care, sedation / general anaesthesia).The findings of this study suggest the ECOHIS instrument is a valid measure and appropriate for use among families of preschool children in Trinidad. The instrument was able to identify negative impacts of poor oral health on the quality of life young children, their families and in particular the problem associated with untreated ECC.

5.19: Conclusion

Information on the first dental visit and the importance of early dental attendance should be an important part of oral health promotion messages in Trinidad and all preschool children should have a dental home.

Cultural competency and health literacy must be considered when developing oral health promotion activity and supporting material. Widening oral health inequalities must be avoided by ensuring that dental services and oral health promotion is appropriate for preschool children and families with higher disease levels and unmet treatment need. Parental oral health ratings could be used in planning of oral health services and preventive strategies, as a proxy measure of treatment need. The ECOHIS could be useful as an adjunct to clinical oral health data both for the design and evaluation of oral health promotion interventions for preschool children.

Oral health promotion should include primary prevention and interventions that offer more practical advice and support for parents and caregivers, including counselling type approaches that consider the social determinants of oral health.

CHAPTER SIX: A QUALITATIVE STUDY OF THE VIEWS OF PARENTS AND CAREGIVERS OF PRESCHOOL CHILDREN

This chapter reports on the conduct and findings from a qualitative study of parents and caregivers of preschool children in Trinidad.

6.1: Introduction

Sociological theory and social research methods can illuminate aspects of human experience of health and illness (Jefferys 1997, Audrey 2010). Sociology has therefore been applied to research in the field of health and health care better to understand these experiences and those aspects of the relationship between individuals and society which influence them (Audrey 2010). Traditional methods of health care research have usually involved a 'positivist approach', where the researcher strives for an objective and neutral position in order to understand the results using the finding from quantitative data. In sociological research, social life is seen as a series of interconnected events and looks for meaning and context, in order to aid interpretation through the use of qualitative data (Green and Thorogood 2009). Whereas quantitative research attempts to measure and enumerate phenomena, qualitative research uses inductive reasoning to generate hypotheses from observed data. Qualitative research therefore looks for the 'why' rather than just the 'what' or 'how much' and aims for depth rather than breadth of information (Masood *et al* 2010).

Qualitative research can be considered the study of human actions and activities or a way of witnessing human events in the context in which they occur (Savage 2000). By the use of a 'naturalistic approach', qualitative research attempts to study phenomena in their natural setting (Green and Thorogood 2009, Masood, *et al* 2010). Through a focus on meaning and understanding, this approach assumes that people are essentially rational and sensible, with the choices they make being based on the environments and constraints they are subject to in their daily lives. Green and Thorogood (2009) state that, "without this empathetic understanding of why people behave as they do we're unlikely to indentify opportunities for change. Hence qualitative research does not start from a position of purely documenting what they are doing wrong or what they do not know but how they manage to maintain their health and the rationale for their behaviour" (Green and Thorogood 2009).

Furthermore, while assuming the role of a 'professional stranger' the researcher in qualitative research attempts to be 'reflexive' by also taking account of his/her influence in the process and how this may have shaped the data (Masood *et al* 2010, Agar 1980).

6.2: Qualitative Methods

Qualitative methodologies include:

- Observational (participant / non-participants)
- In-depth interviews (structured / unstructured)
- Focus groups

6.2.1: Observational methods

Observational methods were developed from ethnography and anthropological research studying behaviours among societies where little in known about their culture. Culture is considered to include ethnicity, habits of thoughts, dress, language, religion / belief systems, rituals, music, art and norms of behaviour (Hillier 1997).

This method involves the researcher observing the subjects in their daily lives without trying to influence their behaviour. To achieve this, the researcher may be a participant or non-participant observer (Bowling 1999):

(a)Non-participant:

In this approach the researcher is usually in a covert role with no involvement in the activities of the subjects being studied.

(b)Participant observation:

This involves the researcher taking part in the activities of the subjects and interacting with them. This method has been successfully used to understand people's experiences and the meaning they attach to their actions.

6.2.1.1: Advantages of observational methods

- By exploring and documenting these natural events this methodology can uncover the culturally specific significance of actions and decode indigenous models of reality.

6.2.1.2: Disadvantages of observational methods

- This method is very time-consuming and costly in terms of human resources. There is a danger of the researcher getting too close and involved in the setting with a loss of objectivity when trying to interpret data (Masood *et al* 2010).
- This approach may also be subject to a 'Hawthorne effect' where study participants change their behaviour due to them being aware that they are being studied (Green and Thorogood 2009, Holden and Bower 1998).

6.2.2: In-depth interviews

In-depth interviews are the most established and widely used methodological approaches to produce data in qualitative research (Green and Thorogood 2009). The interviews can be considered 'guided conversations' and aim to delve beneath the surface of the superficial responses to obtain the true meaning that individuals assign to events (Bowling 1999).

Interviews may take the form of:

(a) Semi- structured – the researcher sets the agenda in terms of topics and the interviewee determines information produced and the relative importance.

(b) Unstructured – allows the interviewee enough time to develop their accounts of the issues important to them. Open-ended questions are developed according to the interviewee's responses and data are generated from these responses.

(c) Narrative – the researcher facilitates the interviewee into telling a story about themselves of or event of significance to them.

These methods can be used interchangeably and have been used to explore beliefs, perceptions and the understanding of phenomena. Several strengths and weaknesses have been identified (Masood *et al* 2010, Green and Thorogood 2009, Bowling 1999):

6.2.2.1: Advantages of in-depth interviews

1. Elicit in-depth information about experiences, feelings and beliefs.
2. Can explore sensitive and complex issues
3. Can explore connections and relationships between events.

6.2.2.2: Disadvantages of in-depth interviews

1. Expensive and time consuming to undertake.
2. Data may be from a small sample and difficult to collect and analyse.
3. Interviewer bias difficult to control.
4. Relies on genuine rapport between interviewer and interviewee to get personal rather the public accounts.
5. May elicit intentional lying due to social desirability and may only provide access to what people 'say they do' rather than 'what they do'.
6. From a positivist view the data obtained may be limited and non-representative and may be considered a poor substitute for empirical evidence.

6.2.3: Focus groups

The use of focus groups originated in market research where they were used to assess consumer views on products and advertising strategies (Green and Thorogood 2009). They are now widely used in health research. In essence, a focus groups is a small group of people brought together to discuss a particular issue (e.g. health services or health promotion campaigns) under the direction of a facilitator. The facilitator has a list of topics to initiate discussion. Open ended questions can encourage participants to explore issues of importance to them, in their own vocabulary, generating their own questions, ideas and priorities (Kitzinger 1995).

A focus group session can be considered an unstructured interview with a group of people who are encouraged to interact with each other and the facilitator (Bowling 1999). The session uses group dynamics to stimulate discussion, gain insights and generate ideas to explore a chosen topic in depth. They are able to produce a large amount of information in a relatively short space of time. Kitzinger (1995) states:

"They can help people explore their views and generate questions in ways they would find difficult in face-to-face interviews and when group dynamics work well the participants work alongside the researcher, taking the research in new and often unexpected directions."

The composition of the focus group is important with respect to whether the members are known to each other. Natural groups are useful in sociological research i.e. groups of people who know each other and already encountered in the course of fieldwork. This helps to maximise interaction between the participants and the facilitator with

insights stemming from their 'shared culture'. More commonly however the groups are a 'formal natural group' having been invited to take part due to a common area of experience. These groups may be homogenous or heterogeneous in composition. Homogenous groups share a common experience and have similar social backgrounds whereas heterogeneous groups would have varied backgrounds in terms of literacy skills, language, culture, gender, socioeconomic background and relationships and therefore may not share a common experience (Bowling 1999). However, it can also be advantageous to bring together a diverse group to maximize exploration of different perspectives within a group setting (Kitzinger 1995). The ideal group size is between four and eight people. Sessions usually last one to two hours, with the facilitator encouraging people to talk to each other, with the researcher attempting to allow for a type of "structured eavesdropping' (Kitzinger 1995).

They are therefore particularly useful for exploring concepts of illness causation, prevention, health knowledge and issues that relate to:

- assessing healthcare messages
- assessing public understanding of illness, health beliefs and health behaviour
- assessing peoples experience of diseases and health services

Focus groups, as a data collection technique, are particularly sensitive to cultural variables by enabling analysis of the shared identity and common knowledge operating within the group along with humour, consensus, and dissent used in their narratives (Kitzinger 1995). Focus group methods are also popular with those conducting 'action research' which attempts to empower research participants who can become an active part of the process of analysis (Green and Thorogood). They have been found to work particularly well for groups discussing health priorities (Bowling 1999). Most studies involve just a few groups, and some combine this method with other data collection techniques (Kitzinger 1995) with the same issues being analysed through the use of different types of data e.g. using quantitative results or from other qualitative methods. This process of 'triangulation' i.e. combining data derived form different methodologies can improve rigor and validity of the findings (Masood *et al* 2010). As described by Kitzinger (1995) and Masood *et al* 2010), the main advantages and disadvantages of focus groups are described below.

6.2.3.1: Advantages of focus groups

- Does not discriminate against people who cannot read or write
- Can encourage participation from those who are reluctant to be interviewed on their own (such as those intimidated by the formality and isolation of a one to one interview)
- Can encourage contributions from people who feel they have nothing to say or who are deemed "unresponsive patients" (but engage in the discussion generated by other group members)
- Reduces individual bias that may occur in face-to face interviews.
- Relatively inexpensive and less time consuming then individual interviews.
- Allows interaction among participants to enrich the data.
- Enable social construction of meaning and opinions
- Can trigger ideas as participants 'feed-off' each others comments.
- Elicits information that might not have been uncovered in individual interviews.

6.2.3.2: Disadvantages of focus groups

- Can be dominated by a particular individual in the group.
- Not an appropriate forum for sensitive or confidential information to be revealed.
- In heterogeneous groups there may be difficulty in generating discussion.

6.3: Qualitative research in dentistry

As in the case of medicine, historically, dental research has in the main used quantitative methods. Recently this has been driven by the movement toward evidence-based dentistry and adherence to stricter publication requirements (Stewart *et al* 2008). However, some studies that have used a sociological perspective have brought new insight to several important dental health issues. "Ethnographic research' through in-depth interviews was used to explore health beliefs of mothers of young children (Nettleton 1986). Nettleton states "ethnography concerns the importance of people's perspectives, perceptions and actions, and the meaning they attribute to

these" and therefore there may be a rationale reason within their one situations why people do not comply with dentally prescribed behaviours.

Finch *et al* (1988) used focus groups to understand the views of irregular dental attenders about their experiences of using dental care and were able to document previously unheard patient perspectives on barrier to dental care. More recently, Gibson *et al* used interviews and observation to describe the social and psychological processes involved in regular dental attendance (Gibson *et al* 2000). Horowitz used focus groups to gain a deeper understanding of people's knowledge, view and beliefs on oral cancer and was able to show that people were generally not well informed about oral cancer and were often unaware as to whether they had been screened for the disease (Horowtiz 2002).

As previously stated, qualitative research has been used as an appropriate methodology to gain understanding of cultures where little is known about norms in relation to health and illness behaviour. It uses an 'emic' approach i.e. trying to understand the experiences of the world from the point of view of the subjects being observed (Green and Thorogood 2009). Scambler *et al* (2010) used focus groups and face-to face interviews to explore the oral health knowledge and access to dental care in culturally distinct Jewish community in London. Using this qualitative approach provided insight into the oral health views and practices of a culturally isolated community.

Despite increasing interest in qualitative approaches, there has been debate as to the value of these methodologies in oral health research, mostly around the issue of validity of the findings and their usefulness in providing evidence to inform health policy (Gibson 2002, Siriphant 2001, Blinkhorn 2000). However, a systematic appraisal of the quality of qualitative research in dentistry by Masood *et al* (2011) reported that qualitative research was still underutilised in oral health research. In their review of 43 papers, the authors found that methodological rigour could be improved by the use of quality guidelines (Masood *et al* 2011).

6.3.1: Qualitative research on preschool children's oral health

Until relatively recently there have been few studies using qualitative methods to investigate issues related to oral health in infants and young children. In-depth interviews were used by Lahti *et al* 1999 to investigate perceived barriers to dental care by Finnish preschool parents (Lahti, *et al* 1999). This study was able to show that

significant barriers were the lack of oral health information, difficulties in making oral care part of the daily routine and finding time to make dental appointments. These issues were coupled to negative feelings and fear of dental treatment. The authors believed that these barriers could be lowered by making dental care more accommodating by promoting positive images of dental care and having better coordination between health care services.

In a focus group study with primary healthcare professionals involved with the dental care of preschool children, the families were of the opinion that EEC could cause significant pain and long term problems for children such as low self esteem and the need complex orthodontic care (Gussy *et al* 2006). These health care providers also felt that many low income families could not access dental care due to cost, which was of concern because irregular dental attendance along with feeding and weaning practices were felt to be the main causes of ECC. Interestingly, these dental professionals thought that anticipatory guidance for parents and caregivers of young children should come from other health professionals and not just those in dental health care (Gussy *et al* 2006).

Lack of awareness of the importance of the primary teeth was a common finding in a focus group study with parents and caregivers in a multiethnic community in the US (Hliton *et al* 2007). Many of the parents in an early head start program (EHS) in the US saw them as temporary teeth whose condition had little bearing on the future dentition (Mofidi *et al* 2009). However, Daly *et al* (2010) found the parents in their study (white mothers attending a Sure-Start program in the UK), viewed the primary dentition as important and were keen to establish good oral health habits. These reports suggest that social and cultural factors play a part in parental attitudes, as dental attendance for preventive dental care was not seen as necessary, rather only if problems arose. These attitudes appeared to stem from strong community beliefs together with past negative dental experiences (Hilton *et al* 2007). Parents with young children in Head-Start programmes in the US were aware of the problems that could arise from poor oral health in their children but felt that their general life demands made oral care a low priority (Mofidi *et al* 2009).

Even where general knowledge and awareness was found to be good, a focus group study with pregnant mothers found that several had misconceptions about oral health such as the role of fluoride and integrity of the teeth during pregnancy (Buerlein, *et al* 2011). Again, these women were concerned about taking their young children for

dental treatment due to their own negative experiences. Hilton *et al* (2007) found the issue of dental anxiety and fear of dental treatment were often spontaneously mentioned in these discussions even when not on the topic list and people seemed to have difficulty separating their past experiences from the child's potentially good one. Another common issue arising in these studies was the lack of availability and access to information on dental health for young children and specific advice on how to effectively translate this information into daily routines (Daly *et al* 2010).

6.4: Oral health of preschool children in Trinidad

In a cross-sectional survey of preschool children in central Trinidad, over a quarter of the sample were found to have ECC (chapter 3). Also, the available information about oral health of children in this age group, suggests that ECC may be a problem in the region (Adewakun and Beltran 2003, Vignarajah and Williams 1992). The persistence of untreated caries in the primary dentition of school-aged children can be considered a public health problem, as a national survey in Trinidad reported almost two thirds of 6-8 year-olds had caries experience (Naidu *et al* 2006) and acute problems arising from decayed primary teeth were the most frequent cause of emergency dental visits in a dental hospital clinic (Naidu *et al* 2005). Risk models have indicated that decayed primary teeth presenting in the primary school age indicate these children were at high risk for caries during their pre-school years (Holbrook *et al* 1993).

6.4.1: Role of parents and caregivers

In their conceptual model Fisher-Owens *et al* (2007), recognized multilevel influences on children's oral health at the individual, family and community levels. These family level influences are mediated mainly through parents and caregivers with whom preschool children spends most of their time. During this period of primary socialization, routine dietary and health behaviors being established are directly and indirectly influenced by the oral health knowledge, attitudes, beliefs and practices of their parents and caregivers (Blinkhorn 1991). The influence of community level cultural factors and health-beliefs was also highlighted in the model proposed by Adair *et al* (2004). Oral health knowledge and self-efficacy among mothers of preschool children are also important influences on oral health habits and routines in the home (Finlayson *et al* 2007). Parents and caregivers of preschool children

attending a dental hospital clinic in Trinidad had inaccurate factual knowledge and low awareness of preventive care (Naidu and Davis 2008) indicating the need for a more in-depth understanding of their health beliefs and practices with respect to their children's oral health care.

6.5: Aim

This aim of this study was to gain further understanding of the determinants of preschool children's oral health among a Trinidadian community, in the West Indies. In particular, to explore and understand parents and caregivers experience of oral health and oral health care and within their own social context, how this may have shaped their oral health attitudes and behaviours towards their young children.

6.5.1: Objectives:

- To explore the oral health beliefs of parents and caregivers of preschool children.
- To describe caregivers experiences of oral health /healthcare and accessing dental care for themselves and their preschool children.
- To explore attitudes, concerns and behaviours toward oral care for their preschool children.
- To explore barriers to oral care and opportunities for oral health promotion to prevent ECC.

6.6: Method

Focus groups were chosen as the qualitative research methodology for this investigation. This method was selected as it was considered to be the appropriate research design to provide in-depth understanding of the issues under investigation and be an efficient means to attain such data with respect to available time and resources.

6.6.1: Sampling and recruitment

A purposive sampling method was used to recruit subjects to the study. The aim of using this method was to obtain a sample representative of the specific group being studied, these being parents and caregivers of children attending preschools in the

Caroni Education District. Caroni is an ethnically mixed, urban-rural community in central Trinidad with a broad social spectrum.

Letters were sent to three preschools from a list used for a previous epidemiological study in the area, explaining the nature and purpose of the study. These letters were addressed to the head-teachers inviting them to have their school take part. Upon agreement they were given letters to send to parents individually, inviting them to be a member of a focus group and what this would entail. When enough parents had responded, the final arrangements were made to run the group session. In each school one teacher assisted in the organising of the focus group meeting with respect to co-ordinating the time and venue and requirements of the study investigators and liaising with the parents.

6.6.2: Approval and consent

Individual written consent was obtained from parents and caregivers in the study.

The study had received ethical approval from The University of the West Indies, Faculty Research Ethics Committee (**Appendix 3.1**).

6.6.3: Conduct of the focus groups.

The focus groups were run by a facilitator (RN) trained in the use of focus group methodology (26 hours, didactic and practical exercises **Appendix 6.1**). The specific areas of interest for the discussion were introduced using a semi-structured topic guide (Table 6.1). This was a short set of preselected topics that comprised open-ended questions based on previous work with similar groups in other countries (Hilton *et al* 2007, Mofidi *et al* 2009, Obeng 2008 and Scambler 2010). Questions were open-ended and probing using terms such as 'who', 'what', 'when' and 'how' and 'why'. This guide was flexible and during the course of the discussions, not always asked in the same order and modified when needed, to explore emerging themes in greater depth. The focus groups lasted 45 to 50 minutes. The sessions took place in a quiet area of the preschools after the school day. During and after the session, light refreshments were made available to the participants to encourage a relaxed atmosphere and put participants at ease. Small gift bags (oral hygiene product samples, pamphlets and tokens), were also handed to each participants after the sessions as a courtesy for giving their time.

Table 6.1: *Focus group topic guide*

Topic guide
• What does it mean to you to have a healthy mouth? • What are the kind of problems people might get with their mouths? • What are some of your experiences of going to the dentist? • Would you say that these experiences of have affected you taking your child for dental care? • What would be the reasons for taking or not taking your child for dental care? • Which health professional would you feel most comfortable with for getting a dental check-up for your child? • How do you feel about your child's first set of teeth? • How important do you think they are and why? • When do you feel is the best time to take your child to the dentist for the first time? • Are there things you know about that can prevent your child getting cavities? • How easy or difficult to do you find it to have your child brush their teeth? • Are there foods or drinks that you know may be good or bad for your child's teeth? • Who makes the decisions about your child's dental care? • Do other people (friends or family) influence these decisions? • What things would make going for dental care for your child easier or more comfortable? • What would make it easier for you to look after your child's teeth?

During the group session, participants were encouraged to respond to each other's comments and engage in an open discussion rather than just talk to the facilitator. As well as shared perspective and consensus, unusual experiences and differing viewpoints on topics were welcomed, to gain a full range of opinions and feelings and insights. The discussions were recorded using a digital audio recording device and an audio cassette recorder. 'Back-up' field notes (including non-verbal communication), were also made by an assistant researcher who was present for all the discussions but

took no part in them. Data were collected from 3 focus groups, in three different preschools between November 2010 and January 2011. The following description of the research process and reporting of results follows the guideline recommended by Masood *et al (*2011)

6.6.4: Data analysis

A thematic content analysis was used to analyse the data. This was an iterative process that involved several readings of the verbatim transcripts, field notes and listening to the audio recordings. Initial analysis was based around the discussion topics used in the question guide (these having been developed from earlier studies on similar population groups).

Key early themes (proto-themes) that emerged from the transcripts were labelled and coded. These proto-themes were flexible categories and, following further study of the transcripts, were expanded and modified to encompass the issues that arose from within the data upon comparison segments of text. The codes were marked on the margins of the transcripts against corresponding areas of text, to enable retrieval and further sorting of the text. The codes were agreed with an assistant researcher (RB) who took field notes and also read the transcripts) and the themes reviewed by an academic anthropologist (MF) at the University of the West Indies.

Using 'MS Word' software, further refinement of the themes was achieved by placing segments of similarly coded text next to each other to explore deeper meaning and context. Final themes were developed and reported with a description and related quotations to underline their meaning.

6.6.5: Respondent validity

The subjects were invited to comment on the focus group discussion (off-record) to consider whether they felt that it covered important/relevant issues and if it had fairly represented their feelings and thoughts. The participants of all three groups agreed that this had been the case.

6.6.6: Reflexivity

The facilitator of the three focus groups was an academic dentist (RN) working in a teaching hospital and this was known to the participants. This did not appear to

compromise the discussion and in some respects enabled participants to express concerns in detail, with respect to issues of access and barriers to care.

6.7 Results

The following sections report the results from the thematic analyses of the focus group transcripts and participant information.

6.7.1 Socio-demographic information

A total of 18 parents and caregivers participated across the three focus groups (FG1, FG2 and FG3) with 5, 9 and 14 in each group respectively. These participants were mainly female (89%) with a mean age of 28 (ranging from 23 to 49 years-old). Just over two thirds (67%) were of Indian ethnicity, with the others being of African (28%) or Mixed ethnicity (5%). The majority were in manual/semi-skilled occupations or housewives, 33% and 39% respectively. Twenty eight per cent were in non-manual or professional occupations. The socio-demographics of the 3 focus groups are shown in Table 6.2.

Table 6.2: Sociodemographics of participants (key: I – Indian, A – African, M – Mixed)

Preschool	Age	Ethnicity	Gender	Occupation
(*Focus Group* 1)	36	I	F	Teacher
ASJA preschool	35	I	F	Housewife
4 participants	32	I	F	Housewife
	not given	I	F	Housewife
(*Focus Group 2*)	47	A	M	Vendor
Flaming word Preschool	33	A	M	Truck driver
9 participants	34	I	M	Truck driver
	29	I	F	Housewife
	23	A	F	Cosmetologist
	27	I	F	Housewife
	32	A	F	Clerical officer
	46	I	F	Housewife
	28	I	F	Housewife
(*Focus Group 2*)	49	M	F	Hairdresser
Kids World preschool	30	I	F	Store manager
5 participants	30	I	F	Secretary
	35	I	F	Teacher
	36	A	F	Manager

6.7.2: Data saturation

The research timeframe and access to preschools and participants limited this study to three focus groups. Some debate exists around minimum sample sizes required in qualitative studies, with respect to achieving data saturation. A minimum of 15 has been cited Mason (2010) and Guest *et al* (2006) states that where there is a high degree of homogeneity in the study population, data saturation can occur with very small samples (less than 10), with data quality being measured by value rather than sample size. In the present study, the main themes described arose in all three focus groups suggesting that these were relevant and important issues for these participants.

Since the facilitator was a dentist, this might have inhibited some disclosure on personal experiences of dental care or views of dentistry, yet the perception was that the discussions appeared honest and uninhibited.

6.7.3: Perceptions of oral health

Participants had reasonably clear thoughts on what constituted good oral health, with some expressing the view that this would include healthy gums and good breath and no cavities. Along with absence of disease, some felt that good oral health included having a nice appearance that aided self-confidence:

> *Plenty of clean looking teeth* (FG3)
>
> *Gums that are not bleeding.* (FG3)
>
> *Well umm... people with healthy teeth have no cavities and umm good breath* (FG2)
>
> *Helps your confidence in umm interacting with people.* (FG2)

Pain and reduced function were mentioned by participants when describing an unhealthy mouth and not paying attention to oral hygiene could cause this. Also some felt that not taking good care of the teeth when young and heeding preventive advice could result in poor oral health later in life:

> *You wouldn't be able to eat properly, with pain from sensitive teeth.* (FG3)
>
> *Being able to chew...*
> *Yes, you wouldn't be able to chew or bite* (FG3)

6.7.4: Dental care experiences

When discussing reasons for attending dental care, a recurring issue raised was that dental treatment was often unpleasant and that going to the dentist was something largely to be avoided, unless there was current pain or problems. However, some believed that this irregular attendance would result in more problems and were concerned by this happening to their child. Reasons for avoiding dental care were largely due to bad experiences, often during childhood. Fear was often related to the procedures, in particular dental extractions:

Toothache for sure...if you have a little cavity or so and it doesn't trouble you then you find you wouldn't really take care of it until you start to get pain, then you know okay, yeah you ready to reach to a dentist. (FG1)

it's only when problems come then you well in my case that's only when you know, have a problem then you would find yourself going to the dentist and you of course don't want that for your children you want them to do the right thing carry them to the dentist. (FG2)

The environment of the dental clinic, that is, the smells, sights and sounds of the equipment and procedures were common issues of concern together with the chair-side manner of the dentist. Fear of reprimand for not doing a better job of looking after their mouth was also mentioned. Some participants described putting off taking their children for dental care due to their own negative experiences.

...I took too long to take them....and it's because of my own experience, the trauma that you've been through, you know as children going to a dentist, I mean, so I transferred that. (FG2)

big as I am, I would really have to make up my mind to go to that dentist. If I don't have pain, I not going for anything. Just to hear the machines, you know that ringing, buzzing thing in your ear. (FG1)

they will always find something wrong to tell you. You need a filling, you not flossing, you always, so you know, it's not like you have any confidence going.. you going because the dentist have something to tell you not doing good enough.(FG2)

Differences between private and public dental care were mentioned by several participants, who related this to their personal experiences and reasons for making choices as to which service to attend. In particular, some felt that private dental care would be safer and more comfortable for their child so having to pay for that was a worthwhile expense.

I prefer to pay your money and leaving it as that. You pay your money, you get your comfort, I believe in that. (FG1)

I am sure they have good workers (in government clinics). I mean they are all qualified people but umm the little extra to put out you know yeah, the little extra care, the little extra smile. (FG2)

You would pay so much just for somebody to be nice to you. (FG3)

to extract a tooth for your little one and there's a needle going into the gum to numb the gum, you want that somebody who will take that extra care with your little one, that's your little one you know. (FG2)

the way they going to treat your children, the way they going to treat you when you reach you know, I think, you know, hear what, I may be safer by a private dentist. (FG2)

Some participants felt that private dental practitioners were aware of the lack of services available in the public sector and tended to exploit the situation and also felt they had little information of the government services available:

I guess the dentist knows that there is no other reputable treatment available for children or otherwise, so they make their money. (FG1)

could sometimes be unfair too.. the professionals know that the health service is bad whether it be dentistry, maternity whatever so you know what.. they know you're gonna pay for it. So they call their price and they will get their patient. (FG2)

and I also didn't know about the Government
I didn't know, cause if I knew that, I think I would have taken my children there. (FG1)

6.7.5: Dental care for young children

Participants were clear in knowing what they would like the dental visit for their child to be like. The personality of the dental care provider was the focus, with several stating that they would want someone who could put the child and ease and communicate well with them. The environment of the clinic was important to most participants and making it less intimidating and 'child-friendly' by reducing the clinical sounds and smells and having tokens and rewards for the child was seen as very helpful.

Somebody pleasant who would make them feel comfortable and not amm not put them down too much even though they have cavities, you know explain to them how they get the cavities but how they could also help prevent it you know and take care of their teeth, some encouragement you know. (FG1)

A room that is ....not scary
.....not too sterile, a room that is fun like .... (FG2)

It could be sterile clean but not smell you know the scary smell that you get in the hospital...there should be some brightly coloured pictures (FG2)

they should never ever hear that... '.zzzzzzzzz'
...that sound, that sound alone is scary (FG2)

Friendly, yes, friendly person...
not just come out and say 'Your turn' you know.
Somebody to talk to the child .. talk to the child and be friendly (FG3)

6.7.6: The first dental visit

There was not much awareness of when to take a child for the first dental visit (other than if there were pain or problems in need of attention). Getting them checked around the time the child would have a full set of primary teeth or preschool age seemed to be the general view:

I'm going to take her for the first dental check-up, she will be four. I don't know if that is right but you know. (FG2)

My son was probably about five or six, but they didn't really do anything major, they just looked at his mouth. (FG3)

My dentist is so warm and so nice that I even told her okay my baby girl is going to come here, right because next month she is going to be four you know you tell me when, what age is good, and I want her to come (FG1)

6.7.7: Importance of "baby" teeth

There were mixed opinions about the importance of the primary teeth. Several participants felt that as the teeth were temporary they were not too concerned about them getting cavities and would focus more on the permanent teeth once they came in. However others believed that problems with the primary teeth could affect the permanent successors and were worried about decay or infections causing pain and problems.

Although aware of their temporary nature, some participants felt that the primary teeth could help the child to enjoy their food allowing variety in their diet and also provide an opportunity to learn good oral hygiene habits.

I not too worried about because I know the teeth will fall out as is baby teeth and they would get the adult teeth and you know. (FG1)

I don't think they so important, because I find they just drop off then you get adult teeth you know. (FG2)

I feel I have more concern about the permanent teeth

..well I mean after that baby teeth come out it's the permanent teeth coming in and when that come out no other teeth coming in so you wanna protect them. (FG3)

Well I think if this teeth, the first set of teeth bad, it will affect the next one not so, the new ones? That is what I always thought it was like that. (FG3)

is like their trial teeth you teach them to brush and take care of it you know and show them if they get that little bit of pain in that set, you could imagine in the permanent set how much more the pain could be. (FG3)

6.7.8: Dental advice from other health professionals

The idea of having someone other than a dentist or dental nurse look at the child's mouth and giving advice was not popular, although some had experience of receiving dental advice from medical doctors:

Dentist or dental nurse, we know that they are the specialist when it comes to teeth (FG1)

A family doctor would look at their mouth you know but wouldn't have the insight to know if they probably have cavities that need immediate attention or you know things like that (FG1)

I like professionals in the field, I go to a dentist. I'm not going to go to an eye doctor, or an eye specialist, I'm not going to go to a general practitioner (FG3)

6.7.9 Diet and food choices

With respect to healthy diets for their children, participants were aware of the risk posed by sweets and chocolates but also conscious of providing a generally nutritious diet. In terms of preventing cavities, more emphasis was given to brushing than the diet.

*you have to kind of teach them from early and groom them into what you want them to get into, good eating habits, good hygiene, you know you start them from now (*FG3)

they have to eat everything to get all the proteins and calcium and all these things, its just to brush. (FG1)

I think brushing is more important (FG1)

6.7.11 Use of the bottle and breastfeeding

Participants felt bottle feeding before bed-time had a role to play in providing comfort for the child and aided in getting them to fall asleep. During the day bottle feeding would allow housework or other activities to get done by the caregiver. There was a generally good level of awareness that falling asleep with the bottle and not brushing the teeth at night might result in cavities, with advice on this received from dental professionals. Some participants felt the child took more food via the bottle rather than the cup and being concerned about overall nutrition, favoured continuing that approach. Breast feeding was seen as beneficial by most of the participants and several had continued into preschool age. The issue of breast milk causing tooth decay was known but caused considerable confusion as several participants had received conflicting messages from dental and medical professionals:

> *One thing about the bottle feeding, it is a source of comfort for the child that they find, you know they even fall asleep with the bottle in their mouth...* (FG1)

> *I think it's a concern because parents sometimes doing their chores and sometimes just for them to do their chores at home and to make baby comfortable, same time they give them a bottle and sometimes they fall asleep with the bottle in their mouth.* (FG1)

> *Yes, well I give him in a cup nah because he drinks from the cup.. just he drinks more if he drinks from the bottle* (FG3)

> *Yes, a dentist told me that, so I was shocked* (breast feeding can cause cavities) *and the doctor saying breast is the best thing* (FG2)

6.7.11: Tooth brushing

The importance of tooth brushing for their children was appreciated by many of the participants, particularly brushing last thing before bedtime. Concerns about leaving sticky sweet foods or milk on the teeth during the night, was understood to be a risk for cavities. Difficulty in achieving night-time brushing was often due to the child falling asleep soon after the last meal.

Supervision of brushing was seen as important due to an understanding that the child lacked manual dexterity and brushing on their own would be somewhat ineffective. However, some participants mentioned that they wanted to encourage the child and build their confidence and not make them feel that they couldn't do it for themselves, so they would let them brush their own teeth.

Especially your child brushing before you go to sleep is important because you have that chocolate and things stuck in your teeth overnight given that time the cavities form and whatever (FG2)

brushing is a big thing too. The night brushing .... they kind of now starting it, they do it now and then I have to be there.
Umm...but I am trying to get them to do it now on a daily basis the night brushing (FG1)

That was the downfall not brushing in the night
...you go to the dentist and he said make sure and get him to brush his teeth, when he drink his tea let him stay up and go to brush his teeth before he go to bed (FG3)

She wouldn't want me to help her because she would think that she's not brushing clean enough. (FG2)

6.7.12: Toothpaste and concerns with fluoride

Considerable confusion was evident among participants around the issues of fluoride and its role in dental health. Being unable to get clear information and advice on its use in young children was apparent. Some were not using fluoride toothpaste due to concerns about young children swallowing excess paste and its toxic effect on their bones. Articles seen on the internet, news and published media about harmful effects were a general concern. Some participants were using non-fluoride / herbal toothpaste for themselves and the availability of non- or low-fluoride children's toothpaste, from established brands, seem to confirm fears of using fluoride toothpaste for their children.

You know you see a lot of advertisements that fluoride toothpastes are not good for small children because they swallow it, they say it's not good for their bone development. I want to know if that is true because I still use a non-fluoride toothpaste (FG1)

....I have switched... (XXXX) bring out their new toothpaste, a non-fluoride baby toothpaste. This is from ages zero to two, they normally recommend that for children who can't spit yet, well at least I think so, but I still give him the non-fluoride (FG1)

Yes, on the internet you see it's bad.
I don't want to use it, I use a herbal one (FG2)

It was on the news, on the news and alternative books also talk about fluoride, how bad fluoride is, you know alternative medicine and all that....(FG2)

6.7.13: Influence of family and friends

A common issue among the participants was the lack of control, bordering on frustration over their child's diet, due to other family influences and environments outside of the home where snacking on sweets / sodas was encouraged. On the whole, the giving of sweets by grandparents and family was acknowledged as an expression of caring, however, participants felt pressured by their child demanding sweet snacks from them because of having seen their friends at school or in the neighbourhood getting them. Keeping sweets snacks in the home was also problematic as children would not be able to self-limit:

> *Grandparents say- when you were small you use to eat lollipop too and why can't they have it now* (FG1)

> *the Grandparents don't have a problem giving her soft-drink but I have a problem giving soft-drink* (FG2)

> *when the children live like with grandparents they would have a greater influence than the parents who live by themselves you know, when you brush teeth, is either morning or night so the Grandparents if they don't really live with you they don't really have that impact* (FG2)

> *It's a bit difficult, like if you go anywhere and they see you know like if you go to somebody house and they have like the chubby and snacks and stuff like that, Mummy I want, and when you tell them no you can't get that, you know they still want it* (FG3)

6.7.14 Sources of dental health information

Information on dental care for young children was sought from a variety of sources. Those who had contact with dental professionals were able to obtain it more easily whereas others relied on friends and family. Dental care information during the perinatal period and infancy was particularly difficult to access even in the nursing home environment. Participants appeared to trust government sources but felt that much more could be done to help educate them via written material or the broadcast media.

> *So you're kind of working on your own wondering like okay when is it good to start brushing .....what type of toothbrush to use, what kind of toothpaste* (FG2)

> *Yeah you're kind of on your own and your probably asking you know friends who have kids or whatever.* (FG2)

> *We did not always have the internet so easily accessible for everybody so you depend on these reading materials.* (FG1)

Yeah hopefully it would be from a reliable source whether it be government institution you know the Ministry of Health you would feel comfortable. (FG2)

Even brochures, when you go to the clinic (health centre), you can always find ones on diabetes or hypertension things you can sense before. Yes they have them, so brochures on dental health would be nice. (FG2)

6.7.15: Main caregiver responsibilities

Making decisions about dental care for the child was largely seen as the mother's responsibility with male partners not sharing this role equally. Mothers felt under pressure to control food choices and implement preventive approaches to dental care in addition to the general demands of childrearing and home care.

It's mummy who have the problem……Mummy who have to wake up whole night (FG1)

Yeah I have the same thing. I make most of the decisions concerning my sons, their daddy he's like a chocolate and a ice-cream freak (FG3)

No we are the ones who have to call and say ok you have to go for a check-up... (FG2)

I think my son's father is concerned about the children's teeth, but he does be like 'You brush this child teeth yet? I'm like 'No, why you don't go and brush it' (FG3)

amm. think not being able to control my children to tell them not to eat the sweets, and you feel terrible, imagine that you can't control your child from eating the sweets. We are the adult, they are the child, it means, you are not in control of. That's, that's, that's what is hard. So you know, you kind of go on a guilt trip, you know, okay. It's in the choices that we make you know. (FG2)

6.7.16: Suggestions to improve dental care for young children

For them to maintain their children's oral health, the participants felt that better access to dental services, largely through reducing the cost factor would help them. Mention was made of having more readily available information and education, both through written material and face-to-face scenarios with dental professionals, such as workshops and programmes in schools via the parent/teacher networks. It was felt that the Ministry of Health could do more to support these kinds of activities.

Check-ups so that your child is monitored throughout and then also a less prohibited cost when doing so because we want to do it but because of the cost we can't do it (FG1)

..a dentist or you know.. somebody who comes with some information to the schools and let the teachers know (FG3)

Having a Parent Teacher Meeting, let somebody come and advise them listen you know you have to help at the school as well as the parents have to help at home. (FG3)

workshops.....so even though you have a pamphlet to read and something have the professional to ask and see if I really understand, if I am doing the right thing you know whatever questions you want to ask you could ask. (FG3)

you know if we have to start taking care of children's teeth as early as this age then we need to get help and information from this age or at least earlier to be prepared. (FG3)

Well I would like if amm the Ministry of Health could get some more workshops in the schools for parents, let different dentists come in....you know meet parents give us some sort of information where we could help our children from early to take care of their teeth to take better care (FG1)

6.8: Discussion

The majority of caregivers in this study were female, in manual work or housewives, in their mid to late thirties and predominantly of Indian ethnicity. The ethnic composition reflects that of the county of Caroni, a former agricultural area and home to the majority of indentured labourers brought from India to Trinidad, during British colonial rule, to work on the sugar estates. The older than expected age of the group may reflect the fact that several of the participants were not first time parents and cared for older children along with those of preschool age. Although not formally recorded, several participants appeared to care for more than one infant or preschool child.

As reported in the results, the three focus groups yielded considerable comment and discussion. The following list provides an overview of the main findings:

- Participants generally valued good oral health.
- Negative dental experiences were common and affected dental attendance.
- Difficulty in accessing dental care for young children was common due to issues of affordability and availability.
- Ambivalence toward the role of primary teeth.
- Confusion over the role of fluoride and timing of child's first dental visit.
- Bottle-feeding was seen to play a role in caring for the preschool child.

- Difficulty in managing external influences when trying to control child's exposure to sweet snacks and drinks.
- Oral hygiene and diet were felt to be important in preventing decay.
- Problems with accessing oral healthcare information and a need for more practical advice.

6.8.1: Views on oral health

Participants' views of oral health in the main referred to a mouth free from pain and cavities, clean teeth, and healthy gums that did not bleed. Along with these issues were aspects of function and aesthetics. In particular, being able to chew and eat comfortably and having a nice smile that would allow one to socialise and make a good impression, were highlighted. Good oral health therefore, appeared to be valued and contributed to quality of life, which is similar to findings from other adult populations where most people felt oral health affected their social and psychological well-being (McGrath and Bedi 2003, Nuttall *et al* 2001).

Views of oral health are known to be influenced by social and cultural norms (Kent and Croucher 1998). Limited data on this issue in the Caribbean suggests the majority of adults perceive their oral health as very important to them (Naidu *et al* 2003), which is supported by the findings of this present study. Negative views of oral health or oral health fatalism (i.e. belief that poor oral health was inevitable and cannot be avoided), did not appear to be a major factor, as participants in the present study felt that taking preventive action such as having dental check-ups and following advice on care of the mouth would help avoid future problems.

6.8.2: Experiences of dental care

Several participants recalled unpleasant experiences during dental treatment that they had received in the past, which is consistent with other, similar qualitative studies (Hilton *et al* 2007, Daly *et al* 2010, Buerlein *et al* 2011) some also admitted transferring their dental anxiety to their child and this is likely to have affected their attitude toward dental care for children. In some cases, these were events that occurred during their own childhood. Mothers' fear of dental treatment is known to be a factor influencing routine dental care for their children (Milgrom *et al* 1998).

Mothers of preschool children in the UK (Daly *et al* 2010), reported that dental anxiety, along with cost of treatment were their main barriers to seeking dental care. Some participants in this Trinidadian study also felt an element of guilt in not being more proactive in seeking dental care for their child due to these negative perceptions of dental care again similar to views expressed by mothers in the UK (Nettleton 1986). Interestingly, even where a child has had a recent good dental care experience, the parent may still be unable to separate out their past bad experiences and their child's potentially positive one (Hilton *et al* 2007, Lahti *et al* 1999). Based on personal experiences of dental care, most expectant mothers in the US would not seek dental even if they had a problem and were anxious about what would happen to their child if they took them to a dentist (Burlein *et al* 2011).

Fear of dental local anaesthetic (LA) injections and having teeth extracted were commonly cited by participants in the present study, which is similar to findings from a previous study of Trinidadian adults attending a dental hospital clinic, where over two thirds of the sample had avoided dental treatment in the past because they were too anxious and over half were still had anxiety about LA injections or extractions (Naidu and Lalwah 2010). This is therefore an important public health issue, as dental anxiety can result in worse oral health, compared to dental patients who are not anxious. For instance, people highly anxious of dental care have been found to have more missing teeth, fewer filled teeth and more likely to be in need of urgent care (Locker and Lidell 1992, Newton and Edwards 2005).

6.8.3: Barriers to dental care

The general opinion in the present study was that better quality care was available for those who could afford it and some indicated that they would seek private dental care for their children in order to make the visit as comfortable as possible even if it involved considerable financial sacrifice. There was a certain level of acceptance that this was just part of the norm in health-care in Trinidad and a reflection of an established 'two-tier' health system. There was also a general feeling that government dental services e.g. health centres and the Dental Hospital, were not well advertised and information on location and services offered were hard to come by, which increased the barriers to dental care for the children. Some participants also believed that dentists were aware of this situation but unwilling to challenge it, as it resulted in more people having to seek private care suggesting a degree of mistrust of the system.

Invasive dental treatment of preschool age children can sometimes be challenging for both patient (their caregiver) and the clinician. Pine *et al* (2004) reported that young children not being able to cope with dental treatment was one of the main barriers to care contributing to health inequalities in childhood dental caries.

Most comments about making the child's dental visit pleasant and productive related to the clinic having a non-threatening atmosphere. This included not having a hospital smell and image but rather a colourful and happy environment, ideally with the child receiving toys and tokens (stickers / toothbrush etc.) after a visit. The dentist having a friendly and warm personality and able to put the child at ease, was also highly valued. These findings echo those of Finch *et al* (1998) where similar aspects of the dental visit and the personality of the dentist were some of the main barriers to care for adults in the UK. In an ethnographic study of parents of preschool children in rural California there was general dissatisfaction with what they perceived as an insensitive attitude of dentists in the management of children who were anxious and/or uncooperative during treatment (Barker and Horton 2008).

6.8.4: Importance of primary teeth

The importance of the primary teeth and timing of the child's first dental check-up suggested there was considerable confusion among the participants on this issue. Consistent with other similar studies is a common view that the 'baby teeth' were temporary and hence not vital to maintain (Hilton *et al* 2007, Mofidi *et al* 2009, Obeng 2008). Participants were somewhat unsure of the role the primary teeth play in oral health and the development of the permanent dentition. Similar to caregivers in the US (Mofidi *et al* 2009), there was a variety of views as to when to take a child for their first dental check-up. Most felt that this would be around the time the child had all the primary teeth, about age three to four years. This is of concern as both the British Society for Paediatric Dentistry (BSPD) and the American Academy of Paediatric Dentistry (AAPD 2011, BSPD 2003) state that dental attendance should ideally occur by the time the first teeth erupt or by one year of age. Early dental attendance can also enable the delivery of anticipatory guidance from a dental health professional about the child's growth and development, preventive dental care and the establishment of a 'dental home' (Nowak and Casamassimo 2009). Early dental attendance has also been shown to increase the likelihood of being caries-free later in childhood (Al-Ghanim *et al* 1998).

6.8.5: Feeding practices and dietary choices

Participants were aware of the role of sugary foods and drinks in the child's diet and the importance of trying to limit their intake to prevent dental caries. Participants seemed aware of the issue of giving a child a healthy and balanced diet, which included fruits and vegetables. Cultural factors may play a role in the giving of sweets snacks and confectionary. This seems very much part of normal family life and social interactions in the Caribbean, there being something of a 'positive value' ascribed to sweet foods. In this respect the availability of sweet snacks and drinks provided by grandparents, other family members, neighbours and school parties was also seen as quite challenging. This was similar to mothers in the UK who felt pressured when their child wanted snacks they had seen other children have (Daly *et al* 2010). The pervasive availability of sweets and sugary snacks also presented difficulty for parents and caregivers despite their being aware of the importance of good dietary habits for their children, a finding also reported in the US (Mofidi *et al* 2009). Regularly receiving sweets snacks and confectionary from grandparents was a common finding among preschool children undergoing caries related tooth extractions in the UK (Hunter *et al* 1997).

Participants in the present study also connected bottle-feeding and breastfeeding to good nutrition, as well as being a comforting and practical part of childcare. Some therefore found weaning from the bottle quite difficult, similar to US caregivers (Mofidi *et al* 2009).

6.8.6: Oral hygiene and self-efficacy

More emphasis was placed on diet compared to oral hygiene unlike findings from the UK where tooth brushing habits were relatively easier to establish however, those parents were already part of a health promotion programme (Sure Start) (Daly *et al* 2010). Similarly diet, more than lack of brushing, was perceived to be the main cause of caries in a qualitative study of health professionals (dental and non-dental), who had early contact with mothers of preschool children in Australia (Gussey *et al* 2006). The present findings also differ somewhat from those from parents of preschool-aged children attending a dental hospital clinic in Trinidad, who had lower awareness and some confusion regarding the importance of oral hygiene and other caries preventive measures for their children (Naidu and Davis 2008).

Oral health behaviours and parental involvement in children's oral health has been linked to the concept of self-efficacy. Self-efficacy refers to a person's conviction that they can successfully execute the behaviour required to produce the desired outcomes (Bandura 1977), that is the belief in his or her ability to carry out and succeed at a specific task (Miller and Rollnick 2002). In an investigation of the relationship between ECC with familial and cultural perceptions and beliefs in a 17-country study, parental self-efficacy was the strongest predictor in the establishing of tooth-brushing habits and controlling sugar snacking (Adair *et al* 2004). Maternal oral health self-efficacy (OHSE) was also strongly related to tooth brushing frequency in a study of African-American mothers of 1-5 year-olds in low income families (Finlayson *et al* 2007). Mothers who had more knowledge about their children's oral hygiene needs felt more efficacious, indicating the importance of imparting oral health information early in the life of the child.

6.8.7: Fluoride use

There was a surprisingly high level of concern and confusion as to the value of fluoride and its safety in young children, similar to previous a study in Trinidad (Naidu and Davis 2008) and to some data from the US (Buerlein *et al* 2011). It is therefore imperative that information about fluoride needs to be imparted to parents and caregivers in a clear and accessible medium, to counter negative perceptions and fears and to support self-efficacy. Anticipatory guidance must include the message that children should have optimal exposure to fluoride to prevent caries as Adair *et al.* (Adair *et al* 2004) state "children are more likely to be caries-free if their teeth are brushed twice daily with fluoride toothpaste, with parental involvement and in an environment where sugar is controlled". Furthermore, there is no clear evidence that toothpastes containing less than the standard concentration of 1000ppm are effective in preventing caries in young children and hence low concentrations are no longer advised for preschool children and infants (Levine and Stillman-Lowe 2009). Avoiding fluorosis in the permanent dentition, due to over-ingestion of fluoride is however, an important issue. Current evidence-based guidelines recommend only a 'smear' of toothpaste on a small toothbrush for a child up to age 3 years, covering no more than three quarters of the brush head and a 'pea size' amount for children up to the age of 7 (Department of Health 2009).

6.8.8: Oral health-literacy

Most participants appeared to rely heavily on family and friends as sources of health information, including advice for children's oral health. These traditional social networks seem to have compensated for what appears to be a lack of information from more 'official' sources locally. Some of these findings also relate to the issue of 'health literacy'. The WHO describes health literacy as "the cognitive and social skills which determines motivation and ability to access and understand health information" (WHO 1998). Health literacy is critical to empowering people to promote and improve their health as it can influence access to health information, managing personal health, those cared for and utilisation of health services (Morris *et al* 2006). This also extends to oral health, with 'oral health literacy' defined as *'the degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate oral health decisions'* (Horowitz and Kleinman 2008). In the present study, the request for more written material suggests that level of health literacy among the participants was quite high, hence more information on dental services may improve uptake and preventive care. This is encouraging but may not be representative of communities where oral health literacy is lower, so other forms of imparting information on early childhood oral health would need to be considered, such as face-to-face delivery through talks and workshops etc._Lack of daily tooth brushing and night-time bottle use were associated with lower health literacy among female caregivers in the US and appears to be independent of SES factors, including education (Vann *et al* 2010).

6.8.9: Practical oral healthcare advice

Despite some ambivalence about the role of the primary teeth, most participants understood the need for maintaining good oral health for their preschool aged children, the importance of healthy nutrition and oral hygiene. However, similar to Daly *et al* 2010), they seem to want more practical help in how to translate this knowledge into effective dental health care on a day-to day basis for their children.

Participants wanted clear and explicit information on brushing, use of fluoride and when best to take a child for a dental examination. These issues are in fact at the core of dental health educational messages for preschool children and therefore need more effective dissemination and delivery in Trinidad.

Dental health education in the preschool and primary school setting could be considered. Encouragingly, primary school teachers in Trinidad have shown positive attitudes towards including dental health in the school curriculum, provided they receive support and training (Ramroop *et al* 2011). Other dental public health strategies that should be considered include anticipatory guidance and motivational interviewing These counselling-based approaches can encourage early dental attendance (e.g. age 1 dental visit), establishment of a dental home and appropriate use of fluoride, which can reduce risk of ECC (Weinstein *et al* 2006, Plutzer and Spencer 2008).

6.8.10: Improving access to dental care

Increasing the availability of dental care for children needs to be addressed as problems with access to care were common. This may be possible with increased training and deployment of Dental Nurses/ Therapists in the country. These mid-level dental providers in Trinidad have previously indicated enthusiasm for providing dental health education and out-of-clinic interaction with young children (Naidu *et al* 2002) and globally been shown to be effective in increasing access to care for children (Nash *et al* 2012). Improving early childhood oral health and prevention of ECC in Trinidad should involve discussion of research findings and potential public health strategies with key stakeholders such as parents, caregivers, teachers, health professionals and policy makers, to enable delivery of appropriateness interventions.

6.8.11: Limitations of the study

As the qualitative method used was not designed to produce data to be extrapolated to the population, a limitation might be whether these findings represent the average views of parents and caregivers in Trinidad. The participants in this study came from an ethnically diverse, mixed urban /rural community which is common to most of the island. The views shared by them are therefore likely to be relevant to parents and caregivers across Trinidad.

Although all three groups received all the questions on the topic guide, some received it in a slightly different order. Though this was done with the aim of being responsive to the participant's views and encourage the flow of the discussion, a possibility of bias may have arisen from not standardizing the sequence of questions. The order of questions may have influenced some responses, for instance asking about the

'importance of baby teeth', after asking the question on 'reasons for not taking a child for dental care' might have produced a different response if asked in the reverse order.

6.8.12: Conclusion

The participants showed generally positive attitudes towards oral health but appear to have encountered several barriers and challenges to achieving ideal preventive care for their child, with respect to maintaining a healthy diet, good oral, hygiene and dental attendance. Dental attendance for young children appeared to be influenced by participants own negative dental experiences. Oral health promotion should include effective dissemination of oral health information, more practical assistance and greater access to dental care for families with preschool children.

CHAPTER SEVEN: THE EFFECT OF MOTIVATIONAL INTERVIEWING ON ORAL HEALTHCARE KNOWLEDGE, ATTITUDES AND BEHAVIOUR OF PARENTS AND CAREGIVERS OF PRESCHOOL CHILDREN. A FEASABILITY STUDY

The findings from the quantitative and qualitative research reported in the earlier chapters indicated a need to develop appropriate oral health promotion for parents and caregivers of preschool children in Trinidad. This chapter reports on an interventional study involving a brief-counselling method to address early childhood caries (ECC) in preschool children.

7.1: Summary of risk factors for early childhood caries

Early childhood caries (ECC) is considered a serious and complex public health problem with biological, social and behavioural determinants (Tinanoff and Resine 2009, O'Mullane and Parnell 2011, Seow 2012). Risk factors include: poor infant feeding and weaning practices, night-time bottle-feeding, prolonged breast feeding, high frequency of sugared snacks, irregular tooth-brushing, lack of exposure to fluoride toothpaste, delayed first dental attendance and lack of a 'dental home' in the early childhood years (Harris *et al* 2004). A dental home has been defined as 'the ongoing relationship between the dentist and the patient where accessible coordinated oral healthcare can be delivered comprehensively while actively involving family participation' (Ramos-Gomez *et al* 2012). These risk factors are influenced by parental, attitudes and behaviours towards infant oral health and dental care in early childhood, which in turn are dependent on parental coping skills, self-efficacy and presence or absence of an environment supportive of positive oral health behaviours (Adair *et al* 2004, Fisher-Owens *et al* 2007).

Pine *et al* (2004) theorized that there is a connection between attitudes to oral health, health behaviour and the caries disease process. In this model, although attitudes can moderate and predict some specific behaviours, they do not map directly onto them. Behaviours on the other hand, can mediate the disease processes and may predict disease development. Importantly for caries which is preventable by certain behaviours, the disease process can also be directly mediated by attitudes and in a feedback loop, caries experience can in turn influence behaviour and attitudes. More recently the social and environmental influences on these behavioural risk factors

have been highlighted in explanatory models proposed by Fisher-Owens *et al* (2007) and Seow (2012) described in chapter 2.

Although it has been shown that oral health knowledge is often lower among parents of children with higher levels of ECC (Blinkhorn 1991, Hinds and Gregory 1995), the relationship between knowledge and behaviour is not clear and is most likely mediated by other social and cultural factors. Furthermore, some research has even reported paradoxical findings with respect to oral health knowledge. Reisine and Douglass (1998) reported that children of parents and caregivers that had good knowledge of the causes of ECC and the effects of a night-time bottle, had a higher prevalence of ECC than those whose caregivers who had lower knowledge scores. One explanation for this may be the 'social value' parents and caregivers ascribe to primary teeth and hence their attitudes to oral health has greater, influence on behaviour than just their knowledge. For example, in their study of Aboriginal communities in Manitoba, Schroth *et al* (2007) reported that the prevalence of ECC was significantly lower in parents who believed that primary teeth were important.

7.2: Dental health education and oral health promotion

Delivering dental health education (DHE) has traditionally been viewed in the context of improving knowledge and attitudes to elicit positive oral health behaviours. However, increasing oral health knowledge through dental health education has been shown to be largely ineffective in bringing about behaviour change (Kay and Locker 1998). Dental health education generally takes the form of expert advice delivered to a passive patient, despite some increase in dental health knowledge, this method has failed to achieve sustainable improvements in oral health, or significantly reduce caries prevalence in populations (Yevlahova and Satur 2009). Increasing peoples' knowledge about healthy behaviours may be insufficient to change unhealthy behaviours (Ismail *et al* 2011). As Watt and Fuller (2007) state: "Oral health related behaviours are not just simple actions but enmeshed in more complex social and environmental conditions". There is, therefore, a need for more supportive and less judgemental approaches to oral health behaviour change, with a movement away from 'downstream' victim blaming' to an 'upstream' model that considers underlying social determinants (Yevlahova and Satur 2009).

This upstream approach is the focus of current public health practice and has moved away from a biomedical model or behavioural approaches focusing mainly on

lifestyles, toward a socio-environmental model. While still acknowledging elements of the medical and behavioural models, the socio-environmental model includes the wider determinants of health such as the social, economic and physical surroundings, personal health practices, psychosocial factors and coping skills (Marmot and Wilkinson 2001, Locker *et al* 2007, Newton and Bower 2005). This model forms the basis of health promotion i.e. *the process of enabling people to increase control over and improve their health* (WHO 1984). The concept of health promotion was further refined and developed at the first international conference on health promotion meeting in 1986 in Ottawa, Canada that produced a 'Charter' for action (WHO (1986). This conference defined health as a positive concept, being a personal resource for people to achieve physical, mental and social well-being and cope with their life and environment (WHO 2013). The five fundamental principles of health promotion are:

1. **Build healthy public policy** – Identifying obstacles to the adoption of health promoting public policies in non-health sectors and ways for removing them.
2. **Create supportive environments –** Work and leisure should be a source of health for people therefore health promotion strategies should generate living and working conditions that are safe, stimulating, satisfying and enjoyable.
3. **Strengthen community action** - Draw on human and material resources in the community to enhance self-help, social support and strengthen public participation in health matters, including access to information, learning opportunities for health and funding support.
4. **Develop personal skills** – Support personal development through providing information, education for health and enhancing life skills to increase options available for people to exercise more control over their own health in school, home and work and community settings.
5. **Re-orientate Health services –** The health sector should move beyond curative services toward a pursuit of health, where services are sensitive and respectful of cultural needs and able to engage with other social, political, environmental agencies that can influence health. Service delivery should be based on health research and changes in professional education and training.

Locker *et al* (2007) describes three key concepts that underpin these strategic principles: *Equity, Advocacy* and *Empowerment*:

Equity is linked to the concept of social justice, and human rights, implying that differences in health and health care are largely unfair and that society has an obligation to minimise them by focusing on those with greatest need. This differs from equality which implies everyone should be treated the same. Health promotion strategies should provide all members of society with the opportunity to be healthy and achieve their full potential.

Advocacy involves health professionals playing an important role in mobilising support policies for improving health through engagement with influential community leaders the media and policy makers.

Empowerment involves supporting people in acquiring the skills they need to use to maintain their health and use health services effectively. Empowerment can be considered the most important idea within health promotion and operates at the community and clients level. Community empowerment involves people acting collectively to gain greater influence and control over the determinants of health and the quality of life in their community whereas individual empowerment refers to the ability to take control over one's personal life and health choices. Tengland (2007) states that empowerment is not only a conceptual goal of health promotion but also a process that fundamentally involves people in problem formulation, decision making and action, thereby requiring health professionals to relinquish some of their control. However this concept may be the most difficult for health professionals to accept as it requires a transfer of responsibility for control over health from a healthcare professional to patients (lay people). This is largely due to health professionals being trained in a model where they are the 'expert' and the patient is the recipient of their expertise. Importantly, empowerment respects a person's right to autonomy as part of the 'change-process' and does not rely on coercion or manipulation (Tengland 2012). Therefore, in the context of health promotion, the most important function of health professionals, beyond providing clinical care, may be helping patients to develop the skills they need to use health information and increasing their confidence to take control of the health options available to them (Locker *et al* 2007).

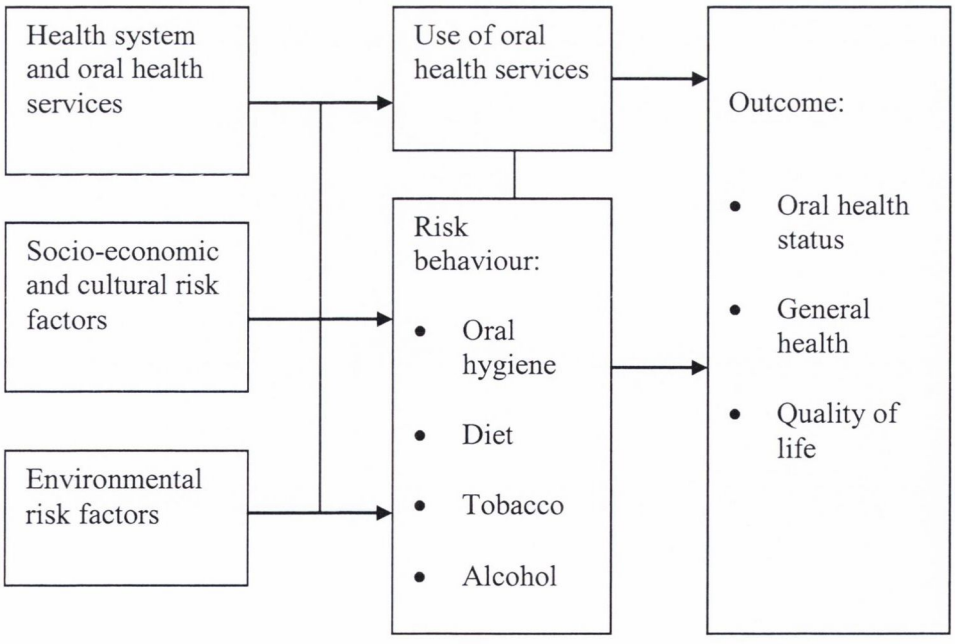
7.2.1: Oral health promotion strategies

Despite health promotion being founded on a socio-environmental model of health, current criteria for good quality evidence for effectiveness in healthcare are based

largely on a biomedical paradigm. Thus evaluating the effectiveness of oral health promotion has been challenging (Singh 2012).

Along with acknowledging these fundamental principles oral health promotion strategies should also include a *common risk factor approach*, as non-communicable diseases (NCDs) and oral diseases share several common risk factors (e.g. poor diets, smoking, alcohol, and lack of exercise). Effectiveness of health promotion strategies may therefore increase through joint-working with agencies involved with other health problems (Sheiham and Watt 2000). Watt and Sheiham (2012) however, caution against interpreting the common risk factor approach as solely relating to a client changing lifestyle choices and practices (e.g. diet, exercise, healthcare usage) without considering the wider social determinants of health that influence health behaviour and health outcomes. This is illustrated in the model proposed by Peterson (2003), Figure 7.1. This view is supported by Singh (2012) who states that oral health promotion strategies should take account of multidimensional influences on health (i.e. social, cultural and environmental), and interventions directed at behaviour change should be culturally and socially acceptable and appropriate for the target population.

Figure 7.1: The common risk factor approach (Peterson 2003)



Consistent with this socio-environmental model, Fisher-Owens *et al* (2007) describe a multilevel conceptual model to explain influences on children's oral health at the child, family and community level. At the child level, risk factors include: genetic,

biological, social and physical environment and health behaviours. At the family level, they include: socioeconomic status, family function and health behaviours, and at the community level: culture, social capital, fluoridation and the healthcare system.
Oral health promotion strategies aimed at improving children's oral health must therefore take account of the socio-environmental determinants of health affecting the child and family.

7.2.3: Models of health behaviour

Bringing about desired changes in health behaviour requires an understanding of the possible mechanisms of these behaviours. Kasl and Cobb (1966) define health behaviour as 'any activity undertaken by a person for the purpose of preventing disease' e.g oral health behaviour such as tooth brushing, flossing or attending for a dental check-up (Kent and Croucher 1998). People's health and illness behaviours are believed to be conditioned by cultural and societal norms while influenced by socioeconomic factors (Peterson 2007). Health behaviours are also considered to be the result of specific beliefs and attitudes towards health. A *belief* represents the information a person has about an object or action and links that object to some attribute whereas an *attitude* describes a feeling towards a particular issue or action (Naidoo and Wills 1994). Several theories and models have been developed to explain the influence of these and other variables on health behaviour and have been used to inform patient counselling programmes and delivery of health promotion. While not an exhaustive list of the theories and models used in health promotion, the following five theories and models have shown good utility for designing health promotion interventions and also share some common elements:

(a)The Health Belief Model (HBM)

(b) Social Cognitive Theory (SCT)

(c)Theory of Planned Behaviour (TPB)

(d) Health Locus of Control (HLC)

(e) The Transtheoretical Stages of Change Model (TTM)

7.2.3.1: The Health Belief Model

In the Health Belief Model (HBM) Rosenstock *et al* (1988), suggest that a person's views about his or her susceptibility to disease, the seriousness of the disease and ability to avoid negative consequences are important influences on their behaviour

According to the HBM, for behaviour change to occur in an individual, there must be the following key elements:

- *Perceived seriousness* - how an individual perceives the severity of the consequences of the health problem e.g. response to seeing gums bleed when brushing.
- *Perceived susceptibility* - the individuals' own evaluation of their risk of developing the health problem. For example a patient concerned that their bleeding gums and loose teeth may lead to tooth loss.
- *Cue to action* - suggests that this could be a trigger event (Zola 1973), such as an acute medical problem that causes a person to change behaviour or make a health-related decision e.g. an individual who has not previously had dental care, attending for emergency dental treatment due to pain from a dental abscess.
- *Perceived benefit* - whether the individual sees the 'benefits' of a new behaviour as being greater than the 'cost' of changing from current behaviour. For example, a patient attending a dental clinic for advice / treatment for a longstanding problem with chewing, due to old and poorly fitting dentures.

Essentially the three health-related actions in the HBM include having sufficient motivation, perceived vulnerability and believing health intervention would be beneficial (Rosenstock *et al* 1988). Although useful for understanding some health behaviours, it is unclear how this model can be translated into effective health promotion interventions (Adair and Ashcroft 2007).

7.2.3.2: Social Cognitive Theory and Self-efficacy

An important and influential contribution to the understanding of health behaviour comes from Bandura (1977). In his Social Cognitive Theory, behaviour is seen as a function of the subjective value of an outcome as opposed to occurring just as an immediate response to a situation. Bandura (1977) states that "through cognitive representations of future outcomes, clients' can generate current motivators for change" i.e. if an outcome is highly valued by a person, he or she is more likely to engage in that behaviour as opposed to outcomes that have little value (Irwin and Morrow 2005). For example if a person values being a non-smoker they are more likely to explore and undertake methods of quitting. Central to this theory is the role

of '*expectations*'. Bandura (1977) proposes that expectations have two main components: *'outcome expectancy'* defined as 'a persons' estimate that a given behaviour will lead to certain outcome and '*efficacy expectancy'* defined as 'the conviction that one can successfully execute the behaviour'. Efficacy expectancy can also be defined as '*Self-efficacy'* which refers to "beliefs in one's capabilities to organize and execute the courses of action required to manage prospective situations" (Bandura 1995), or more simply as 'belief in the ability to carry out and succeed at a specific task'. Bandura further suggests that levels of self-efficacy are based on four main sources of information: *Personal accomplishments* (successfully overcoming challenges), *vicarious experience* (seeing others perform successfully), *verbal persuasion* (help from others in developing skill and gaining support and encouragement) and *emotional arousal* (physical response to situations). Importantly, in clinical studies, the perceived level of self-efficacy was found to be a better predictor of behaviour than past performance (Bandura 1977), suggesting that people can be motivated to undertake new behaviours despite past failed attempts at doing so. Self-efficacy can therefore be seen to link with the concept of 'empowerment' in health promotion which also relates to developing personal autonomy and coping skills. With respect to health promotion practice, Irwin and Morrow (2005) state "a client who receives positive encouragement and support about a new health-related behaviour from 'respected others' is likely to experience an elevation in self-efficacy". Self-efficacy as a construct has been incorporated into several other theories for health behaviour whether described explicitly or implied.

- Self-efficacy and oral health in early childhood

In a 17 -country study, Adair *et al* (2004) investigated the relationship between ECC and familial and cultural perceptions and beliefs and found that overall, parental self-efficacy was the strongest predictor in the establishment of tooth-brushing habits and controlling sugar snacking. Self-efficacy among caregivers of Head-Start children in Connecticut was also an important predictor of sugar intake in a longitudinal study by Litt *et al* (1995). In this study, using multidimensional modelling, children of more self-efficacious mothers had less sugar intake and this was predictive of bacterial levels and the prevalence of dental caries.

Maternal oral health self-efficacy was also strongly related to tooth brushing frequency in a study of African-American mothers of 1-5-year-old children among low income families in Detroit (Finlayson *et al* 2007a). In this study, mother's

knowledge of oral health was positively related to their child's tooth-brushing frequency. In addition, if a mother brushed her own teeth at bedtime this increased her child's brushing frequency by one third. Interestingly, those mothers who had more knowledge about their children's oral hygiene needs felt more efficacious, indicating the value of providing oral health information. Along with oral health self-efficacy, the phenomenon of '*oral health fatalism'* is also believed to be of relevance in that 'fatalistic' individuals believe that there is nothing they can do to cure or prevent any condition that they are fated to develop (Petti and Polimeni 2011). Importantly, based on agreement with the statement, '*most children develop cavities*,' Finlayson *et al* (2007b) reported an association between maternal oral health fatalism and early childhood caries among preschool age children in the US.

7.2.3.3: The Theory of Planned Behaviour

Proposed by Ajzen (1991), the Theory of Planned Behaviour (TPB) was an extension of the earlier Theory of Reasoned Action (TRA) (Fishbein and Ajzen 1975). Both these theories include '*intention*' as a central idea. Intention is considered the preceding stage before health behaviours and captures motivational factors that determine how willing a person is to put effort into performing a behaviour i.e. the stronger the intention toward a specific behaviour the more likely would be its performance.

Ajzen (1991) states it is possible to accurately predict behavioural intentions based on three main factors: (a) *attitudes* (b) *subjective norms and* (c) *perceived behavioural control.* Attitudes toward a behaviour are beliefs about the outcome of a behaviour weighed against the value of the outcome. For example, a mother considering whether to follow advice on not using a sweetened baby bottle to reduce the risk of her young child getting tooth decay. S*ubjective norms are* the influence of other people's views toward a particular behaviour, including cultural beliefs. For example, whether a mother believes other mothers/ family members are using sweetened baby bottles for their children. P*erceived behavioural control* (PBC) is the degree of control a person feels they have over a change in behaviour, for example, not upsetting the child or going against cultural practices by changing to unsweetened juice or water in the baby bottle. Therefore, the more positive the attitude, subjective norm (peer/social pressure) and perceived behavioural control, the stronger should be the intention to behave in a certain way.

Adair and Ashcroft (2007), state that conditions favouring a change in behaviour will be whether the person has a positive attitude, believes that others see this change as important, peer/social pressure (the subjective norm) and having confidence in their ability to make the change (PBC). Ajzen (1991) suggest the TPB is flexible and can also include other factors such as the role of knowledge as another influence on attitudes and also proposes that the construct of PBC is compatible with that of self-efficacy (Bandura 1977) as it includes the elements of confidence, coping, personal resources and skills.

The TPB has been shown to be a good explanatory model for health and oral health behaviours. Dumitrescru *et al* (2011) attempted to use the TPB to model preventive oral health behaviours in a sample of adults using the following constructs: Intention - *how likely people were to regularly engage in oral hygiene behaviour*, Attitudes - *how people felt when considering these behaviours*, Subjective norms - *how other people they knew felt about oral hygiene* and PBC– *how difficult they felt it was to perform oral hygiene behaviours*. This study also included levels of oral health knowledge about prevention in the model and found that, except for 'subjective norms' all other components of the TPB predicted intentions regarding oral health behaviour. The TPB was also recently used to predict oral health behaviours in a large study of 5- year-old children in Belgium (Van den Branden *et al* 2013). Using self-reported parental questionnaires, attitudes, social norms and PBC were explored with respect to dietary habits, oral hygiene and dental attendance. This study found that intentions and PBC predicted sugar snacking, tooth brushing behaviour and dental attendance (Van den Branden *et al* 2013).

7.2.3.4: Health Locus of Control

The theory of Health Locus of Control HLC (Wallston and Wallston 1978), refers to the extent of an individuals' perceived control over their health outcomes. These health loci can be considered as being 'internal' (ILC) or 'external' (ELC). Those with an internal locus of control believe they are responsible for and can influence their own health, whereas people with an external locus of control believe that 'powerful others' or the external environment, such as health professionals or health services are responsible for their health, along with luck or fate. Those with an internal locus are more likely to take control of their own health, seek health information, act on that information and try to maintain well-being. Like the HBM,

and TPB, this concept has also been linked to self-efficacy. Rosentock *et al* 1988) suggest that this may present as the following interaction: a person with high self-efficacy and ILC are most likely to comply with preventive health advice, whereas someone with ILC but low self-efficacy may believe the preventive advice is valid and important yet not feel they have the skills or capability to follow it. Those with ELC and low self-efficacy would be the least likely to change behaviour.

7.2.3.5: The Transtheoretical Model (TTM) (stages-of-change model)

The Transtheoretical Model (TTM) was proposed by Prochaska and DiClemente (1984), who in working with people with addictive behaviour, developed a model to understand self-initiated and professionally assisted changes in health behaviour (Prochaska *et al* (1992). The TTM presents a series of key stages though which an individual must pass before adopting a new behaviour. These stages are (a) *Precontemplative,* (b) *Contemplative* (c) *Preparation,* (d) *Action* and (e) *Maintenance.* The following is a brief description of each stage:

- Precontemplation – The stage at which there is no intention to change behaviour in the foreseeable future. People in this stage are unaware or of their problem or it is not perceived as any risk to their health. For example, a person with poor periodontal health exacerbated by their smoking habit and yet unconcerned and seemingly unaware of the problem.
- Contemplation – The stage in which people are aware that a problem exists and are seriously thinking about overcoming it but have not made a commitment to take action, and they are weighing pros and cons. For example, a patient informed by their dentist that their smoking habit is causing oral health problems, requiring them to quit smoking. who considers the potential value quitting would create against the disruptive change in lifestyle quitting would create
- Preparation– The stage that combines intention and behavioural criteria. People in this stage are intending to take action in the near future (within the next month) and may have unsuccessfully taken action in the past year. Although they have made some reductions in their problem behaviours they have not yet reached a criterion for action. For example, a patient who puts a

quit-date in her/his calendar and makes an appointment to get a nicotine patch prescription based on advice from a dental professional.

- Action – The stage in which people modify their behaviour, experiences or environment in order to overcome their problems. This usually involves overt behaviour change and requires considerable commitment of time and energy. For example, following discussion with their dentist, a patient committing to and engaging in, a smoking cessation programme.
- Maintenance – The stage at in which people work to prevent relapse and consolidate the gains attained during the action stage. This is not a static stage but involves a continuation, not an absence of change. For addictive behaviour, being able to remain free of the old behaviour and engage in the new positive health behaviour for more than six months are criteria for someone to be in the maintenance stage. For example a person who quits smoking because of oral health / general health concerns and over the following year maintains a quit-free status and improves their oral hygiene and dental attendance for check-up and cleanings.

Prochaska *et al* (1992) note that people in the action stage increasingly believed that they had the autonomy to change their lives in key ways. This again relates to the concept of increasing self-efficacy and personal empowerment, these being fundamental aims of health promotion.

7.3: Motivational Interviewing.

The theories and models included in the previous sections (HBM, TPB, SCT, HLC and TTM) were selected for inclusion in the review due to their seminal contribution to the understanding of health behaviour. In the context of health promotion they all share a common theme of developing personal coping skills and improving self-efficacy, consistent with the principle of developing personal empowerment.

Although not a theory of health behaviour, Motivational Interviewing (MI) is a clinical behaviour change approach that overlaps with the theories and models described above, in particular the concept of personal empowerment and self-efficacy. Miller and Rollnick (2013) define MI as "*a person-centred counselling style for addressing the common problem of ambivalence about change*" MI has been used successfully for over 30 years, mostly in the area of addictive behaviours.

7.3.1: Ambivalence

Ambivalence is considered a normal part of the human experience and in the context of health behaviour change means simultaneously wanting and not wanting something at the same time or wanting two incompatible things. For example, some people who smoke or drink too much or exercise too little, know the consequences of their behaviour but can also see reasons, personal to them, for and against changing and hence become stuck in a position of ambivalence (Miller and Rollnick 2013). Ambivalence can therefore affect a person's motivation for change. Understanding ambivalence also provides an alternative to blaming people for appearing unwilling to act on health advice. This relates to the discredited approach of 'victim blaming' where people with poor health were blamed for their lifestyle choices and poor health status (Watt and Sheiham 2000). Furthermore, trying to 'prescribe' a positive health behaviour change in an ambivalent person usually makes them argue for the opposite position (i.e. no change).

7.3.2: Evoking

During MI the health professional/educator does not try to instil motivation in the patient/client but attempts to 'evoke' motivation that is already there. In an 'MI conversation' this means asking questions like: *Why would you want to make a change? How might you go about it? What are the best reasons for doing it and how important is it you?* (Miller and Rollnick 2013). MI therefore sees behaviour change as a partnership between the patient / client and counsellor / health educator that respects autonomy, enabling the patient / client to feel engaged, understood and empowered.

This differs radically from traditional health education approaches in which it is assumed from the outset that a person is prepared to act upon information imparted to them by an expert (health professional/ educator). Rather than the health professional assuming the role of 'expert', MI places the client/ patient in that role, letting them decide how to interpret and integrate information in the context of their lives own and social circumstances and whether it is relevant for them (Yevlahova and Satur 2009).

7.3.3: Discrepancy

An MI counsellor attempts to overcome a client's ambivalence by evoking a sense of '*discrepancy*', defined by Miller and Rollnick (2013) as: *a difference between a*

person's stated goals or values and his her actions. For example resolving a dental patient's ambivalence about giving up smoking might involve exploring the discrepancy between their current smoking habit causing stained teeth, bad breath and poor periodontal health versus not-smoking and having a healthy feeling mouth and attractive smile.

Miller and Rollnick (2013) state that discrepancy between a current behaviour and a core value can be a powerful motivator as "when a behaviour comes into conflict with a deeply held value it is usually the behaviour that changes".

7.3.4: OARS

Evoking motivation for change and developing discrepancy in a patient/client requires the use of a core MI strategy, given the acronym OARS (Open, Affirming, Reflective, Summarizing). Using the OARS approach the health professional/educator tries to elicit '*change-talk*' (i.e. client speech that favours movement toward a particular change goal). This involves using:

- **O**pen-ended questions: *Allowing the client to reflect before answering.*
- **A**ffirming: *Recognizing the clients' strengths and any efforts already made.*
- **R**eflective listening: *Stating back to the client what they say they want to achieve.*
- **S**ummarizing: *Highlighting the client's stated goals and values.*

7.4.5: Motivational interviewing and the TTM

Miller and Rollnick (2013) state that although MI is not a theory of change, it is compatible and complimentary to the TTM (Prochaska and DiClemente 1984). The TTM was intended to provide a comprehensive conceptual model of change, whereas MI is a specific clinical method to enhance personal motivation for change (Miller 2009). However, a fundamental insight of the TTM is that people come to the 'conversation about change' with very different levels of 'readiness'. This can be related to the stages of change describe in the TTM model. Some people are ready and committed to change (action stage), for example, a person about to embark on a weight loss and fitness programme. Some are 'ambivalent' (contemplation stage), such as a mother concerned that her young child has decayed front teeth but not yet ready to make changes to dietary or oral hygiene routines and some see no problem

and no need for change (pre-contemplation), for example, an obese person who perceives no obvious health concerns. Through the process of MI the counsellor aims to move people towards a position of 'readiness for change' (Miller and Rollnick 2013).

MI can therefore be viewed as a useful clinical tool to help people move through ambivalence toward change along with increasing the level of readiness for change, supporting self-efficacy and facilitating the change process.

In their review, Britt, *et al* (2003) found the greatest support for the effectiveness of MI applied to health behaviour change has come from smoking cessation but MI has also been effective in a range of health-related behaviours such as diet and exercise, diabetes, substance misuse and medication adherence (Mantler *et al* 2010, Yevlahova and Satur 2009, Ismail *et al* 2011).

7.3.6 Motivational interviewing and oral health behaviour

More recently, MI has also been applied to dentistry to improve clinician-patient interaction and outcomes of preventive advice. Friedman *et al* (2013) state that dental professionals have a tendency to dispense advice in a prescriptive manner due to having a wealth of clinical knowledge and expertise. However, a more effective approach for patients may be to find out what a patient values about their oral health using the MI principles of OARS (i.e. using open-ended questions and affirming, reflective and summarizing statements). These might be *'What are your goals for oral health? 'What's important for you about your oral healthcare?' 'I can see you are trying to work on your oral hygiene, what can we do to help you achieve these goals?'*

This approach would be more likely to build a therapeutic alliance / partnership and, as Miller and Rollnick (2013) state, have patients / clients feeling engaged, understood and empowered.

7.3.7: Motivational Interviewing and ECC

The evidence supporting traditional dental health education (DHE) for mothers in preventing ECC has been inconclusive (Twetman 2009). Research indicates that even where parents accept the value of preventive measures they may need support in implementing that behaviour (Adair *et al* 2004). Parents and caregivers can be considered gatekeepers for their children's oral health (Plutzer and Spencer 2008), however, cultural and socioeconomic barriers suggest that many children at high risk

of caries are in families where parents wait until decay in the primary teeth is advanced and symptomatic before bringing their child to the dentist (Weinstein *et al* 2004, Milgrom *et al* 1998).

As stated earlier, MI and the TTM are complementary. The TTM may help may explain why education messages to parents regarding dental care of their child may not elicit a desired behaviour change, as those at the pre-contemplative stage may not see their dental health behaviour (e.g. lack of regular brushing and high sugar diet) as a problem and have no intention of changing it. Those at the contemplative stage may accept that brushing should occur and why sugar should be controlled but are not ready to change (consistent with ambivalence in MI) and those that make a change often have difficulty in maintaining these new behaviours and avoiding relapse (Weinstein *et al* 2004).

The limited body of research on the effect of MI in relation to early childhood oral health has been encouraging. For instance, Weinstein *et al* (2006) and Harrison *et al* (2007) reported findings of a two-year randomized controlled trial of MI involving 240 infants aged 6-18 months from Punjabi Sikh immigrant families living in British Columbia, Canada. In this blinded, randomized control trial, the experimental group received a dental health pamphlet and video, along with MI delivered by trained Indo-Canadian women lay counsellors (who were not health professionals), using a specifically developed protocol. Mothers in the control group received only the initial pamphlet and video and no telephone follow-up. After two years, a 46% lower prevalence of decayed tooth surfaces was reported in children whose mother had received MI compared to those whose mothers received only pamphlets and videos. In the subjects in the MI group, 35% had new carious lesions compared to 52% of those in the control group. The MI protocol proposed involved establishing rapport with the mothers through questions such as "*what would you want for your child's teeth in the future*?" and "*what are your worst fear for your child's teeth?"* and the presentation of a menu of caries-preventive options, from which mothers could choose, based around safe diet and feeding and weaning, oral hygiene and compliance with dental visiting and fluoride varnish applications. This initial (home) visit was followed up over the first year of the trial with repeated phone calls, which provided further support, counselling and help if problems were being encountered with respect to compliance to the menu items. In addition, the oral health behaviour that was most likely related to the reduction in ECC, was that families in the MI group attended

more routinely for fluoride varnish application than the control families. This indicated that the use of MI in this study positively influenced preventive behaviour (Harrison *et al* 2007).

Freudenthal *et al* (2010) undertook a small-scale intervention study of DHE plus MI versus received traditional DHE alone. Subjects were English-speaking mothers of low SES in Idaho, with children aged 6 to 24 months enrolled in a health and nutrition programme. The outcome measure for this study was the effect on ECC risk-related behaviours, measured by the Readiness Assessment of Parents Concerning Infant Dental Decay (RAPIDD) instrument developed by Weinstein and Reidy (2001) and an oral health questionnaire. This instrument includes the four constructs (*Valuing dental health, child permissiveness with oral health, Convenience and Change difficulty* and *Openness to health information*). These constructs are related to the TTM stages of change model where for instance parents at the precomtemplative stage would be identified by low scores for openness to health information and valuing dental health, together with high scores for convenience and change difficulty and child permissiveness. The converse would be expected for those in the action stage (Weinstein and Reidy 2001).

The intervention group received a 30-minute MI session from trained health professionals and the control group received a dental health pamphlet on DHE only. Although there was a significant improvement in oral hygiene practice reported in the MI group, no statistically significant difference was found between the control and intervention group for any of the RAPIDD domains except 'valuing dental health'.

The authors suggest that this may have been due to the short duration of the study (one month between pre and post-test instruments) and may also have been affected by the sample size (40 in Test-group, 32 in the Control-group) and recommended a longer time-frame with a more diverse population.

The effectiveness of MI with respect to promoting health behaviour, including brushing, food choices, checking the mouth for pre-cavities, seeing a dentist and reducing ECC was evaluated in randomized study of low-income African-American families with children (0-5 years) (Ismail *et al* 2011). Over 506 children were in the test group; this involved MI for caregivers, a 40-minute discussion about what changes they could make to achieve oral health goals for their child delivered by trained interviewers and a 15-minute health education DVD. The control group (516 children) received the health educational DVD only. The test group received follow-

up phone calls at 6 months and those that had set oral health goals, a new copy of a brochure and DVD at 7 months.

Outcome measures in this study included oral health self-efficacy (Finlayson *et al* 2005), oral health fatalism and questions on brushing frequency / time of brushing and prevalence of ECC at 6 months and 2 years.

At the two-year follow-up, apart from 'checking the child's mouth for pre-cavities', there were no statistically significant differences in oral health behaviour of caregivers between test and control groups and no statistically significant difference in the development of untreated caries in the children. These findings are inconsistent with those of Weinstein *et al* (2004, 2006) and Harrison *et al* (2007).

Explanations given for this inconsistency were (a) an overall general effect in both groups due to the intensity of both the test and control interventions that limits ability to show incremental efficiency (it should be noted the authors felt that a 'no-intervention' control group would have been unethical), (b) lack of fidelity to the MI protocol, (c) MI may be ineffective with participants who are already motivated to make the changes in the target behaviour, (d) differences in the population group with respect to access to dental care, (e) MI may be more effective for addictive behaviours with negative personal impacts hence oral health practices for a child may be less clearly relevant, particularly for caregivers who have multiple responsibilities. These authors also suggest that as the change process is non-linear and intermittent (as indicated by the Transtheoretical model) there is need to understand which aspect of change MI can affect i.e. discrepancy, readiness to change, ability to change and barriers to change (Ismail *et al* 2010).

Another factor that may account for differences in outcomes between these studies is that of fidelity or conformity to the MI process by the person delivering MI i.e. whether the MI training was extensive, theoretical or applied and 'hands-on' before giving the intervention and how closely the protocols were followed (Madson and Campbell 2006, Miller and Rose 2009). Despite these recent findings, most reviews have found MI effective. In particular, MI has shown promise in the context of community-based preventive strategies for young children (Twetman 2009), for instance Weinstein *et al* (2006) reported a 17% reduction in caries incidence among preschool British Columbia.

Summary

Traditional dental health education approaches with the main focus on improving parental oral health knowledge have not been effective in improving preschool children's oral health (Tinanoff *et al* 1999, Weinstein 2011, Yevlahova and Satur 2009). Alternative approaches that draw on the principles of health promotion strategies and aim to elicit positive oral health behaviours, need to be implemented and evaluated. In their protocol for risk assessment, prevention and management of ECC in young children, Ramos-Gomez *et al* (2012) acknowledge that traditional generic recommendations such as 'brush your child's teeth twice and day and reduce consumption of sweet snacks and drinks' have limited success. They conclude that more supportive parent counselling techniques such as Motivational Interviewing, can reduce the caries risk for young children. Therefore, using MI methods to establish what parents of young children value about their child's oral health and oral healthcare may increase adherence to, and the practice of, health education messages (Friedman *et al* 2013).

7.4: Rationale for present study

Parents and caregivers can be considered gatekeepers for the oral healthcare of preschool children, therefore their oral health knowledge, beliefs, attitudes and behaviour may directly or indirectly influence early childhood oral health.

Motivational interviewing (MI) has shown promise in improving the oral health of preschool children (Weinstein *et al* 2004, Weinstein *et al* 2006, Harrison *et al* 2007), by changing the oral health practices within the family.

The MI approach may be an appropriate intervention in the context of oral health promotion for families of preschool children in Trinidad where previous research has shown low oral health awareness among parents and caregivers (Naidu and Davis 2006) and a high prevalence and severity of caries in the primary dentition of young children (Naidu *et al* 2005).

7.5: Aim

The aim of this study was to assess the effect of an MI approach, on parent /caregiver oral health beliefs, attitudes and behaviour toward the oral healthcare of their preschool children by contrast with traditional dental health education (DHE).

8.6: Objectives:

- To assess the effect of MI on participants' oral health knowledge, beliefs and attitudes, and tooth brushing behaviour.
- To assess the effect of MI on participants' oral health self-efficacy and oral health fatalism.
- To assess the effect of MI on participants' 'readiness for change'
- To explore participants' views and opinions of the MI intervention.

7.7: Method

To achieve the objectives of this study two study designs were employed. An interventional study using quantitative methods was used to test the effectiveness of MI and a qualitative approach to explore participant experience with the MI intervention.

7.7.1: Interventional study

The accessible population group for the MI intervention were families of children attending preschools within the catchment area of the Arima District Health Facility (Eastern Trinidad). This Health Centre also housed the local dental clinic, staffed by Dental Nurses who would be assisting in the research.

7.7.2: Sample selection:

The sampling frame consisted of 12 preschools on a contact list for community dental outreach activity by Dental Nurses working at the Arima District Health Facility. Six preschools (clusters) was drawn randomly from this list and subsequently assigned to test or control-group, with 3 preschool clusters in each group. The placement of preschools in particular study group was based on simple randomization (preschools numbered 1-6 and these numbers randomly assigned to test or control group).

7.7.3: Approval and consent

Ethical approval was obtained from the Faculty of Medical Sciences Research Ethics Committee (The University of the West Indies) (**Appendix 7.1**). For the selected preschools, letters of request to be included in the study were sent to the head teacher / preschool administrator, for each preschool (**Appendix 7.2**). If approval was

obtained, packages were then hand–delivered by a Dental Nurse to each preschool. These packages contained information about the study and a consent form requesting parent/caregiver participation (**Appendix 7.3** and **7.4**) and the study questionnaire (**Appendix 7.5**) These documents were distributed to parents/caregivers via the head teachers who were also asked to collate the returned consent forms and completed questionnaires, for collection by the study team.

7.7.4: Experimental design and MI protocol

- **Control group** – *(Dental Health Education)*

All participants (parents and caregivers) in the control group were given a 30 -minute talk (as a group) on dental care of preschool children's teeth by a Dental Nurse. This talk included advice on diet, oral hygiene, fluoride use and dental attendance. At the end of the talk participants were given a DHE leaflet reinforcing the information to take home (**Appendix 7.6**). All participants in the control-group were given dental health products (toothpaste samples and floss) as a token of appreciation for taking part in the study.

- **Intervention group** – *(Motivational Interviewing & Dental Health Education)*

Participants in the intervention group received a 30-minute talk (as a group) based on a Motivational Interviewing approach, delivered by an MI counsellor /educator (RN) (a dentist trained in MI), assisted by a Dental Nurse. Training of the MI counsellor /educator involved a one-day course (8 hours) on Motivational Interviewing and coaching skills for health professionals that included both applied (hands-on) and theoretical elements, with the theoretical materials also made available for self-study (**Appendix 7.7**).

The group-talk was based on an MI protocol designed to aid delivery of oral health information to families with young children: *Motivate your Dental Patient: A workbook -Public Health / Paediatric Edition* (Weinstein 2002).

All participants in the intervention group received the same DHE information leaflet as the control group along with toothpaste samples as tokens of appreciation. All the talks took place at the preschools after a normal school day. The outline of the study protocol and MI intervention with intended goals of each contact and the time-line is shown in Table 7.1

Table 7.1: Summary of the MI intervention / study protocol

Mode of contact, venue & time-line	Objective
First contact *Test-group* - MI group-talk Given at preschools by MI counsellor / educator (RN) and Dental Nurse *Control-group* - DHE group-talk Given at preschools by Dental Nurse. Oral health questionnaire given to all participants in *Test and Control-group.*	For *Test-group* - Establish rapport and discuss oral health goals. Introduce dental health menu items. Use of MI to support change to participant's oral heath behaviour (OARS approach). Given written dental health information. For *Control-group*–delivery of verbal and written dental health information. Collection of baseline data on oral health knowledge, attitudes and behaviour & Readiness Assessment of Parents Concerning Infant Dental Decay (RAPIDD)
1st MI follow-up with *Test-group* 2 weeks after MI group-talk. (telephone contact by Dental Nurse)	As part of MI, provide support and encouragement for participants. Re-establish oral health goals and commitment to items selected from oral health menu options. Help to solve problems encountered.
2nd MI follow-up to *Test-group* 1 month after MI group-talk (telephone contact by Dental Nurse) End of MI intervention	As part of MI, promote maintenance of any positive changes made to oral health behaviour. If needed offer further advice and help with problems encountered.
Oral health questionnaires to all participants in *Test and Control-group* (4 months after MI group-talk)	Collection of questionnaire data: Oral health knowledge, attitudes and behaviour. & RAPIDD.
Focus group with a sub-sample of participants in Test-group at preschool. (7 months after MI group-talk)	Collection of qualitative data on participant experience of the MI intervention.

7.7.5 Details of the MI group-talk:

Establishing rapport (using the **OARS** method to evoke motivation and change-talk) i.e. showing concern and getting the parent/caregiver to talk about their child's oral health and their goals for their own and their child's oral health and oral healthcare (using **o**pen-ended questions and **a**ffirming positive efforts).

Examples of these questions were:

"How many children do you care for" Tell me about your child? What is it like to be his/her parent?" "What are your worst fears about your child's teeth? Any problems finding dental care? How would you like things to have turned out? How could it be better?

- **Paraphrasing the parent/caregiver's wants and desires for their child's oral health**. (Using **r**eflective listening and **s**ummarizing parent/caregiver goals). For example:

  "What do you want for your child's teeth in the future?" If you could have one with wish for your child's teeth, what would it be?" "Thank you for telling me about your child let me be sure I understand, you would like your child to……"

- **Presenting dental health menu options.**

  Participants in the MI group were shown and encouraged to share their thoughts about a written list of preventive options. These options were based on the Weinstein (2002) protocol but modified to take account of participants with older children along with items based on comments from parents and caregivers of preschool children in Trinidad (Thesis Chapter 6). From this list participants were asked to choose and to commit to items they felt able to, as part of the intervention and follow-up. Discussion of the dental health menu (Table 7.2) included the following themes:

  <u>Introduction of the menu</u>

  "I want to share with you some of the things we have recently learned about keeping your child's teeth and mouth healthy." "The recommend steps are on a menu that I would like to show you."

  <u>Eliciting commitment:</u>

  "Let's look at the items on the list, talk about them briefly and begin to decide which one might be for you. "How do you think each one will work as you are the expert on your family?"

  <u>Identify potential problems</u>

  Let's talk about ones you feel most comfortable with?" "What problems might you face if you tried to do this?" "Maybe you have some ideas of your own that you would like to include." "What might go wrong and who could help?"

Enhance commitment:

"Often it is useful to tell other people who will be supportive of your commitment to (brush, change diet, etc.), who will you tell" "What kind of help and support would you need?" "It can be useful to plan out what you will do, let's go over the steps you would take and how you would try to do this before you try them out"

Recognizing and dealing with resistance:

Participants who may not have an opinion / express a desire of good dental health for their child or feel that 'baby teeth' are not important (pre-contemplation), or that keeping baby teeth is not achievable (Ambivalence / contemplation stage)):

"We *(dentists) have learned that if infections occur in the baby teeth or if we have to take them out early, there can be problems later for their adult teeth"*

Table 7.2: The Dental Health Menu (participants could select some or all of the advice options)

- If breastfeeding discontinue.
- Stop bottle feeding (switch to cup).
- Don't give sugary drinks at night.
- Limit sweet drinks to mealtimes and try to give natural fruit juice instead of colas or other sweet drinks.
- Help to brush your child's teeth twice a day (one of which should be at bedtime)
- Help to brush from behind your child.
- Use fluoride toothpaste (pea size amount)
- Limit sweet snack to no more than three times a day at mealtime.
- Use fruits and savoury snacks instead of chocolates and candies.
- Register child with a dental clinic.
- Take your child for a dental check-up and fluoride varnish treatment every six months.

7.7.6: Telephone follow-up

As well as the MI group-talk at baseline, for those included in the intervention group, there was a follow-up of participants via telephone contact. Names and telephone numbers of participants were collected by the Dental Nurse (equivalent of Dental Therapist) who had also been taking field notes. Follow-up was to maintain contact between participants with the MI team, anticipate problems / problem solve, reinforce commitment and provide support. The telephone follow-up was undertaken by Dental Nurses. Without follow-up new behaviours will not be tried out or the new behaviour will be tried out but not maintained because of (a) unanticipated problems (b) new behaviour was not integrated into daily routine causing relapse (Weinstein 2002).

The Dental Nurses were trained for this phase of the intervention by the MI counsellor /educator (RN) in a one hour face-to-face training session that included reviewing the written follow-up protocol This document contained a telephone 'script' used in the Weinstein protocol (**Appendix 7.8**). It was agreed that the script was not to be followed word-for-word but used as a basis / reference point for the telephone conversations.

Questions included in the telephone follow-up included the following: *"I am calling to go over your plan (dental health menu choices)." "Let's go over parts of the plan that are a problem, sometimes a small adjustment can make a big difference" "Another mother I spoke to, had a similar problem ...she tried* (insert example)*...it seemed to work for her family...you are the expert on your family, what do you think?"*

7.7.7: Instruments

At baseline (MI group talk) and 4 months later, parents and caregivers were asked to complete a self-administered oral health questionnaire (**Appendix 7.5**). This instrument contained two main elements (a) Oral health knowledge, attitude and behaviour and (b) An assessment of 'readiness for change'.

7.7.7.1: Oral health knowledge, attitude and behaviour

The oral health section of the instrument included demographic information along with sections on oral health knowledge and experiences of dental care for preschool children based on previous research in Trinidad (Naidu and Davis 2008). Questions on dental attendance, attitudes toward dental healthcare, brushing frequency, Oral Health Self-efficacy (OHSE) and Oral Health Fatalism (OHF) and were based on subscales used in a large study of children aged 1-5 from low-income African American children in the USA (Detroit Dental Health Project), where they were found to have good internal reliability and validity (Finlayson *et al* 2005 & 2007a). The adapted instrument used in this present study was reviewed for face validity by the local research coordinators (RN, JN) and found to be appropriate for language and question structure.

7.7.7.2: The Readiness Assessment of Parents Concerning Infant Dental Decay (RAPIDD)

The parent/ caregiver oral health questionnaire also included a specific instrument, the Readiness Assessment of Parents Concerning Infant Dental Decay (RAPIDD) developed by Weinstein and Reidy (2001). Based on the Transtheoretical model (TTM) of Prochaska *et al* (1992), this instrument was designed to measure parent/ caregiver *'readiness for change'*. Using four constructs: Openness to health information, Valuing Dental Health, Convenience and Change Difficulty and Child Permissiveness, RAPIDD attempts to assess whether the parent/caregiver is one of the following stages: *pre-contemplative, contemplative, preparing for action*, with respect to their child's oral healthcare. The RAPIDD was validated in a study among families with young children (age 6 to 36 months) in the US Commonwealth of the Northern Mariana Islands, in the Pacific. In the US study the instrument showed acceptable reliability for the four constructs and good overall validity. Again, for use in the present study, the instrument was assessed for face validity and modified for use with a slightly older age-group (3 to 5 years) by the local research coordinators (RN, JN). This included rewording of questions relating to bottle-use. Table 7.3 shows the four constructs and construct items. It should be noted that within the questionnaire these items are not themed by construct but listed as statements for which the participant is asked to agree with on a 5-point Likert scale (i.e. Strongly Agree, Agree, Neither agree or disagree, Disagree, Strongly Disagree).

Table 7.3: Readiness Assessment of Infant dental decay (RAPIDD) constructs

Construct	Construct items
Openness to health information	• I would take my child off the bottle if a healthcare professional told me to do so. • I get advice on taking care of my baby from TV, radio, magazines and internet. • I feel comfortable asking a healthcare professional about ways to care for my child. • It is easier for me to get answers about ways to take care of my child from the healthcare professional
Valuing Dental Health	• Keeping my child's teeth healthy is important to me. • My child benefits a lot when I clean his/her teeth. • I like the idea of a dentist or dental nurse putting fluoride on my child's teeth to protect them from cavities • I believe using fluoride toothpaste every day would help my child's teeth
Convenience and Change Difficulty	• It would be hard to give my child less sweets. • My child gives me a hard time when I try to brush his/her teeth. • It is not easy to use fluoride toothpaste every day. • I am unable to put my child to sleep without feeding him/her.
Child Permissiveness	• Food and drinks that are not sweet don't taste good to my child. • I feel like a bad parent if I don't give my child sweets. • My child is happier when I give him/her something sweet in the bottle. • I makes me feel good to give my child something sweet to eat.

In the present study RAPIDD data were used to assess change in participant's 'readiness for change' as an outcome measure of the MI intervention (baseline v follow-up) based on change in mean scores for the above-listed constructs:

Two constructs assess pros: '*Openness to Health Information*' and '*Valuing Dental Health*' and two constructs assess cons: '*Convenience and Change Difficulty*' and '*Child Permissiveness*'. As parents and caregivers weigh both pros and cons of changing their behaviour, tipping the balance in favour of pros and reducing the cons may facilitate behaviour change. Although the MI intervention in this protocol was not modified in relation to the participants' baseline RAPIDD scores, Weinstein and Reidy (2001) propose that these pros and cons can be related to the TTM as follows:

- Lower scores for '*Openness to Health Information*' and '*Valuing* Dental *Health*' and higher scores for '*Convenience and Change Difficulty*' and '*Child Permissiveness*'. = **Pre-contemplative stage**.

- Higher scores for 'Openness to Health Information' and 'Valuing Dental Health' scores. = **Contemplative**
- Higher scores for '*Openness to Health Information*' and '*Valuing Dental Health*' and lower scores for '*Convenience and Change Difficulty*' and '*Child Permissiveness*'. = **Preparation / Action stage**

7.7.8: Statistical analysis

To assess the effect of the MI intervention within Test and Control-groups, statistical tests for significance were used to measure changes for dependent variables: baseline versus follow-up. The Chi square test was employed for categorical variables related to oral health knowledge: *causes of caries, toothbrush size, brushing position, diet / frequency of sweet snacks, toothpaste and fluoride use* (significance level: $p<0.05$).

A linear regression model based on analysis of variance (ANOVA) was used to test the effect of the MI intervention on mean values for continuous variables related to oral health behaviours and attitudes: *Brushing frequency, Oral health Self-efficacy, Oral health fatalism, RAPIDD constructs* (significance level: $p<0.05$).

7.7.9: Qualitative study (Focus groups)

Qualitative research can be considered the study of human actions and activities or a way of witnessing human events in the context in which they occur (Savage 2000). By the use of a 'naturalistic approach', qualitative research attempts to study phenomena in their natural setting (Green and Thorogood 2009, Masood, *et al* 2010). With an emphasis on meaning and understanding, this approach assumes that people are essentially rational and sensible, with the choices they make being based on the environments and constraints they are subject to in their daily lives (Green and Thorogood 2009).

The present study used a focus group approach to collect qualitative data on participants' experiences with the MI intervention. Focus groups are one of several methods for acquiring qualitative data. They can be considered as an unstructured interview with a group of people who are encouraged to interact with each other and the facilitator, using group dynamics to stimulate discussion, gain insights and generate ideas to explore a chosen topic in depth (Bowling 1999).

7.7.9.1: Focus group sample selection

In liaison with the preschool head teachers / administrators, a focus group discussion was arranged for parents/caregivers from one of the three preschool (clusters) that had received the MI intervention. This took place 6 months after the end of MI intervention (i.e. last telephone follow-up), Due to the busy schedule of events in the other two preschools their head-teachers /administrators indicated that they were unavailable for inclusion in this phase of the study. All parents /caregivers from the preschool who had attended the group-talk and engaged in the follow-up were invited to participate, through the head-teacher/ administrator. The venue for the focus group discussion was the preschool main classroom, after working hours during middle of a school week

The focus group was run by a facilitator / moderator (RN), previously trained in qualitative methodology (26 hours, didactic and practical, **Appendix 6.1**) and a Dental Nurse, who served as the assistant moderator.

7.7.9.2 Conduct of the focus group

The facilitator/ moderator, welcomed the parent's and caregivers to the event. To obtain informed consent for participation in the focus group, the purpose and conduct of the event (focus group) was explained i.e. an open discussion (not an interview) around the theme of preschool children's dental healthcare based on the dental health group-talk and telephone calls given some months previously. It was explained that an audio recording of the discussion would be made but that all comments and opinions offered would remain anonymous and individuals would not be identified by name during transcription and reporting of the findings. It was also emphasized that all comments (positive or negative) would be considered of value. All the parents and caregivers present gave verbal consent to participate in the focus group discussion. Participants were also invited to complete a short form to record socio-demographic information.

To initiate and facilitate the discussion the moderator used a *focus group topic guide* (Table 7.4). This topic guide was designed to help explore how participants felt about receiving the MI intervention (group talk, dental health menu and telephone follow-up), along with specific issues related to making changes to oral healthcare practices and routines following the intervention. Questions in the topic guide were open-ended and not asked in a specific order but rather in response to the flow of the discussion.

The discussion was recorded on a digital audio recorder and field notes taken by the assistant moderator. At the end of the session, participants were thanked and given dental products as tokens of appreciation (toothpaste / floss samples). Light refreshments were provided before and during the discussion.

Table 7.4 Focus group topic guide

- After the group talk how confident were you in making any changes?
- Did any of the things we talked about help you to make a change? (If yes, what were they/)
- What did you find most difficult to change?
- What were the easiest things to change?
- What experiences did you have with tooth brushing or changing the type of feeding?
- Did any of you have to change from a feeding bottle to a cup? How was that for you?
- Did the talk feel different to any dental talks / advice you had before? (If so how?)
- Was the dental health menu helpful? (If so how?)
- What did you feel about the telephone follow-up calls (Were they helpful)?
- Overall how have you been managing with your child's oral healthcare and are there any problems you are still having?

7.7.9.3: Qualitative data analysis

A thematic content analysis as described by Green and Thorogood (2009) was used to analyse the qualitative data collected in the focus group session. In thematic analysis of qualitative data, the researcher looks in detail at the transcript to determine what each section of the text is about and how it is 'like' or unlike other sections of text Green and Thorogood (2009). As a first step, the focus group audio recording was transcribed into a Word document. The verbatim transcript was then numbered line-by-line for identification. After several readings of the transcript, field notes and listening to the audio recording, the data underwent a process of initial labelling of sections of the transcript by placing codes in the text margin (**Appendix 7.9**). Similarly coded pieces of the transcript were re-assembled near to each other by cutting and pasting text sections into a new Word document. These initial codes (which could overlap) were then further developed to identify emerging early 'themes' (proto-themes) which were themselves further refined into the final themes These themes were reported in the results with supporting verbatim quotes from the transcript.

7.7.9.4 Data reliability and validity

To determine respondent validity (member checking), at the end of the session participants were invited to give their opinion (off-record) as to whether the discussion had accurately documented their own experiences (Green and Thorogood 2009). The focus group participants all agreed that the points discussed and views presented had been a good representation of their collective and individual experiences with the MI intervention. After the focus group discussion, the moderator and assistant moderator together reviewed segments of the audio recording and the field notes to compare impressions and explore any possibility of researcher bias during the discussion.

7.7. 9.5: Reflexivity

Reflexivity in qualitative research recognises that the researcher is part of the process of producing the data and interpreting their meaning (Green and Thorogood 2009). Furthermore, consideration was given to the facilitator /moderator having also been an active part of the MI intervention. This was not however, believed to have influenced the views expressed in the focus group discussion or subsequent interpretation of the data.

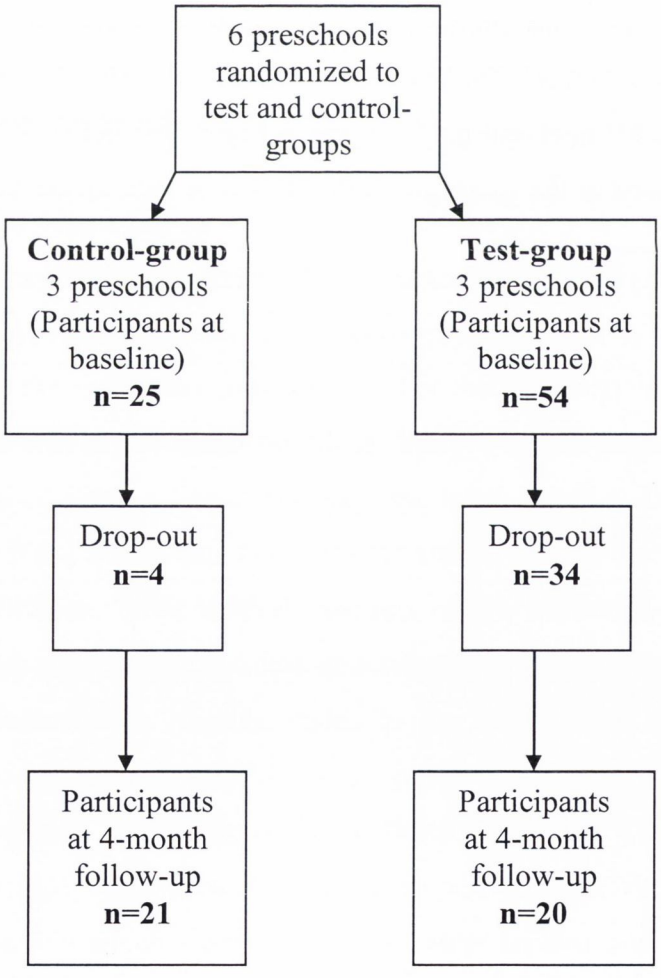
7.8: Results

The following section describes the results of the MI intervention study, from the data gathered in the oral health questionnaire as well as the results for the qualitative study, based on a thematic analyses of the focus group data.

7.8.1 Intervention study enrolment and retention.

From an initial study enrolment of 79 parents/caregivers, a follow-up 20 and 21 participants remained in the test and control-groups, respectively (Table 7.2). A higher proportion of participants dropped out of the control-group compared to the test-group by the end of the study (Chi Square $p<0.001$).

Figure 7.2: Study flow diagram



7.8.2: Sample characteristics at baseline

The socio-demographic characteristics of participants (parents and caregivers) at baseline are described in Table 4. The majority of the participants were in the 25-34 year age range indicating a sample of young adults as would be expected among parents of preschool age children. The majority were females of mixed ethnicity and most participants were in manual employment or housewives. Most participants were educated to secondary level and cared for 1- 2 children. At baseline in the test-group there were significantly less participants of African ethnicity, a greater proportion employed in professional / managerial jobs and having tertiary level education, compared to the control-group (Chi square $p<0.05$) (Table 7.5). Also compared to the control group a significantly greater proportion of participants in the test-group did not have a regular dental clinic for their child and reported finding it easier to find a medical doctor than a dentist (Chi square $p<0.05$) (Table 7.6 and 7.7).

Table 7.5: Socio-demographics for groups at baseline

	Control		Test		All	
Age group	n	%	n	%	n	%
18-24	9	16.7	1	4.0	10	12.7
25-34	22	40.7	16	64.0	38	48.1
35-44	17	31.5	5	20.0	22	27.8
45-54	2	3.7	2	8.0	4	5.1
55-64	2	3.7	0	0.0	2	2.5
0ver 65	1	1.9	0	0.0	1	1.3
Missing	1	1.9	1	4.0	2	2.5
Total	54	100	25	100	79	100
					Not significant (Chi square)	
Gender						
Female	45	83.3	21.0	84.0	66	83.5
Male	7	13.0	13.0	16.0	11	13.9
Missing	2	3.7	3.7	0.0	2	2.5
Total	54	100	100	100	79	100
					Not significant (Chi square)	
Ethnic group						
African	24	44.4	7	28.0	31	39.2
Indian	3	5.6	7	28.0	10	12.7
Mixed	26	48.1	9	36.0	35	44.3
Missing	1	1.9	2	8.0	3	3.8
Total	54	100	25	100	79	100
					$p<0.05$ (Chi square)	
Occupational group						
Professional	1	1.9	2	8.0	3	3.8
Managerial / lower professional	6	11.1	9	36.0	15	19.0
Non manual (skilled)	13	24.1	3	12.0	16	20.3
Skilled manual	6	11.1	2	8.0	8	10.1
Semi-skilled manual	3	5.6	1	4.0	4	5.1
Non-skilled manual	7	13.0	0	0.0	7	8.9
Housewife/ unemployed	13	24.1	7	28.0	20	25.3
Missing	5	9.3	1	4.0	6	7.6
Total	54	100	25	100	79	100
					$p< 0.05$ (Chi square)	
Highest level of education						
University	8	14.8	9	36.0	17	21.5
Technical college	6	11.1	4	16.0	10	12.7
Secondary	32	59.3	9	36.0	41	51.9
Primary	7	13.0	2	8.0	9	11.4
Missing	1	1.9	1	4.0	2	2.5
Total	54	100	25	100	79	100
					$p<0.05$ (Chi square)	
No of children cared for						
1-2	49	90.7	22	88.0	71	89.9
3-4	3	5.6	2	8.0	5	6.3
4+	0	0.0	1	4.0	1	1.3
Missing	2	3.7	0	0.0	2	2.5
Total	54	100	25	100	79	100
					Not significant (Chi square)	

Table 7.6: Dental attendance for groups at baseline

Time of last dental visit	**Control**		**Test**		**All**	
	n	%	n	%	n	%
<6 months ago	11	20.4	8	32.0	19	24.1
> 6 months < 1 year ago	6	11.1	2	8.0	8	10.1
> 1 year ago	6	11.1	3	12.0	9	11.4
> 2 years ago	6	11.1	1	4.0	7	8.9
> 3 years ago	5	9.3	1	4.0	6	7.6
> 5 years ago	8	14.8	5	20.0	13	16.5
never been	11	20.4	5	20.0	16	20.3
Missing	1	1.9	0	0.0	1	1.3
Total	54	100	25	100	79	100
					Not significant (Chi square)	
Reason for last dental visit						
Check-up	15	27.8	6	24.0	21	26.6
Cleaning	12	22.2	7	28.0	19	24.0
Filling	8	14.8	6	24.0	14	17.7
Extraction	8	14.8	2	8.0	10	12.7
Toothache	7	13.0	2	8.0	9	11.3
Denture repair	2	3.7	0	0	2	2.5
Bleeding gum	0	0.0	1	4.0	1	1.3
Loose tooth	1	1.9	0	0	1	1.3
Wisdom tooth	1	1.9	2	8.0	3	3.8
Other	3	5.6	4	16.0	7	8.9
					Not significant (Chi square)	
Reason for not going for dental visit						
Had no problem	20	37.0	5	20.0	25	31.6
Afraid to go	1	1.9	1	4.0	2	2.5
Could not take time off work	4	7.4	0	0	4	5.1
Too expensive	3	5.6	3	12.0	6	7.6
Unable to get appointment	2	3.7	0	0	2	2.5
Unable to leave my child	0	0	0	0	0	0
Other	4	7.4	0	0	4	5.1
					Not significant (Chi square)	
Ever taken child to a Dentist/Dental Nurse						
Yes	17	31.5	9	36.0	26	32.9
No	37	68.5	14	56.0	51	64.6
missing	0	0	2	8.0	2	2.5
Total	54	100	25	100	79	100
					Not significant(Chi square)	
Does your child have a regular dental clinic						
Yes	13	24.1	5	20.0	18	22.8
No	19	35.1	17	68.0	36	45.6
Missing	22	59.3	3	12.0	25	31.6
Total	54	40.7	25	100	79	100
					***p*<0.05 (Chi square)**	

Table 7.7: Dental attendance for groups at baseline (cont.)

If child needed dental care where would you go	**Control**		**Test**		**All**	
	n	%	n	%	n	%
Health Centre	20	37.0	5	20.0	25	31.6
Private Dentist	18	33.3	11	44.0	29	36.7
Dental Hospital	10	18.5	2	8.0	12	15.2
Not sure	5	9.3	4	16.0	9	11.4
Missing	1	1.9	3	12.0	4	5.1
Total	54	100	25	100	79	100
					Not significant (Chi square)	
Rating of availability of dental services for family						
Excellent	9	16.7	3	12.0	12	15.2
Very good	9	16.7	5	12.0	14	17.7
Good	17	31.5	10	40.0	27	34.2
Fair	11	20.4	3	12.0	14	17.7
Bad	3	5.6	1	4.0	4	5.1
Very Bad	0	0	1	4.0	1	1.3
Missing	5	9.3	2	8.0	7	8.9
Total	54	100	25	100	79	100
					Not significant (Chi square)	
Dental Insurance						
Yes	13	24.1	7	28.0	20	25.3
No	41	75.9	16	64.0	57	72.2
Missing	0	0	2	8.0	2	2.5
Total	54	100	25	100	79	100
					Not significant (Chi square)	
Is it easier to find Dentist or Doctor						
It is easier to find a Dentist	8	14.8	2	8.0	10	12.7
It is easier to find a medical Doctor	14	25.9	17	68.0	31	39.2
It is not easy to find a Dentist or Doctor	3	5.6	2	8.0	5	6.3
It is easy to find both	27	50.0	4	16.0	31	39.2
Missing	2	3.7	0	0.0	2	2.5
Total	54	100	25	100	79	100
					$p<0.05$ (Chi square)	
How would you rate your teeth and mouth						
Excellent	4	7.4	2	8.0	6	7.6
Very good	10	18.5	6	24.0	16	20.3
Good	23	42.6	9	36.0	32	40.5
Fair	13	24.1	6	24.0	19	24.1
Poor	3	5.6	2	8.0	5	6.3
Missing	1	1.9	0	0.0	1	1.3
Total	54	100	25	100	79	100
					Not significant (Chi square)	

7.8.3: Effects on oral health knowledge

Tables 8.8 and 8.9 describe the effect of the MI and traditional DHE, on oral health knowledge in the test and control-groups, respectively. The following sections describe significant differences found for knowledge items, between follow-up and baseline values (for test and control-groups).

7.8.3.1: Toothpaste quantity and brushing position

At follow-up, 45% of participants in the control-group correctly chose 'from behind the child' for the question '*From what position should you help brush your child's teeth*', compared to 17% at baseline ($p<0.05$, Chi square test), (Table 8.8). In the Test-group the proportion of participants who correctly chose a 'pea-size amount of toothpaste' increased from 56% at baseline to 90.5% at follow-up and none chose 'enough to cover brush head' compared to 24% at baseline ($p<0.05$, Chi Square test). The proportion who correctly responded 'from behind the child' in the test-group increased to 90% at follow-up compared to 24% at baseline ($p<0.001$, Chi square test), (Table 7.9).

7.8.3.2: Fluoride use

At follow-up, half the participants in the control-group agreed with the statement '*Fluoride should be placed on the teeth of young children every six months by a dentist or dental nurse to prevent cavities*', compared to 4% at baseline ($p<0.05$, Chi square test), (Table 7.8). Over three quarters of participants in the test-group agreed with the statement on the need for twice yearly fluoride application at follow-up, compared to less than a fifth at baseline($p<0.001$, Chi square test) (Table 7.9)

7.8.3.3: Dietary practices

In the test-group over half the participants correctly chose '*at mealtimes*' as the best time to give sugary snacks and drinks, compared to just 16% at baseline ($p<0.05$, Chi Square test) (Table 7.9).

Table 7.8: Oral health knowledge for control-group (follow-up v baseline)

Question	Baseline n	Baseline %	Follow-up n	Follow-up %	*p* value Chi square
Bacteria on the teeth of young children can cause cavities					
Yes	50	92.6	18	90.0	
No	1	1.5	1	5.0	0.758
Don't know	3	5.6	1	5.0	
Total	54	100	20	100	
What size of toothbrush is best for a young child					
Small	42	79.2	18	90.0	
Medium	8	15.1	2	10.0	0.447
Large	0	0	0	0	
Don't know	3	5.7	0	0	
Total	53	100	20	100	
How much toothpaste should be placed on the brush head					
Enough to cover brush head	10	18.5	3	15	
Pea size	33	61.1	17	85	0 .144
Smear	8	14.8	0	0	
Don't know	3	5.6	0	0	
Total	54	100	20	100	
From what position should you help to brush					
From in front of the child	35	64.8	9	45.0	
From behind the child	9	16.7	9	45.0	
From the side	4	7.4	2	10.0	**<0.05**
Don't know	6	11.4	0	0	
Total	54	100	20	100	
How much fluoride should be in the toothpaste					
Not less than 1000ppm	1	1.9	1	5.0	
450-600ppm	3	5.6	2	10.0	0.590
Don't know	50	92.6	17	85.0	
Total	54	100	20	100	
Fluoride varnish should be placed on teeth every six months					
Yes	2	3.7	10	50.0	
No	8	14.8	1	5.0	**<0.05**
Don't know	14	81.5	9	45.0	
Total	54	100	20	100	
When is it safe to give sugary drinks and snacks					
Between meals	25	46.3	9	45.0	
At mealtimes	5	9.3	1	5.0	
At night	0	0	2	10.0	0.200
in the morning	7	13.0	3	15.0	
Don't know	17	31.5	5	25.0	
Total	54	100	20	100	
When should you take your child for their first dental visit					
Only if problems	1	1.9	1	5.0	
By 1 year-old	21	38.9	4	20.0	
When some adult tooth	1	1.9	1	5.0	0.412
When all baby teeth	20	37.0	11	55.0	
Don't know	11	20.4	3	15.0	
Total	54	100	20	100	

Table 8.9: Oral health knowledge for test-group (follow-up v baseline)

Question	Baseline n	Baseline %	Follow-up n	Follow-up %	*p* value chi square
Bacteria on the teeth of young children can cause cavities					
Yes	22	88.0	18	85.7	
No	0	0	0	0	0.819
Don't know	3	12.0	3.0	14.3	
Total	25	100	21	100	
What size of toothbrush is best for a young child					
Small	19	79.0	17	81.0	
Medium	4	16.7	4.0	19.0	
Large	0	0	0	0	0.633
Don't know	1	5.3	0	0	
Total	24	100	21	100	
How much toothpaste should be placed on the brush head					
Enough to cover brush head	6	24.0	0	0	
Pea size	14	56.0	19	90.5	
Smear	2	8.0	2	9.5	**<0.05**
Don't know	3	12.0	0	0	
Total	25	100	21	100	
From what position should you help to brush					
From in front of the child	11	44.0	0	0	
From behind the child	6	24.0	19	90.5	
From the side	4	16.0	2	9.5	**<0.001**
Don't know	4	16.0	0	0	
Total	25	100	21	100	
How much fluoride should be in the toothpaste					
Not less than 1000ppm	1	4.0	1	4.8	
450-600ppm	0	0	4	19.0	0.071
Don't know	24	96.0	16	76.2	
Total	25	100	21	100	
Fluoride varnish should be placed on teeth every six months					
Yes	4	16.7	16	76.2	
No	0	0	1	4.8	**<0.001**
Don't know	20	83.3	4	19.0	
Total	24	100	21	100	
When is it safer to give sugary snacks and drinks to a young child					
Between meals	7	28.0	9	42.9	
At mealtimes	4	16.0	11	52.4	
At night	0	0	0	0	**<0.05**
in the morning	3	12.0	0	0	
Don't know	11	44.0	1	4.8	
Total	25	100	21	100	
When should you take your child for their first dental visit					
Only if problems	2	8.0	1	4.8	
By 1 year-old	5	20.0	7	33.2	
When some adult tooth	1	4.0	0	0	0.178
When all baby teeth	8	32.0	11	52.4	
Don't know	9	36.0	2	9.4	

7.8.3.4: Tooth brushing behaviour

In the regression model, at follow-up, the mean weekly claimed tooth brushing frequency in the control-group reduced whereas in the test-group it increased ($p<0.05$ ANOVA) (Fig 7.3). There were no statistically significant changes for '*How many times did your child brush at bedtime in the last week*' in the test and the control-group (Fig 7.4) or for '*How many times did you or someone else help brush your child's teeth in the last week*' (Fig 7.5).

7.8.3.5: Self-efficacy and oral health fatalism

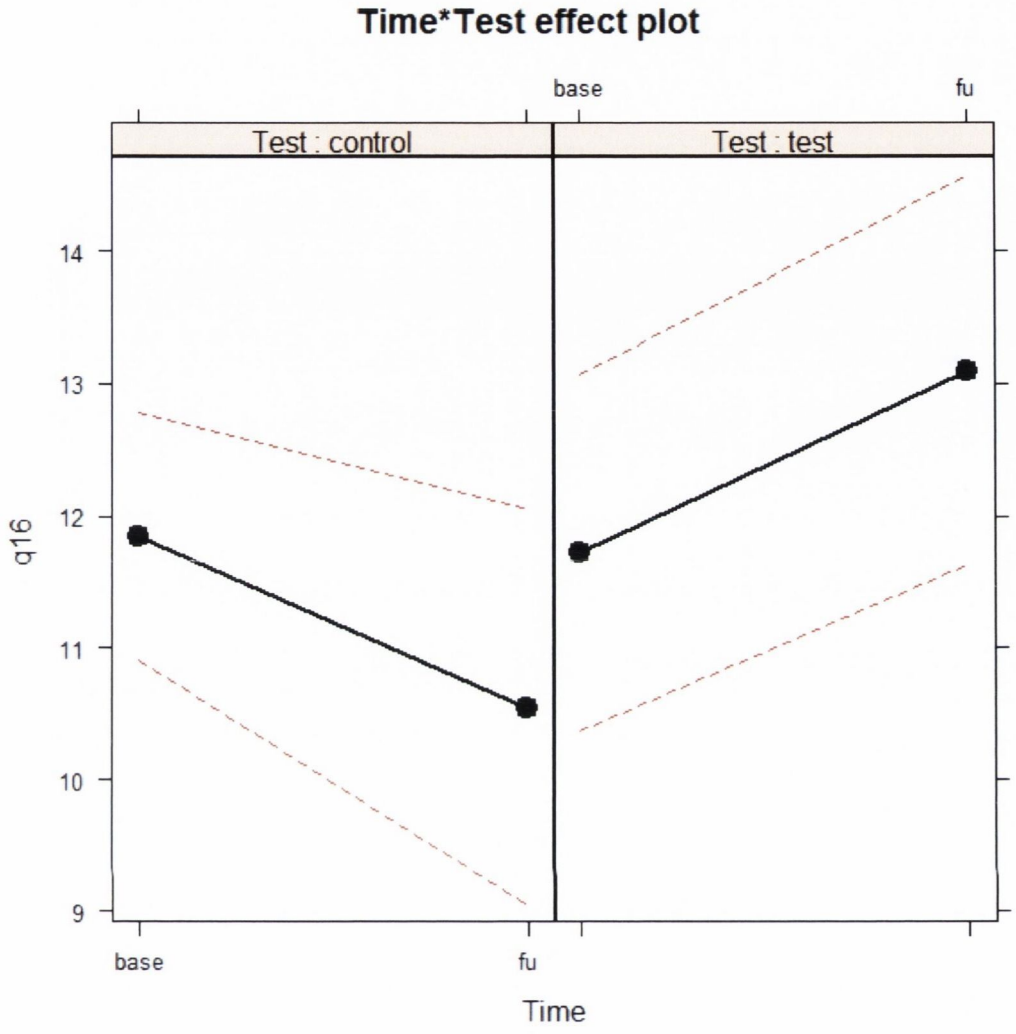
Although not statistically significant, the test-group showed an increase in 'Self-efficacy' (Fig 7.6) and reduction for 'Oral Health Fatalism' (Fig 7.7) whereas there was little apparent change in these variables in the control-group in relation to base-line levels.

7.8.3.6: (RAPIDD) constructs

There were no statistically significant changes in mean scores for '*openness to health information*' in both group (Fig 7.8) but for the construct '*valuing dental health*' both groups showed increase from baseline (Fig 7.9). Though not reaching statistical significance, mean scores for *convenience and change difficulty*' (Fig 7.10) and '*child permissiveness*' (Fig 7.11) showed a reduction in the Test-group. Mean scores for RAPIDD 'pros' appeared to increase (Figs 7.12) and RAPIDD 'cons' showed a decrease (Fig 7.13) but the changes were not statistically significant.

To visualise both within-group and cross-group differences over time, the following Time-Test plots (figs 7.2 - 7.13) show the mean score for a specific question variable, at both time points (baseline v follow-up), for Test and Control groups separately.

Figure 7.3: How many times did your child brush their teeth in the last week



***p*<0.05**

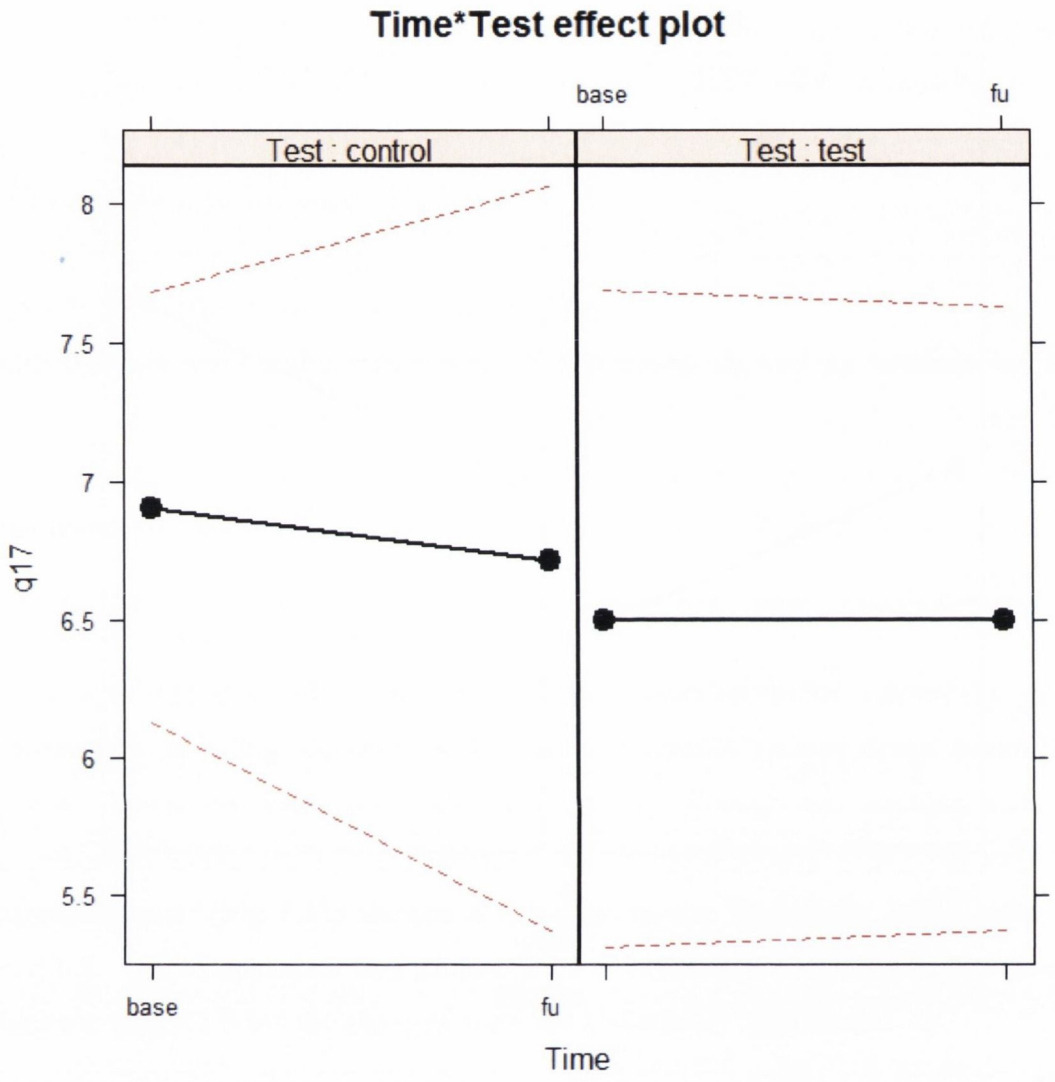
Key:

X axis = Time points (baseline v follow-up)
Y axis = Mean for question variable
base = Baseline
fu = Follow-up
Black line = change in mean value over time
Red line = 95% Confidence Interval

In this Time*Test effects plot, the interaction term (test-group (MI) v control-group (DHE) is significant in relation to the variable Time (i.e. baseline v follow-up) (*p*<0.05).

This plot therefore shows that reported mean weekly brushing frequency increased significantly in the test-group

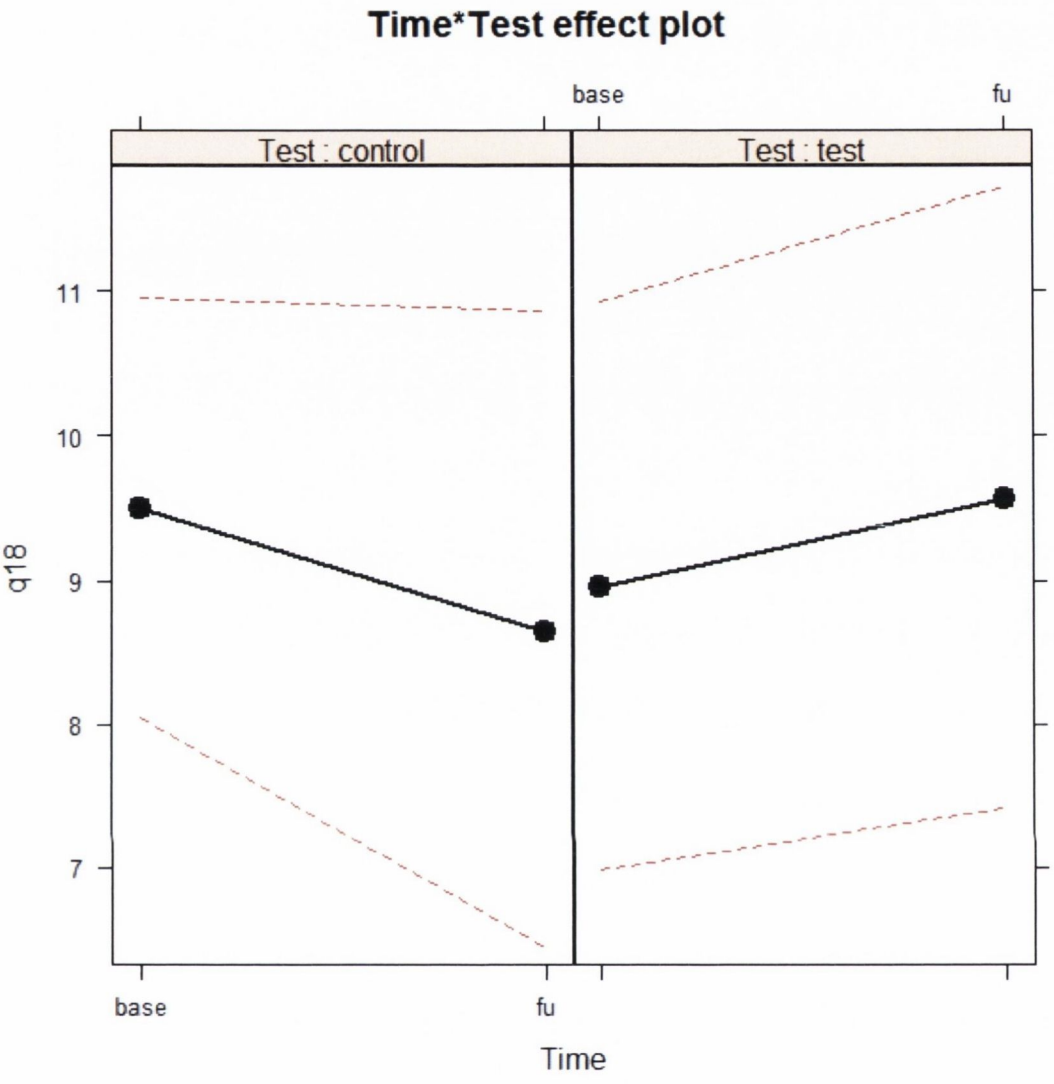
Figure 7.4: How many times did your child brush their teeth before bedtime in the last week.



***p*=0.867**

This plot shows no obvious change in the frequency of tooth brushing at bedtime in control or test-group.

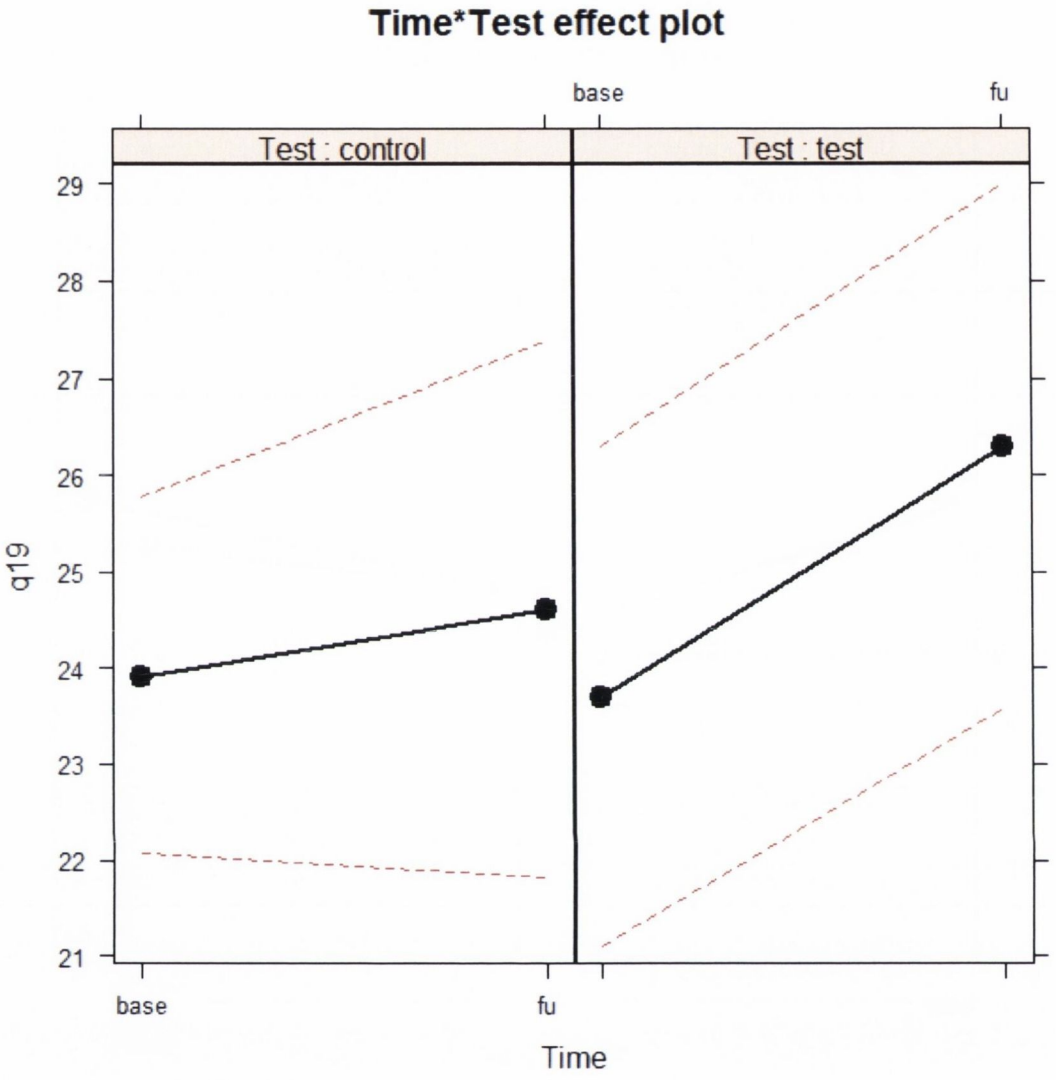
Figure 7.5: How many times did you or someone else help to brush your child's teeth in the last week



***p*=0.464**

This plot shows a decrease in the frequency of supervised tooth brushing in the control-group but an increase in the test-group. These changes were not statistically significant.

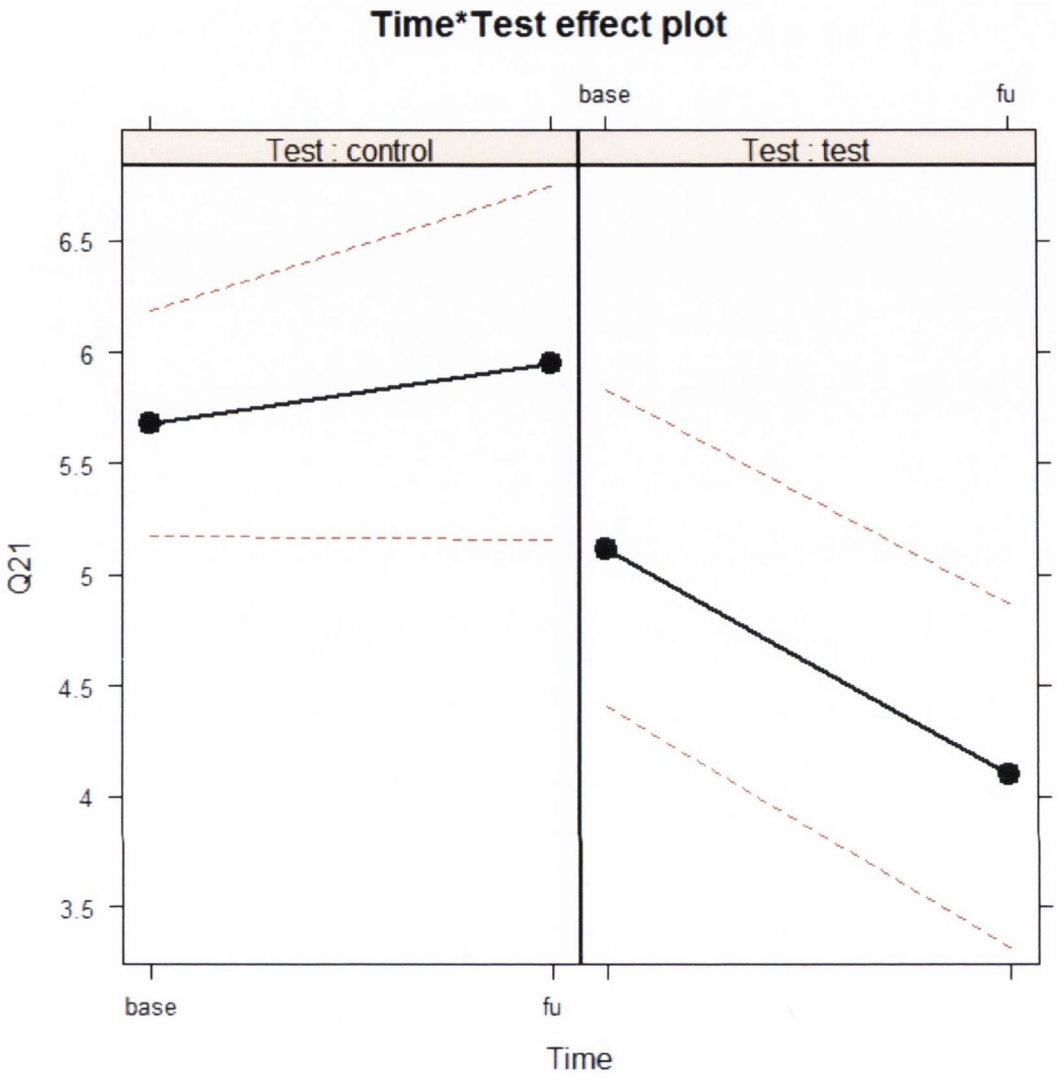
Figure 7.6: Oral health self-efficacy



***p*=0.931**

This plot shows an increase in oral health self-efficacy in both groups. These changes were not statistically significant.

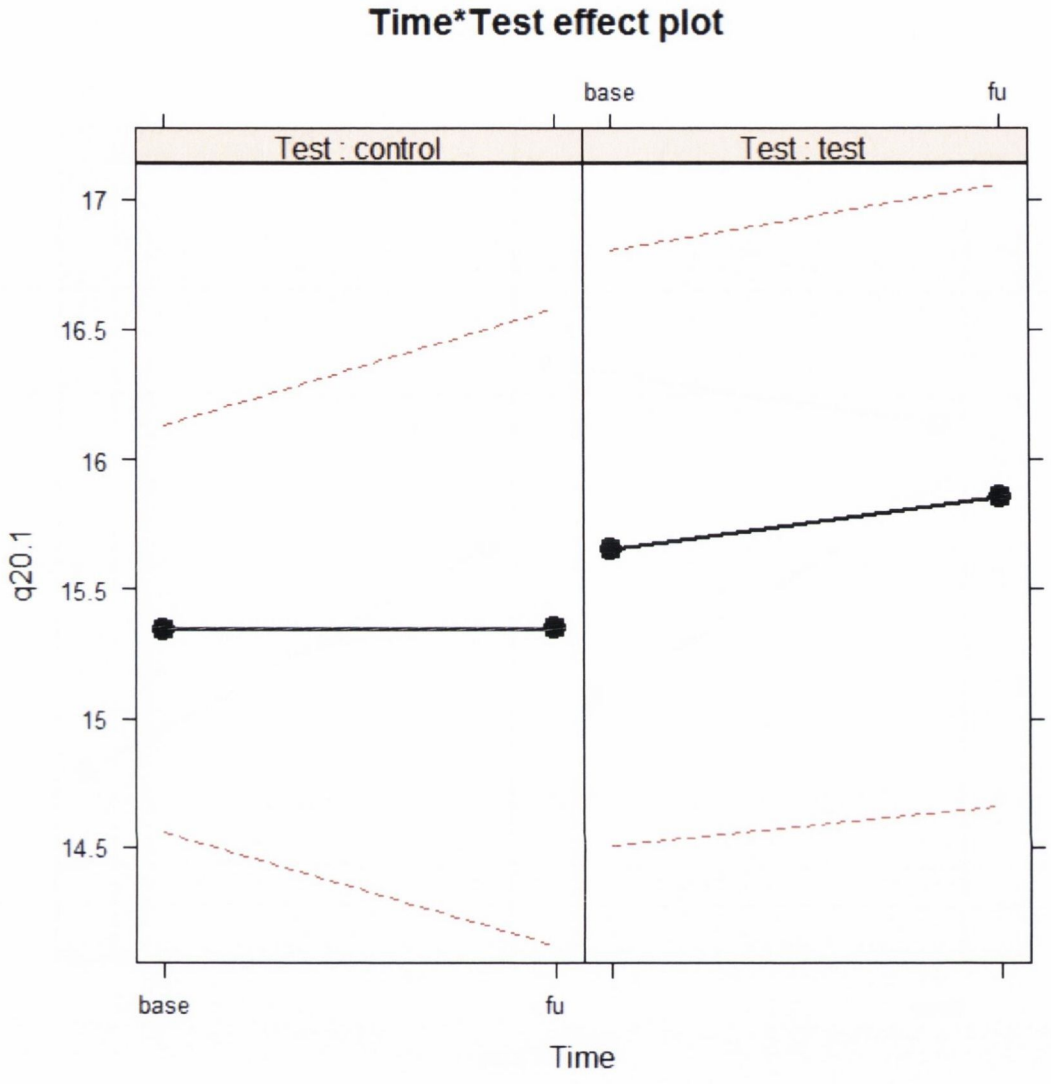
Figure 7.7: Oral health fatalism



***p*=0.07**

This plot shows an increase in oral health fatalism in the control-group but a decrease in this variable in the test-group. These changes were not statistically significant.

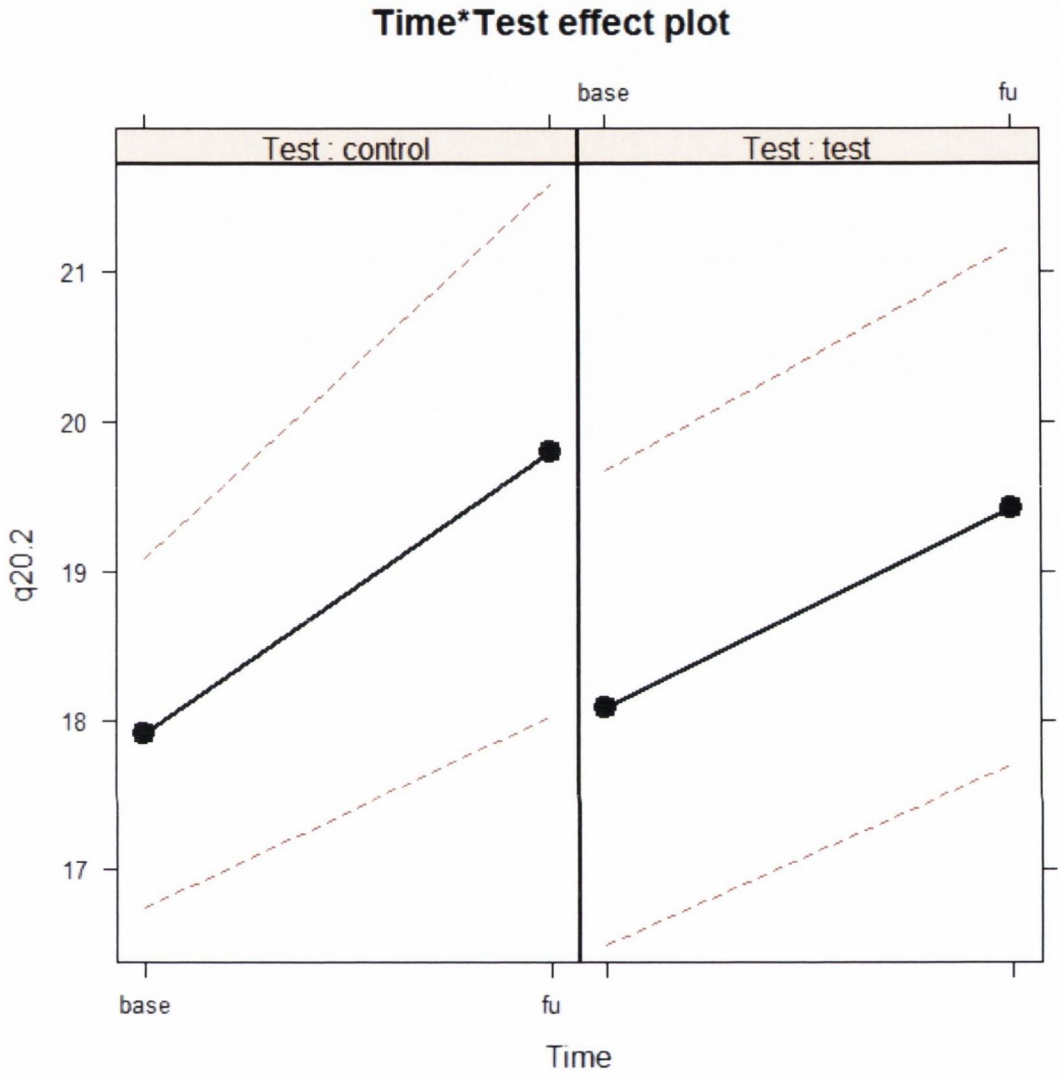
Figure 7.8: RAPIDD – Openness to health information



***p*=0.857**

This plot shows no change in 'openness to health information' in the control-group but an increase in the test-group. These changes were not statistically significant.

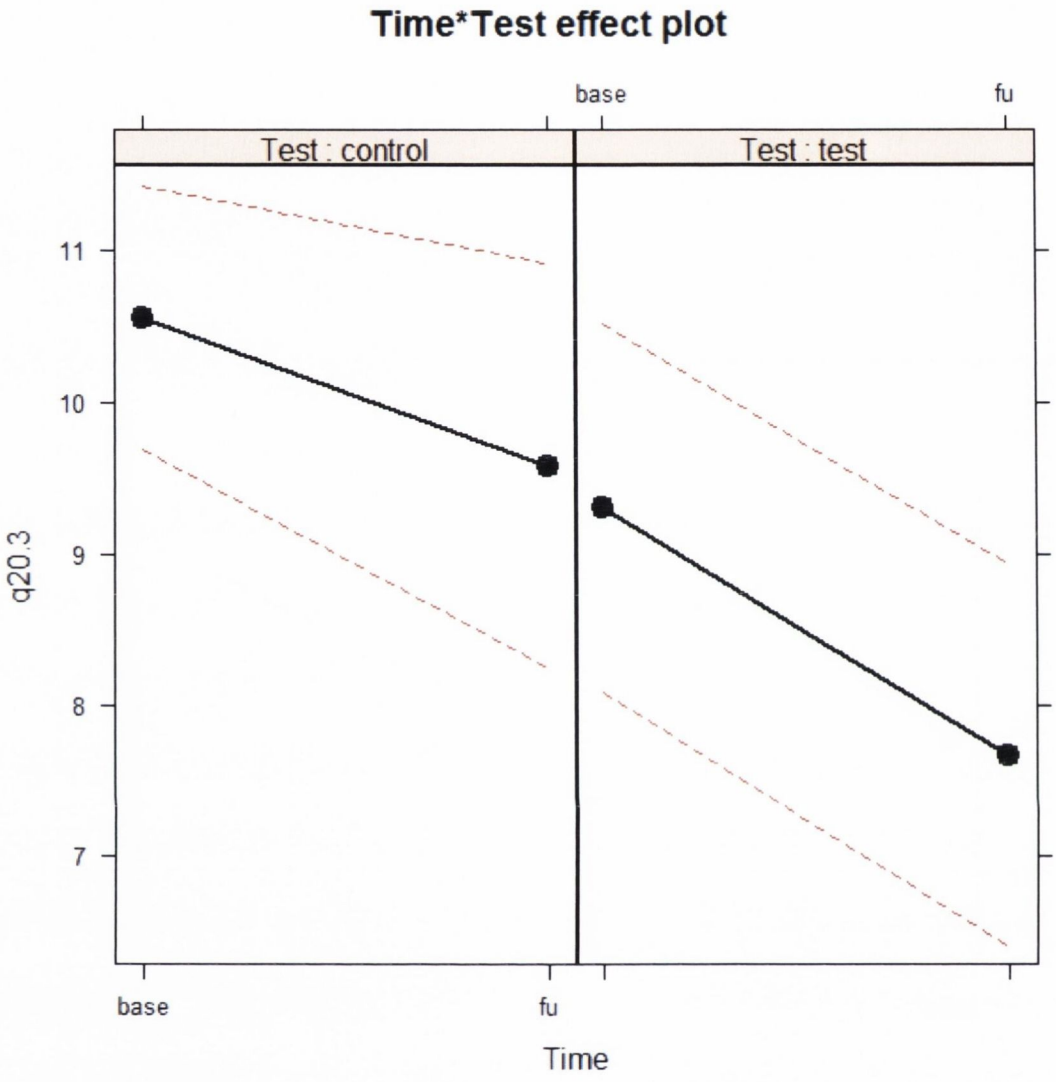
Figure 7.9: Valuing dental health



***p*=0.738**

This plot shows an increase in 'valuing dental health' in both the control and test-group. These changes were not statistically significant.

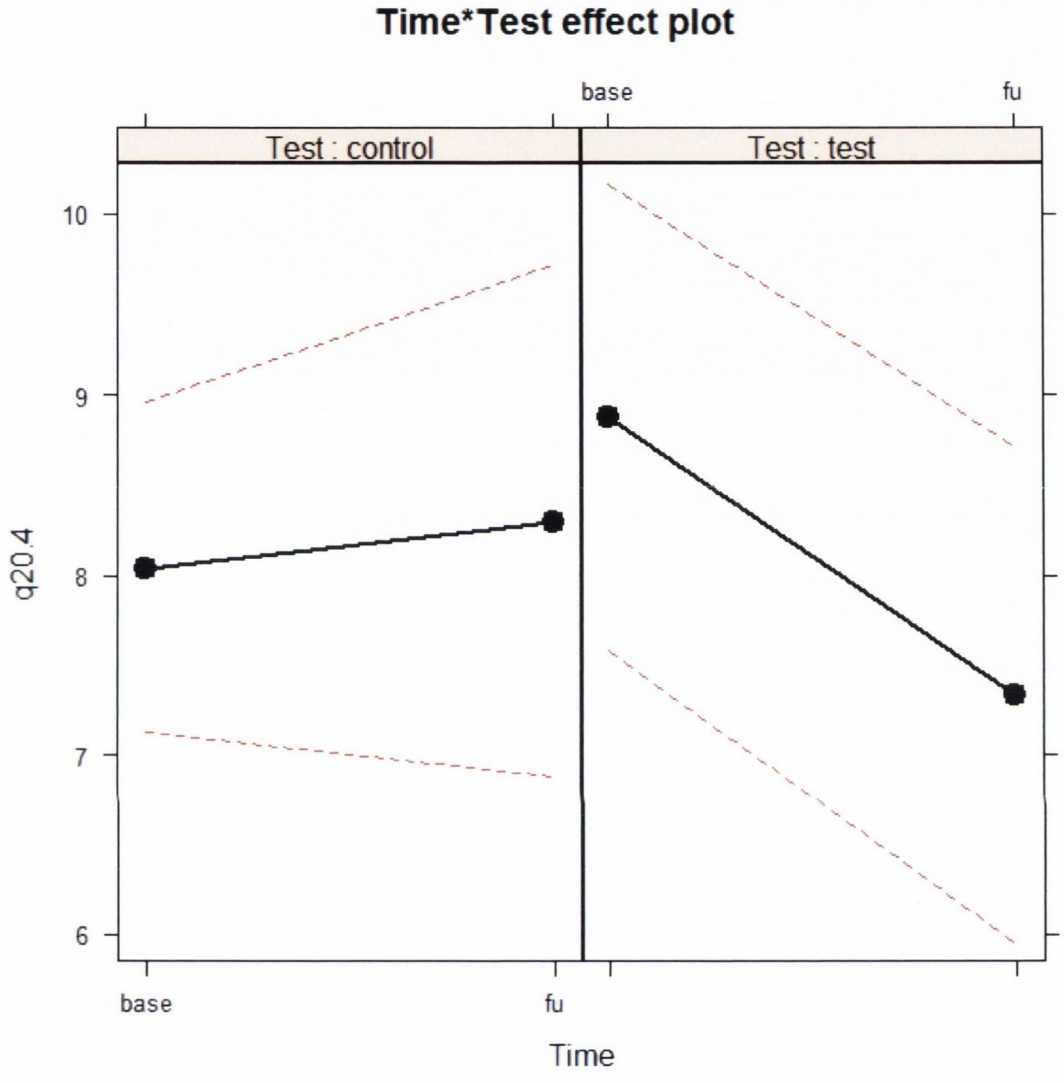
Figure 7.10: RAPIDD Convenience and change difficulty



***p*=0.583**

This plot shows a decrease in 'convenience and change difficulty in the control and test-group. These changes were not statistically significant.

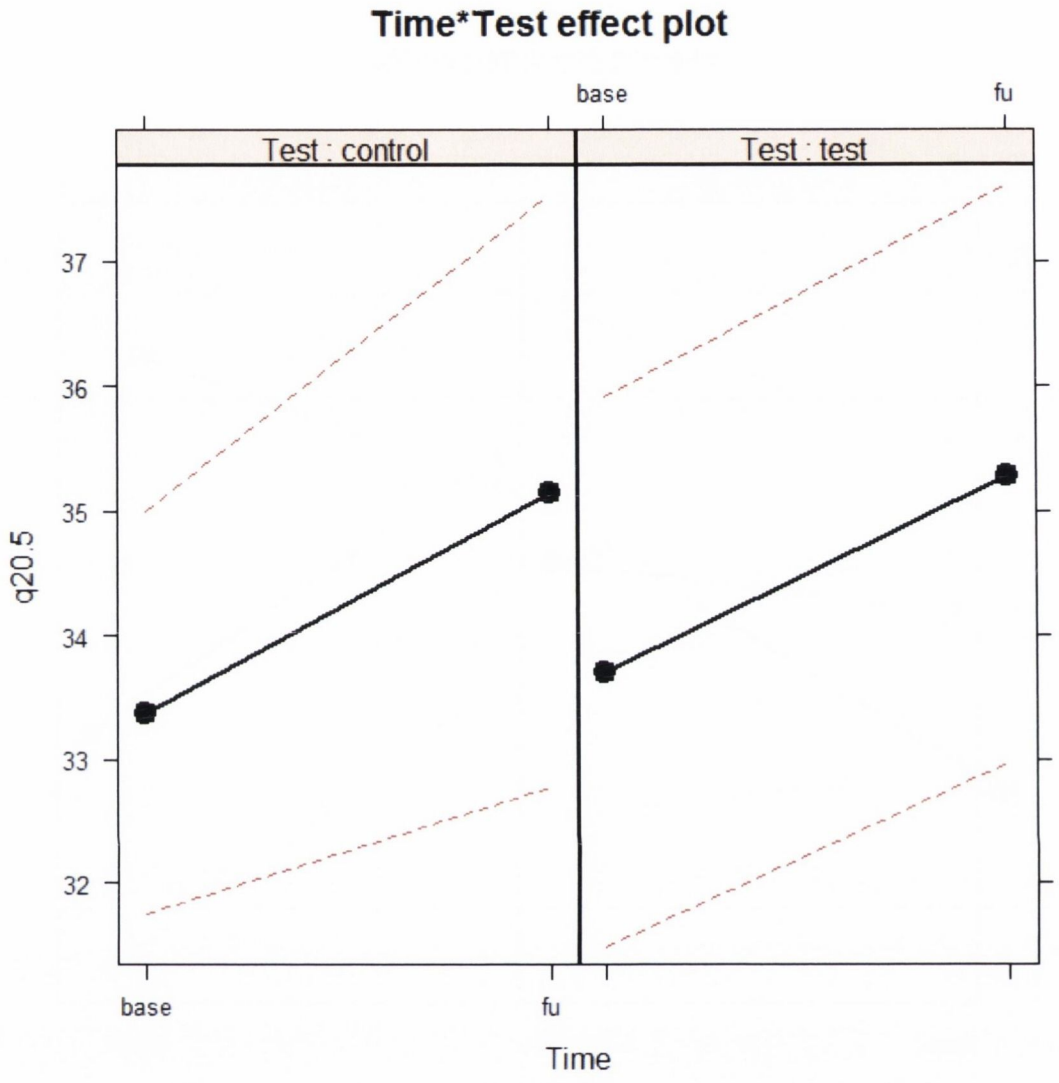
Figure 7.11: RAPIDD Child permissiveness



***p*=0.163**

This plot shows little change in 'child permissiveness' in the control-group but a decrease in the test-group. These changes were not statistically significant.

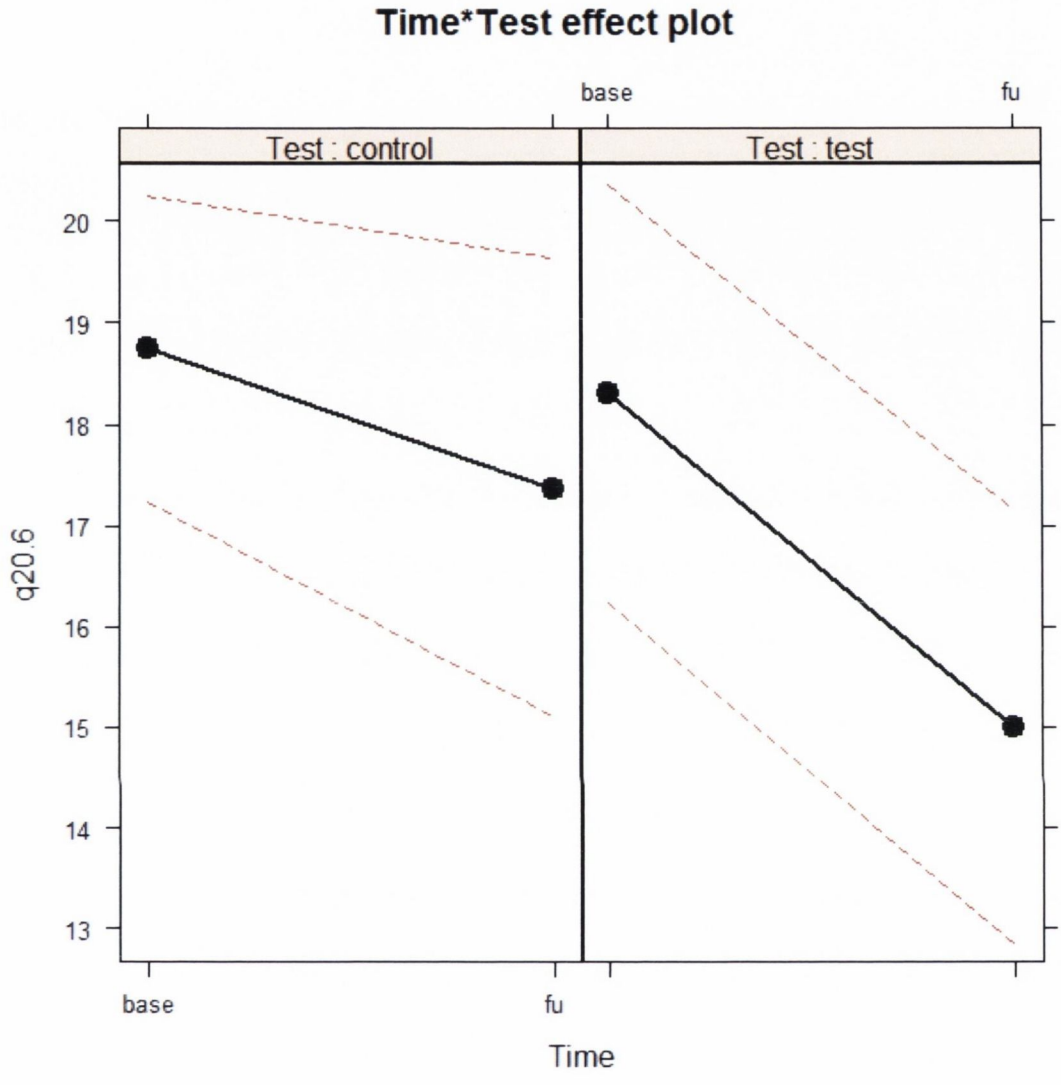
Figure 7.12: RAPIDD Pros



***p*=0.931**

This plot shows an increase in RAPIDD constructs (pros for change) –'*Valuing dental* health' & *'Openess to health information'* in both the control and test-groups. These changes were not statistically significant.

Figure 7.13: RAPIDD Cons



***p*=0.346**

This plot shows a decrease in RAPIDD constructs (cons for change) – *'Conveniene and change diffiulty'* & *'Child permissiveness'* in both the control and test-groups. A greater decresase can be seen in the Test Group. These changes were not statistically significant.

7.8.4: Qualitative results

The following section describes the results of the qualitative study, based on the thematic analysis of the focus group discussion.

7.8.4.1: Participant characteristics

Six participants from the 20 parents and caregivers who had remained in the MI intervention study at 4 month follow-up, accepted an invitation to take part in the focus group discussion. All participants were female, ranging in age from 25-34, with two thirds (4) of Indian ethnicity. Four participants stated secondary school was their highest level of education the remainder educated to tertiary level. Three participants were in professional / managerial occupation, the others being in manual occupation and housewives. Two participants cared for more than one child.

7.8.4.2: Views on the MI group-talk

During the discussion it became apparent that participants had not had any kind of dental health education (DHE) delivered to them prior to the MI group talk, therefore they could not compare it to other types of DHE delivery. However, they all appeared to feel comfortable with the MI approach in particular, the open discussion of oral health goals and barriers along with sharing of experiences with other parents / caregivers. Opinions offered on the telephone follow-up element of the MI protocol suggested that it did not feel intrusive and was helpful; no participants indicated discomfort with that aspect of the MI.

> *I find it* (MI group talk) *was good and it helped*
>
> *I think it* (MI group talk) *was better because sometime you might even forget about something to mention and another parent might bring it up and you know you would benefit from it.*
>
> *Yes, it was really good* (MI group talk), *because I never knew about the fluoride varnish before and I did enquire from my dentist*
>
> *That helped me amm... a lot* (telephone follow-up)..*and making sure that she brushes her teeth twice-a-day... because sometimes you know, they small so you'll say well if they fall asleep, so we now try to kind of wake her up and brush it...*

7.8.4.3: Mode of delivery of oral health information

Mixed opinions were expressed about the value of giving written material but most found written information helpful as a reinforcement / reminder of issues presented in the MI group talk. It was unclear at times if participants were referring to the value of the dental health information leaflet (**Appendix 7.6**) or the dental health menu used as part of the MI, as to some participants they may have seemed similar in content.

> *Yes, to reiterate what you did at the talk and see it* (information leaflet and dental health menu) *and remember certain things that you didn't remember*

> *I don't think it would matter to me to much because I mean at the end of the day we could verify the information* (information leaflet) *on the internet 'cause everything is there on the internet.*

> *I find the talk does be better because sometimes you get the hand-out* (Information leaflet) *and you misplace it*

> *You should give both* (MI group talk and written information)

7.8.4.4: Changing oral health practices

As a result of the MI intervention most participants had tried to implement some changes to oral health practices for their child such as twice daily tooth brushing, change of brushing position, use of fluoride toothpaste etc. In particular, after the MI intervention some participants, appeared to have made concerted effort to overcome practical difficulties such as their child falling asleep before night-time brushing. Following the intervention there also appeared to be greater understanding of the importance of using fluoride toothpaste and supervision of tooth brushing. Despite it being a little challenging, after the intervention, participants seemed to feel more confident in adopting the brushing from behind method. For some participants the follow-up phase of the intervention, was particularly helpful to support changes that had been made.

> *For me the positioning was one thing, I think that was the only thing I was not doing so umm, we did try to change that* (after MI group talk) *and using the mirrors as well, for her to see and so she could learn...*

> *I did learn from the talk because the amount of toothpaste.. so I changed that...*

> *.. since after the talk we try to get her to brush with toothpaste.*

she kind of like wants to brush her teeth on her own now but I still make sure and do with her it at least once-a-day especially by bedtime to make sure and do it properly. (MI telephone follow-up phase)

Yes, well the amount of toothpaste I was using, I was using too much (Before MI group talk)

How I position the child, 'cause I use to do it from in front and now I know how to do it from behind so I learnt about that. I guess he is more comfortable with me doing it that way

*That was the only thing (*brushing from behind*) that really that was different from the list* (Dental Health Menu) *as opposed to what we were doing*

*For me it wasn't a must before (*night-time brushing*)... then I tried to make sure ...*

7.8.4.5: Changing dietary practices

Some of the participants had children who were still using the feeding bottle (mainly at night). Though they expressed difficulty changing this behaviour in the past, following the MI intervention new efforts were made to discontinue this practice.

She still begs for the bottle. Well I threw away the nipple (feeding bottle) recently because it was like really bad but only like in the night.., like if she get up around three o'clock in the morning but we cut it down like real plenty.

... but you know when she sleeping and start crying for this bottle, it real hard to go back to sleep. But now I throw away the bottle.

So how she drinking now?...oh in a cup...

She would drink the Milo (cocoa drink) in the bottle but when you give it to her in the pack she would have two or three sips and that is it, she want that bottle..

7.8.4.6: Changing dental attendance behaviour

After the MI intervention some participants had made attempts at taking their child for a dental visit but had been hampered by difficulty in getting appointments. Overall, participants' awareness of dental service availability for young children appeared to have improved with more considering the dental hospital along with private practice. There was a persisting view that dental attendance was only for problems and in one

instance an inquiry about fluoride varnish at a private dental practice was met with the GDP not being aware of this as a preventive option for primary teeth.

> *I rarely took my son to the dentist because... I'm kind of ashamed..... I've been brushing his teeth regular and not notice that he has been getting a cavity on the inside.....*
>
> *Well we brought her to a private dentist and sometimes you have a waiting period, like if it's a emergency probably have to wait for an appointment.*
>
> *...sometimes you might have to get like four Saturdays after, or something like that....even if the child in pain.*
>
> *...and he* (family dentist) *said he don't recommend it* (fluoride varnish) *for children that age...*
>
> *She don't complain with no toothache, no ...so I never take her to any doctor yet*

7.8.4.7: Barriers to change

For some participants, the main barrier to changing oral healthcare practices was the child's non-acceptance of new brushing regimes, toothpaste use and change from feeding bottle to cup. Participants recounted concerted attempts to implement new oral health practices. Sometimes these efforts were further hampered by other family member involvement, in particular grandparents.

> *With my daughter she does not want to brush her teeth with toothpaste, so I don't know what to do again, now she only using mouthwash.*
>
> *...she not even giving up the comforter right now, she want that to sleep whole night, if that out the mouth, she not sleeping, she will be searching for it on the bed.*
>
> *I try, I go to Pennywise* (local pharmacy chain) *and buy all these different kids toothpaste and she still retaliating she don't want toothpaste and that is my biggest challenge right now, she brushing her teeth with no toothpaste.*
>
> *She just cried and cried...I hide the bottle and give her the cup.., she says "No Mummy I don't want it".*
>
> *...she likes to lie down and drink her tea...not sit down. The only way she drinking from a cup is with Milo* (sweetened cocoa drink)....
>
> *...you know grandparents spoiling the grandchildren...*

It does be harder for you too, cause they think they right (grandparents).. *I tell them she is three, she supposed to cut off the bottle....*

7.8.4.8 Summary of main findings from focus group

- All participants felt that the process had been helpful in improving awareness of good oral health practices related to their child/children.
- The key elements of the intervention (group talk, dental health menu, telephone follow-up) were all well accepted.
- The group-talk and follow-up had aided their efforts to make the desired changes to dietary practices, tooth brushing and fluoride use.
- Barriers to change were still being encountered (e.g. efforts at dental attendance) suggesting that on-going support and follow-up would be of value.

7.9: Discussion

This study has provided some insights into the usefulness of MI as part of an oral health promotion strategy for preschool children and their families. Among parents and caregivers who received the MI intervention there was a trend of improved oral health knowledge and preventive dental health behaviour. In discussing the findings from this study consideration must be given to baseline differences between test and control groups. Along with difference in ethnic composition, the test-group had a greater proportion of participants with post-secondary education and in non-manual occupations however they also reported having more difficulty in finding dental care for their child/ children.

Improving the knowledge and awareness of parents and caregivers is a key element of dental prevention in preschool children (Blinkhorn *et al* 1991, Levine and Stillman-Lowe 2009, Santos *et al* 2013).

In this study, participants who received MI showed improved knowledge across a wider range of knowledge items (correct amount of toothpaste, supervised brushing position, fluoride varnish, and safest time to give sugary foods and drinks) compared to those who received traditional DHE. Knowledge of the importance of fluoride varnish application also has practical implications for preventive strategies as this clinical intervention is effective in reducing ECC separately and in combination with fluoride toothpaste (Weintraub *et al* 2006, Marinho 2009). Also the reduction in prevalence of early childhood caries (ECC) following an MI intervention reported in

Asian families in Canada was largely attributed, to a greater uptake of fluoride varnish by those families (Harrison *et al* 2007).

Establishing good tooth brushing habits and routines in preschool children can be a challenge for families (Truby *et al* 2013). Importantly, in this present study, the MI intervention had a significant effect on this preventive oral health behaviour with the test-group claiming an increased frequency of weekly brushing. Regular (at least twice daily) brushing with fluoride toothpaste is a core aspect of caries prevention in preschool children (Uribe 2006, Macpherson *et al* 2013, Santos *et al* 2013). Brushing with fluoride toothpaste before the child's evening bedtime gives further protection, as during this time the teeth are more vulnerable to the effects of plaque bacteria (Levine and Stillman Lowe 2009). In the present study the focus group data suggested that getting the child to brush at night-time was one of the more difficult behaviours for parents and caregiver to change, often because the child refused or fell asleep. This is consistent with findings from the UK where parents of preschool children found more difficulty in establishing a routine of tooth brushing at that time of day (Trubey *et al* 2013). Again based on findings from the focus group it appeared that some participants in the test-group had experienced success with efforts to stop use of the night-time feeding bottle. This was encouraging as this routine may also have been a particularly difficult to change as bottle-use has been associated with issues of closeness and comforting by the mother as well as 'buying time' time away from their crying child (Freeman and Stevens 2008).

Miller and Rollnick (2002) state that "for a client to change they must feel both confident in their ability to change and believe the change is important to them". This is consistent with Finlayson *et al* (2007a) who reported that the brushing behaviour of young children was positively related to maternal self-efficacy.

In the present study, although the changes did not reach statistical significance, the trend of higher self-efficacy was therefore important, as self-efficacy can be viewed in the context of empowerment, one of the core principles of oral health promotion. The importance of parental self-efficacy was also noted by Blinkhorn (2001) who stated that effective parental involvement in tooth brushing for preschool children requires more than just knowing it is important.

Lower levels of oral health fatalism (OHF) may lead to a more positive attitude toward oral health and increased motivation to adopt preventive practices as Finlayson *et al* (2007a) reported a trend of preschool children who brushed less

frequently having 'fatalistic' mothers. Levels of OHF among all participants in the present study were similar at baseline but the trend in the data suggested that unlike traditional DHE, the MI approach reduced parent/caregiver OHF, hence reducing possible barriers to change.

Further support for the value of MI in oral health promotion for preschool children was provided by recent clinical guidelines from the Scottish Dental Clinical Effectiveness Programme (SDCEP) – 'Prevention and management of dental caries'. This guidance states the importance of considering the parent/ caregiver's motivation for change and that establishing rapport is essential to the child's oral health, especially in relation to brushing and dietary practice at home (Scottish Dental Clinical Effectiveness Programme 2010).

Huber and Weinstein (2011) state that focusing on motivation and 'readiness to change' is critical in establishing effective oral health risk assessment and determining a course of action tailored to the needs of the client. The concept of readiness for change, in this study was explored using the RAPIDD instrument. Although the analyses did not demonstrate a statistically significant effect of MI on the RAPIDD construct scores, some interesting trends were evident, such as the changes seen for 'valuing dental health', 'convenience and change difficulty' and 'child permissiveness'. Tipping the balance in favour of positive change requires increasing the pros for change and reducing the cons for change, or both (Weinstein and Reidy 2001). The trend of increase in pros and reduction cons in the test-group was therefore encouraging and possibly indicates a movement of participants from contemplation stage towards preparation for action. This was consistent with the favourable improvements seen in oral knowledge and attitudes, the positive behaviour change seen in tooth brushing frequency and the comments in the focus group. The present findings are also similar to those of Freudenthal *et al* (2010) who reported an effect of improvement in brushing frequency in mothers who received MI but, apart from 'valuing dental health', reported no significant changes in the RAPIDD scores between test and control-groups.

On the issue of tooth-brushing practices, understanding these parents and caregivers' perspective was vital. This aspect formed part of the MI conversation that uses 'reflective listening', where, over the course of the session, the educator / counsellor seeks to increase the clients strength for expressed motivation in order to target a

behaviour change. Trubey *et al* (2013) reported that parents of preschool children found difficulty of changing tooth brushing habits where it involved changing established daily routines. From the views that were expressed in the present study relating to attempts at changing brushing habits, it could be inferred that these participants felt more confident in their ability to use the oral health information. Exploring practical ways to overcome barriers to oral healthcare for their child/children may also have helped participants to persist with introducing new oral healthcare regimes about which they had learned.

In a systematic review of behaviour change techniques including face-to-face counselling approaches such as MI, Noordman, *et al* (2012) concluded that there was good evidence for the use of these types of behaviour change techniques across primary health care, although more research was required to explore and understand the underlying mechanisms.

Recently, the concept of *mediating variables* has been proposed to better understand the mechanism of health promotion interventions (MacKinnon *et al* 2011). In this theory, the adoption of positive oral health behaviours would be termed an intermediate construct or 'mediating variable' i.e. a variable that results in an overall outcome of public health importance e.g. reduction in prevalence of ECC following the use of an intervention. MI might then be considered an intervention that effects 'mediators' such as parental oral health knowledge, attitudes and self-efficacy as opposed to traditional dental health education, which only targets oral health knowledge. The process could be described as the intervention (MI) having a causal effect on the mediators (parental oral health practices), which in turn have a causal effect on the outcome variable i.e. reduction in ECC.

Understanding the relationship between mediating variables and desired health outcomes could therefore be key to understanding which public health intervention would be appropriate in a given situation for a specific target population (Litt 2011). In their systematic review of parental influences on ECC, Hooley *et al* (2012) highlight the importance of socio-cultural factors that are likely to affect mediating variables such as attitudes and oral health beliefs. Watt (2010) and (Yevlahova and Satur 2009) suggest the MI approach enables oral health professional to focus more on underlying social determinants of disease by tailoring interventions to suit a clients' social circumstances while attempting to develop their 'readiness for change'

'Readiness for change' has been defined as 'a client's current thoughts, feelings and attitudes regarding their intention to institute a change in their habits' (Miller and Rollnick 2002). From another perspective, Wanyonyi *et al* (2011) suggest that MI provides an opportunity to address 'felt needs' which is supportive of the view of Williams, Sheiham and Watt (2012) who state that primary healthcare professionals should address the needs of families in the context of their environment and experience. Interestingly, the review by Britt *et al* (2004) and the systematic review by Wanyonyi *et al* (2011) both conclude that considering patient /client's 'readiness for change' can be useful in face-to–face communication in the primary health care setting. This may be of particular value as a means for working with people who are ambivalent toward change, a situation commonly encountered in families with young children. Britt, *et al* (2004) suggest that health practitioners are likely to gain a greater sense of achievement from recognising progress in a client's 'readiness for change' as an important outcome rather than using behaviour change as the only goal, as obvious behaviour change may not be measurable in the short term.

Another important finding from the present study was that comments from the focus group indicated participants in the test-group were comfortable with the telephone contacts made by the Dental Nurses. This element of the protocol may in fact have been one of the main strengths of this MI intervention, as indicted by the significantly lower drop-out rate for participants in the Test-group, suggesting the telephone contacts helped to maintain motivation and commitment from participants. This is consistent with the findings of Weinstein *et al* (2004) who believed that longer telephone or in-person follow-up could add even more value to the process.

The challenges the participants in the present study encountered in trying to alter dietary and dental attendance behaviour, indicates the value of on-going support to achieve these goals. This has human resources implications, as a behaviour change technique (BCT), such as MI may be time-consuming for a single person/ health professional, therefore opportunities should be explored for dividing this workload through involvement and delegation to other professions who can be trained in MI e.g. dental therapists, community nurses, preschool teachers (Noordman *et al* 2012). This has been successfully demonstrated by Cook *et al* (2012) who reported that a broad range of staff in a Head-Start programme were able to successfully use MI techniques in counselling parent of preschool children on oral health behaviours. Ismail *et al* (2011) also states that developing MI approaches requires an understanding of how

best to customize it to diverse situations and population groups. Primary healthcare providers, working with other stakeholders for oral health in early childhood, therefore, have the potential to have a positive impact in reducing early childhood caries by greater contact with families with preschool children and offering support and practical advice through community-based interventions.

7.10: Limitations of the study

Some limitations of the present study must be considered when interpreting the findings.

1. Sample sizes and subsequent group allocations were relatively small due to difficulty in subject recruitment and retention. Smaller sample sizes reduce the ability to determine effects on the variables under investigation.
2. Differences in characteristics between the test and control-group at baseline (education level, occupation, experiences of accessing dental care) may have influenced the effect of the intervention. Although the groups were randomly allocated these socio-demographics imbalances may have been due to some preschools having significantly more parents from a particular ethnic or socioeconomic group.
3. The duration of the study was short (4 months). This was to avoid further drop-out and loss of contact with participants as their children moved on to primary school / families leave the area.
4. Self-reported questionnaires can be affected by participant recall (Bowling 1999). Furthermore, some response bias may have resulted from 'social desirability' i.e. bias due to clients who misrepresent self-reported behaviours by over-reporting behaviours considered socially desirable, and underreporting undesirable ones (Sanzone *et al* 2013).
5. More extensive training in MI for the dental nurses who undertook the telephone follow-up may have helped increase fidelity to the MI protocol. (Training in MI for the dental nurses consisted of one hour face-to-face, supplemented by written information for home-study).
6. Absence of a non-intervention control-group may have masked absolute effects of the MI intervention. It was felt that a non-intervention group would not have been acceptable in the context of this study.

7. Delivery of MI in group setting has not been as extensively evaluated as one-to-one counselling. Miller and Rollinick (2013) suggest that MI delivered in a group setting has less predictable outcomes as little is know about the 'active ingredients' in the group context i.e. what are the mediating and moderating factors for efficacy and point out that (a) Each group member has less time to engage in the process of evoking and change talk. (c) Group dynamics can alter the probability of change talk. (d) People within the group may reinforce ambivalence in others.
8. It was not possible to include all parents and caregivers who received the MI in the focus group discussion as most were unavailable. This limited the sample size and group size of the focus group. Minimum sample size for focus group has been stated as six (Bowling 1999) and Guest (2006) states that where there is a high degree of homogeneity, for qualitative studies, samples of less than ten can still achieve data saturation.

7.11: **Conclusion**

Although the findings should be considered as exploratory, in this controlled study there was evidence that using an MI approach when delivering oral health information had a positive effect on parent/ caregiver oral health knowledge, attitudes and behaviours compared to traditional DHE. The acceptability of the MI protocol, which included follow-up telephone contact was also good, as indicated by discussions with the recipients both during and after the delivery of the programme. These findings suggest that further development of this person-centred counselling approach could be of benefit for improving oral health of preschool children in Trinidad and should form part of oral health promotion strategies for this population group.

CHAPTER EIGHT: PREVENTION AND MANAGEMENT OF EARLY CHILDHOOD CARIES: AN ORAL HEALTH PROMOTION STRATEGY FOR TRINIDAD

This chapter reviews best-practice for prevention and management of early childhood caries (ECC) and presents an oral health promotion strategy for preschool children.

8.1: Introduction

Delivery of high quality patient care including preventive regimes and management of disease outcomes requires information and evidence on the effectiveness of available approaches. Evidence-based dentistry (EBD) has been defined as clinical practice that integrates research evidence, clinical experience and patient preferences (Grace 2002). Implementation of EBD requires the synthesis of primary research, critical appraisal and systematic reviews to inform clinicians, policy makers, dental professional groups and industry and the public (Pitts 2004). This is also relevant to the development of appropriate public health strategies and interventions. Based on a review of evidence-based guidelines and findings from the present research this chapter concludes with an oral health strategic framework for prevention and management of early childhood caries in Trinidad.

8.2: Summary of main findings from present research

In the following sections the main findings from the research studies described in the previous chapters are summarized under the categories quantitative, qualitative and interventional.

8.2.1: Main findings from the quantitative study

From the cross-sectional survey, the prevalence of ECC among preschool children in Central Trinidad was 29.1% with a dmft of 1.4 (sd 3.01), with visible caries experience largely attributable to decayed teeth (dt). For those children with ECC the severity of visible caries experience was high (mean dmft 4.8, range 1 -13 teeth). As indicated by the levels of untreated decay, treatment needs were largely unmet with most of the children with ECC requiring restorative care or extractions and over third needing urgent care for a caries-related problem.

Logistic regression analyses and statistical modelling indicated that ECC in this sample was associated with problems of access to dental care and frequent intake of sugary foods and drinks. Consistent with the literature there was also an association between ECC and enamel developmental defects (demarcated and diffuse enamel hypoplasia). The prevalence and severity of ECC was also associated with negative impacts on oral health related quality of life (OHRQoL).

With respect to other oral conditions, over a quarter of children had signs of dental erosion but the presence of traumatic dental injuries was very low (5%). Oral hygiene was generally good and the prevalence of gingivitis was very low. Few children had visible dental anomalies (7%).

8.2.2: Main findings from the qualitative study

The focus group study, based on a sub-sample of parents and caregivers, reported findings consistent with those from the questionnaire survey. These participants experienced barriers to dental care related to previous dental experiences and negative perceptions of children's dental care. Along with issues of affordability and low awareness of service availability, this appeared to cause problems with accessing dental care for their child/children. Oral care at home was affected by confusion regarding fluoride toothpaste and effective tooth brushing, continued use of the feeding bottle and the difficulty in controlling sugary drinks and snacks in the face of other parental responsibilities. These parents and caregivers expressed a need for more information and practical support to improve their oral healthcare practices and wanted more contact with oral health professionals in non-dental settings, such as preschools.

8.2.3: Main findings from the intervention study

The findings of the interventional study showed a trend of greater effectiveness with respect to improved oral health knowledge, attitudes and behaviour in parents and caregivers who had received a motivational interviewing (MI) approach compared to those who had received traditional dental health education (DHE). In particular, participants in the MI group appeared to show greater 'readiness for change' indicating that this person-centred counselling approach has utility in oral health promotion aimed at improving early childhood oral health.

8.3: Approaches to prevention and management of ECC

Addressing oral health in early childhood requires the development and implementation of oral health promotion strategies based on research evidence and appropriate to the target population. The following sections describe research and international evidence-based guidelines for prevention and management of ECC.

Approaches include:

- Caries risk assessment (CRA).
- Tooth brushing with fluoride toothpaste.
- Topical fluoride therapy involving fluoride varnish, early dental attendance / establishing the dental home).
- Preventive advice from medical and non-dental health professionals
- Utilisation of mid-level providers (Dental Therapists) to improve access to dental care
- Alternative approaches (MI)

8.3.1: Caries Risk Assessment (CRA)

Caries risk assessment (CRA) has been defined by the American Academy of Paediatric Dentistry as "the determination of the likelihood of the incidence of caries during a certain time period or the likelihood that there will be a change in site or activity of lesions already present" (AAPD 2013).

CRA is considered essential for prevention of ECC in infants and preschool aged children by The Scottish Intercollegiate Guideline Network (SIGN) and Scottish Dental Clinical Effectiveness Programme (SDCEP) (SIGN 2005 and SDCEP 2010). A well designed CRA serves as a guide for dental health professionals to design treatment and preventive protocols for children considered at risk for ECC (Ramos-Gomez *et al* 2012). Targeting interventions at young children at high risk of ECC can benefit those who traditionally do not yet have a dental home (American Academy of Paediatrics 2008) Furthermore, preventive interventions targeting high-risk preschool children at an early stage in the natural history of ECC, provide cost-benefit by reducing expenses from restorative care and management of advanced caries (Hirsch *et al* 2012). Ideally, CRA should be done before disease onset and is linked with the concept of early dental attendance and establishment of the dental home but even with

later / symptomatic attendance, CRA still has an important role in establishing management and follow-up care.

CRA for infants and preschool age children should be based on a clinical examination and an interview with the parent/ caregiver. Clinical information assessed includes: oral hygiene (visible plaque levels, gingival health), caries experience (restorations, decay, missing teeth), integrity of restorations, white / brown lesions, developmental defects, erosive lesions, level of compliance with the dental examination as possible Dental Behaviour Management Problems (DBMP). Information from the parent/ caregiver interview should include: Child general health / medical concerns, dietary practices (breastfeeding, bottle / feeder cup-use, night-time feeding), frequency of non-milk extrinsic sugars (NMES) in meals, snacks and drinks), use of fluoride toothpaste, tooth brushing frequency and degree of parental / caregiver supervision, use of dental services, dental health of siblings, health literacy, occupation and area of residence.

Information from the CRA can also inform the need for radiographic assessment and frequency of recall, appropriate fluoride regimes, and specific information to include in anticipatory guidance / oral health counselling for the parent/caregiver. Anticipatory guidance is the process of providing practical, information about children's health to prepare parents for significant developmental milestones (American Academy of Paediatrics 2008).

Ramos-Gomez *et al* (2012) suggests six risk categories and the required management: *Low*, *Moderate*, (*compliant or non-compliant), High (compliant or non-compliant)* and *Extreme*. Importantly, this risk classification takes into account the level of compliance of the child and DBMP, which has implications for delivery of care in primary or secondary care setting, need for specialist referral and general anaesthesia (GA) services.

Several national / international CRA protocols have been developed for preschool age children. *The Dundee Caries Risk Assessment Model* (SIGN 2005) was developed from longitudinal data to include social, medical, and dental data on 1500 children born in the same year. The two most significant caries risk indicators at the age of one year, for a child having ECC at age of four years, were: living in a council home (social housing), and the health visitor's / community nurse opinion that the child was at risk of caries The guidance states a dental practice-based CRA for preschool children should include:

- Evidence of past caries experience
- Residence in a deprived area
- Healthcare workers opinion
- Oral streptococci mutans counts (if accessible)

This risk model would be appropriate for use by both dental and non-dental professionals (SIGN 2005). The Scottish Dental Clinical Effectiveness Programme also developed and published in Scotland, affirms that CRA is an essential part of the of prevention of ECC again including caries experience, health care worker opinion and residence in a deprived area but does not include S.mutans counts (SDCEP 2010). A similar risk assessment tool for dental professionals for use in children and adolescents, the *Caries Risk Assessment Checklist,* has been proposed by the Irish Oral Health Services Guidelines Initiative (IOHSGI 2009).The checklist was developed on the basis that as all children are potentially at risk of caries, the tool would help identify only those at high risk, in order to prioritise their dental care (Table 8.1). It was designed to be simple and quick to apply in dental clinical setting. One of the aims of the initiative was to have all children offered a dental assessment during the first year of entry to primary school (i.e. just after leaving preschool). The checklist is divided into three sections. The first section relates to factors/indicators considered most important in identifying high caries risk children based on the literature and expert clinical experience. The middle section refers to other potential risk factors and DMFT cut-off points. The third section lists factors derived from systematic reviews of caries prevention with the final assessment based on the dental professional's assessment of the balance of risk factors versus protective factors.

Table 8.1: The Caries Risk Assessment Checklist (Irish Oral Health Service Guideline Initiative 2009)

RISK FACTOR / INDICATORS	**Circle most appropriate answer**	
A 'YES' in the shaded section indicates that the child is likely to be at high risk of or from caries		
• Age 0-3 with caries (cavitated or non-cavitated)	YES	NO
• Age 4-6 with dmft >2 of DMFT>2	YES	NO
• Age 7 and over with active smooth surface caries (cavitated or non-cavitated) on one or more permanent teeth	YES	NO
• New caries lesions in last 12 months	YES	NO
• Hypomineralised permanent molars	YES	NO
• Medical or other conditions where dental caries could put the patients general health at increased risk	YES	NO
• Medical or other conditions that could increase the patients risk of developing dental caries	YES	NO
• Medical condition that may reduce the patients ability to maintain their oral health, or that may complicate treatment	YES	NO
The following indicators should also be considered when assessing the child's risk of developing caries		
• Age 7-10 with dmft>3 or DMFT >0	YES	NO
• Age 11-13 with DMFT>2	YES	NO
• Age 14-15 with DMFT>4	YES	NO
• Deep pits and fissures in permanent teeth	YES	NO
• Full medical card	YES	NO
• Sweet snack or drinks between meals more that twice a day	YES	NO
PROTECTIVE FACTORS		
• A 'NO' in this section indicates the absence of protective factors which may increase the child's risk of developing caries	YES	NO
• Fissure sealants	YES	NO
• Brushed twice or more a day	YES	NO
• Uses toothpaste containing 1000ppm F or more	YES	NO
• Fluoridated water supply	YES	NO /DK
IS THIS CHILD AT HIGH RISK FROM CARIES?	YES	NO

The Irish Oral Health Services Guideline Imitative states that CRA is a continuous process, as individual risk status can change over time and recommends that ' *recall of high risk children should be based on the clinician's assessment of the child's caries risk status using the Caries Risk Assessment Checklist and should not exceed 12 months.*' (IOHSGI 2009)

Like the caries risk assessment proposed in the guidance from Scotland which records an area deprivation score (SIGN 2005, SDCEP 2010), the Irish caries risk assessment checklist takes SES into consideration by using medical card status as a proxy for deprivation .

In its policy document on caries-risk assessment for infants, children and adolescents, The American Academy of Paediatric Dentistry recognises the critical role caries risk assessment can play in the oral healthcare of children and states "risk assessment tools can aid in the identification of reliable predictors and allow practitioners, physicians and other non-dental healthcare providers to become more actively involved in identifying and referring high risk children" (AAPD 2013). This policy provides the rationale for their Caries Risk Assessment Tool (CAT) designed for children and adolescents with an age-specific version for children 0-5 (Table 8.2). Similar to the Irish guidance, factors included are frequent sweet snacks, caries experience and exposure to fluoridated water or toothpaste, and health conditions or special healthcare needs. Unlike the 'Caries Risk Assessment Checklist' (IOHSGI 2009) this tool categorizes children as low, medium or high risk. Also making the tool more relevant to prevention of caries in the preschool child, the CAT also considers socio-economic status, presence of enamel defects, visible plaque and bacterial S.mutans) levels, bottle use and exposure to professionally applied topical fluorides. The guidance also gives discretion to the clinician when making the final decision by stating "*risk assessment categorization is based on a preponderance of factors for the individual however, clinical judgment may identify the use of one factor in determining overall risk*". This considers the clinicians experience and that all factors on the list may not be assessable (e.g. S.mutans counts). The guidance also includes a CAT for 0-3 years-olds designed for non-dental healthcare providers, which is simplified by eliminating the 'moderate risk' category (these being reassigned to high risk). Based on this risk assessment the AAPD guidance proposes a management protocol which specifies diagnostic approached (e.g. radiographs, *s*.mutans counts) and recall intervals, fluoride regimes (toothpaste, supplements, topical applied), diet counselling, sealant use, restorative approaches for early and cavitated lesions. Importantly, and consistent with the Scottish guidance (SCDEP (2010), the AAPD protocol considers that level of parent or caregiver engagement/ motivation, with more aggressive preventive protocols targeted to families with low parent engagement.

This again reflects the critical role parents and caregivers have in any management strategy for ECC.

Table 8.2: Caries risk assessment from for 0-5 year-olds (for Dental Providers) (AAPD 2013)

Factor*	High risk	Moderate risk	low risk
BIOLOGICAL			
Mother of primary caregiver has active caries	YES		
Parent./ caregiver has low socioeconomic status	YES		
Child has > 3 between meal sugar containing snacks of beverages per day	YES		
Child is put to bed with a bottle containing natural or added sugar	YES		
Child has special healthcare needs		YES	
Child is a recent immigrant		YES	
PROTECTIVE			
Child receives optimally fluoridated water or fluoride supplements			YES
Child has teeth brushed daily with fluoridated toothpaste			YES
Child receives topical fluoride from a health professional			YES
Chid has dental home regular dental care			YES
CLINICAL			
Child has one or more decayed/missing / filled surfaces	YES		
Child has active white spot lesions or enamel defects	YES		
Child has elevated *s. mutans* levels	YES		
Child has plaque on teeth		YES	

*Circle when factor present

Overall Risk category:

- High risk = the presence of a single risk factor in any of the high risk category
- Medium risk = the presence of at least one medium risk factor but no high risk factors
- Low risk = No medium or high risk factors

8.3.2: Tooth brushing and fluoride toothpaste

Several research and policy-based institutions have produced guidelines and protocols that highlight the effectiveness of tooth brushing with fluoride toothpaste in young

children (British Society of Paediatric Dentistry 2003, American Academy of Paediatric Dentistry 2011, Department of Health 2009).

The effectiveness of tooth brushing with fluoride toothpaste is highlighted in the guidance from the UK in '*Prevention and Management of dental decay in the preschool child'* (SIGN) 2005. This guidance was drawn from the findings of randomized controlled trials (RCT), systematic reviews, meta-analyses and observational studies which were arranged into the following hierarchy of evidence (Table 8.3):

Table 8.3: Hierarchy of evidence

I_a=Evidence from a meta-analysis of RCT.
I_b=Evidence from at least one RCT.
II_a=Evidence from at least one well-designed controlled trial without randomisation.
II_b=Evidence from a least on other type of well-designed quasi-experimental study.
III=Evidence from well-designed experimental descriptive studies such as comparative, correlation or case-studies.
IV=Evidence from expert committee reports or opinions or clinical experience of respected authorities.

The categories in this hierarchy of research were then used to develop a 'grading of evidence' to enable clinical recommendations:

A: Requires at least one RCT as part of a body of literature of overall good quality and consistency addressing the specific recommendation (evidence levels Ia, Ib).

B: Requires the availability of well-conducted clinical studies but no RCT on the topic of recommendation (evidence levels IIa, IIb, III).

C: Requires evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities.

Based on the above-mentioned hierarchy, the SIGN recommendations for tooth brushing in children aged 3-5 years-old, the were graded for evidence as follows:

- Children should have their teeth brushed with toothpaste containing 1000ppm (+/- 10%) fluoride with a normal or powered toothbrush. **A**

- Children should have their teeth brushed or be assisted with brushing by an adult at least twice a day with a smear or pea-sized amount of paste. **B**
- Tooth brushing should commence as soon as teeth erupt. **C**
- Children should be encouraged to spit rather than rinse out toothpaste, post-brushing. **A**.

In the document, '*An evidence-based toolkit for prevention'* (Department of Health 2009), a similar hierarchy of research evidence was used to develop the guidance for this age group and included the following recommendations:

- Optimal toothpaste content of 1350-1500ppm.
- One episode of brushing must be at night-time.
- A small-headed tooth brush with soft round-headed bristles and comfortable handle.

Recommendations in the Scottish guidance for *'Prevention and Management of Dental Caries in Children'* (SDCEP 2010) are consistent with those described earlier and include: "for children aged 2 -3 years, tooth brushing for two minutes under adult supervision., using a smear of toothpaste containing 1000ppm and allowing the child to spit and not rinse, For a child 3-4 years-old this should be a pea-size amount of toothpaste". The SDCEP also recommends providing this advice directly to families at least once year as part of an 'action-plan'.

The Irish guidance '*Strategies to Prevent Dental caries in Children and Adolescents'* (IOHSGI 2009) states that: "tooth brushing with fluoride toothpaste is close to the ideal public health method, in that its use is convenient, inexpensive, culturally appropriate and widespread".

Again, the recurring theme among these guidelines was the recommendation of twice-daily brushing and use of toothpaste with fluoride content no less than 1000ppm for the preschool age group. The exception to the 1000ppm concentration toothpaste use was in the Irish guidelines where the advice was to only commence fluoride toothpaste use from two years of age upwards, because of concerns about dental fluorosis. The importance of including brushing advice in anticipatory guidance for parents of infants was also highlighted, as brushing before 12mths of age is significantly associated with lower caries prevalence in primary teeth (Creeden and O'Mullane 2001). The aforementioned European guidelines (Scotland, England and Ireland) are supported by policy on early childhood oral health from the USA. The

American Academy for Paediatric Dentistry (AAPD) and American Academy of Paediatrics (APD) (AAPD/ AAP 2011).

8.3.2.1: Effectiveness of Topical Fluorides Therapy (TFT)

The effectiveness of fluoride toothpaste has been assessed in Cochrane systematic reviews in the context of Topical Fluoride Therapy (TFT). The overall findings of seven Cochrane systematic reviews of topical fluoride therapies (Marinho *et al*, $2002_{a,b}$, $2003_{a,b,c}$, $2004_{a,b}$) were reported by Marinho (2008) (Table 8.4).

These reviews assessed the effectiveness of fluoride toothpaste, gels, varnishes and mouthrinses through comparison to non-fluoride controls and to each other with the primary outcome measure of caries increment DMFS and Preventive Fraction (PF). In this context the PF has also been termed '*percentage caries reduction*', which is the difference in mean caries increment between the treatment and controls expressed as a percentage of the increment in the control group (Marinho 2008). PF has also been described as '*the proportion of disease prevalence in a population averted due to protective factor or public health intervention*' (Garqiullo *et al* 1995).

Table 8.4: Effectiveness of Topical Fluoride Therapy

Topical fluoride & (number of studies)	Prevented Fraction (PF)	95% Confidence Interval
Varnish (3)	40%	09-72%
Gel (13)	21%	14-28%
Rinse (30)	26%	22-29%
Toothpaste (70)	24%	21-28%
Overall	24%	22-27%

Interestingly, fluoride toothpaste trials appeared to show the greatest acceptability among children (i.e. lower drop-out). Furthermore, using a random effects meta-regression analyses for fluoride toothpaste, DMFS prevented fractions were significantly associated with (a) higher initial levels of caries, (b) higher fluoride concentration, (c) higher frequency of brushing, and (d) supervised brushing. The

evidence showed that using another form of topical fluoride therapy (TFT) together with fluoride toothpaste, provides additional reductions in dental caries compared with children using toothpaste only, although this should be considered mainly for children at high risk of caries (Marinho 2008). These findings were supported by Twetman (2008) from a systematic review of studies on children aged 1-16 years.

A recent systematic review and meta-analysis by dos Santos *et al* (2013) on the effect of fluoride toothpaste in preschool children, reported on eight studies, out of 1,932 published in the last ten years that met their inclusion criteria. Outcome variables were dmft and dmfs, preventive fraction (PF) and the numbers needed to treat (NNT). From these studies, the pooled preventive fraction (PF) due to fluoride toothpaste was high (31%) and fluoride toothpaste was found to be more effective where caries prevalence was high. For instance, in a populations with a high five-year incidence of caries, the NNT would be 11 (i.e. 11 preschool children would need to use fluoride toothpaste to prevent caries occurring in one child), whereas in populations with low to medium, five-year caries incidence the NNT would be 15 and 37, respectively. However the authors conclude that even with a higher NNT, fluoride toothpaste would be beneficial because it is safe and inexpensive and these findings provide good evidence for the effectiveness of fluoride toothpaste in this age group.

The effectiveness of supervised tooth brushing in a preschool environment as part of a community trial was reported by Macpherson *et al* 92013) based on mean $d_3$mft in 3-5 year-olds (where d_3 = decayed teeth with dentine involvement), before and after a school-based intervention in Scotland. In this national study, over the three-year period, the mean $d_3$mft reduced from 3.06 to 2.07, indicating that this community level intervention was effective. Importantly, this study also showed that reductions in caries severity were greater for children living in deprived communities, indicating that supervised brushing (by parent at home or teacher in preschool) with fluoride toothpaste can help address oral health inequalities in a preschool population.

8.3.3: Fluoride varnish

The beneficial effects of fluoride varnish have been firmly established from a sizable body of research evidence (Marinho 2009, Marinho *et al* 2013) but this still remains an underused preventive strategy for children (Richards 2013). A Cochrane review of fluoride varnish evaluated data from RCTs comparing fluoride varnish to no intervention in children up to 16 years of age. This meta-analysis included nine

studies assessing effect of fluoride varnish on both primary and permanent teeth (three of these studies were on preschool children) (Marinho 2002). In primary teeth, with respect to defs and dmfs, the pooled preventive fraction estimate was 33% (95% CI= 19-48%) indicating the significant caries-preventive effect of fluoride varnish.

These findings are similar to those from a community trial involving 376 children with a mean age of 1.8 for low-income families attending preschools in the US (Weintraub *et al* 2006). Families received dental health education and were randomized to test and control groups. Over two years the children received once / twice yearly fluoride varnish (test) application or no fluoride varnish (control), respectively. The caries incidence was significantly higher in the 'DHE counselling only' group versus the 'fluoride varnish groups'. A dose response effect was also reported as the PF for once a year or twice-yearly application were 58% and 61%, respectively.

Importantly, twice-yearly fluoride varnish applications have been recommended for use for young children at risk of ECC (Richards 2013). A two-year, community trial of fluoride varnish among 1,275 first-nations children aged 6 months to two years in the US, found a 25% reduction in dmfs for all children compared to controls (Lawrence *et al* 2008).

Despite its effectiveness, some safety concerns have been considered with respect to fluoride varnish in young children. Duraphat™ is one of the most commonly used fluoride varnish in young children and contains Sodium Fluoride at 22000ppm F. Although this is a very high concentration of F, the recommended amount of varnish to be applied in children under 6 years is 0.25ml and this converts to approximately 5.6mg F. As a preschool child's average body weight is 11-30kg this is well within safe limits before fluoride toxicity is approached (i.e. 5mg/Kg body weight) (Macpherson and Ball 2013).

In their systematic review of fluoride varnish, Azarpazhooh and Main (2008) looked at issues of effectiveness, acceptability and cost-effectiveness. From seven studies that met their inclusion criteria, they determined the frequency of fluoride varnish application for children at low to moderate caries risk (deft 0-3) should be at least once a year and those at high-risk (deft 4<), twice a year. Also, fluoride varnish is easier to apply than gels and takes less time, involves less patient discomfort and has greater acceptability.

Twice yearly fluoride varnish for preschool children at high risk of caries is currently included in several evidence-based clinical guidelines: British Society for Paediatric Dentistry (BSPD) Raynor *et al* (2003), Scottish Intercollegiate Guideline Network (SIGN) 2005, Irish Oral Health Services Guideline Initiative (IOHSGI) 2009, Scottish Dental Clinical Effectiveness Programme (SDCEP) 2010, UK Department of Health 2009, American Academy of Paediatrics and American Academy of Paediatric Dentistry (AAPD/ AAP) 2011) Despite evidence for its clinical effectiveness of fluoride varnish, some challenges remain with the implementing this preventive therapy at the community level.

8.3.3.1: Implementing fluoride varnish programmes for preschool children

In a pilot fluoride varnish programme for preschool and primary school children in southern England, involving extended duty dental nurses, dental therapists and dentists, Buckingham and John (2013) reported that the greatest challenge was recruitment of children to the programme. This was even after these families of children at high risk of caries were informed of the need for this treatment following an initial screening. Non-uptake and within-study drop-out resulted in less than a third of the 589 children completing the full three (i.e. once per school term) fluoride applications. Importantly, those families with lower uptake rates are also likely to have children at higher risk of caries therefore potentially exacerbating oral health inequalities (Buckingham and John 2013).

Problems with delivery and uptake of fluoride varnish during community-based programmes for children under seven in North-east England were also reported by Holmes *et al* (2013). This programme involved 19 NHS dental practices in one Primary Care Trust (PCT) receiving payment for every child / family who received oral health education (OHE) on oral hygiene / dietary advice, a toothbrush, with additional payment for fluoride varnish appointments. The OHE could occur at the practice or at a community venue decided by the dental practice team, with referral to the practice for the fluoride varnish appointment. Despite the payment incentive to practices, three-quarters of children aged 3-7 years did not receive fluoride varnish after the OHE was given. The authors suggest reasons for this as being: (1) Difficulties in organising practice-based appointments while working in the community environment (2) insufficient numbers of dental care professionals trained in giving OHE (3) families subsequently failing to attend for the fluoride varnish

appointment. These findings are in contrast to those from a national preschool-based tooth brushing initiative in Scotland (*Childsmile*), that reported greater improvement in oral health for those children living in deprived areas (Macpherson *et al* 2013), suggesting more effective uptake and coverage of the programme. Ensuring uptake of fluoride varnish may therefore be as important as the clinical effectiveness of the agent itself. Motivating parents and caregivers with respect to accessing this type of preventive care and keeping appointments, need to be a key component of community-based OHE programmes for preschool children. For instance, higher levels of uptake of fluoride varnish among preschool children was associated with mothers who had received motivational interviewing (MI) resulting in a significant reduction in caries prevalence (Weinstein *et al* 2004 & 2006, Harrison *et al* (2007).

8.3.4: Early dental attendance and establishment of the 'dental home'

The AAPD states that "the oral health needs of infants and young children be addressed as early as possible as part of well-child care (AAPD 2011). Dental visits in early childhood are important to enable the child to experience regular dental care, build up positive experiences and avoid invasive treatment (Leroy *et al* 2013). In a longitudinal study involving over 1000 preschool children in Belgium it was found that almost two thirds of 3-year-olds and one fifth of 5-year-olds had not visited a dentist, indicating that parents and caregivers need to be informed about the importance of early dental visits for their children (Leroy *et al* 2013).

The American Academy of Paediatric Dentistry policy statement on early childhood caries states: "to prevent ECC, children at high risk of caries must be indentified early through the establishment of a dental home" (AAPD 2010). A dental home has been defined as 'the ongoing relationship between the dentist and the patient where accessible, coordinated oral healthcare can be delivered comprehensively while actively involving the family participation' (Ramos-Gomez *et al* 2012). General dental practitioners, therefore, need to be able to accept young children for their first dental visit. This infant oral health visit should consist of a caries risk assessment, proper positioning of the child in knee-to-knee examination, age-appropriate tooth brushing, clinical examination of the mouth, fluoride varnish treatment, risk assignment and anticipatory guidance or counselling (Ramos-Gomez *et al* 2012).

- Nowak and Casamassimo (2009) state that the dental home should ideally be, *family-centred*, provide *continuous / comprehensive / coordinated /*

compassionate care and be *culturally appropriate* (i.e. welcoming to families of all ethnic and cultural backgrounds).

8.3.5: Role of medical professionals (non-dental)

The Scottish interdisciplinary guidance network guidelines state that oral health of preschool children should be promoted through multiple interventions and multi-sessional programmes for parents of young children, ideally prenatally (SIGN 2005). In this respect non-dental clinical professionals can be effective, increasing oral health knowledge through specifically designed training and this should form part of an oral health promotion strategy.

Family physicians / general practitioners (GP), paediatricians, health visitors and other members of the primary healthcare team usually have much earlier contact with families of infants and preschool age children than dental practitioners. Children below the age of three years may on average visit a paediatrician eight times, whereas most children under three years have not visited a dentist (Rozier *et al* 2003). This is due to the common uptake of immunization services, well-baby visits and infant health checks, generally available both in the public and private sector in both developed and developing countries. In a dental health education programme for families with children under 5-years-of-age, offered in a paediatric dental department in Australia, none of the parents had previously visited a dentist but all had seen a family nurse or family physician, However, none had received any advice on oral health prevention in early childhood at these medical visits (Blinkhorn and Blinkhorn 2013).

Although medical visits and child health checks have been considered an ideal opportunity for providing oral health advice to parents and caregivers and undertaking screening for dental problems in young children, this approach depends on the willingness of medical professionals to include oral health in their protocols. Encouragingly, in their national survey of paediatricians in the US, Lewis *et al* (2000), found that 90% of paediatricians believed that they had an important role in the oral health of young children. Similarly, in a national survey of paediatric specialty trainees in the UK, it was found that although three quarters of the 479 respondents agreed that paediatricians should assess oral health, nearly all felt that their training in oral health was insufficient and 61% felt that their ability to undertake this role, was below average (Kalkani and Ashley 2013).

Involving medical professionals in children's oral health has been included in some oral health preventive strategies for preschool children such as '*Into the mouth of babes'* (IMB) in North Carolina in the US (Rozier *et al* 2003). In this State-wide strategy, paediatricians and family physicians as well as providers in community clinics, were reimbursed by Medicaid to provide: caries risk assessment, fluoride varnish and oral health advice to caregivers and referral to dentists. These medical professional received training in oral health via a one and half hour Continuing Medical Education (CME) course that included PowerPoint presentations, case-based presentations and discussion of clinical interventions. The programme was successful in increasing coverage for infants and preschool children, in particular the group that has not yet established a dental home and often accesses expensive dental services because undetected disease has progressed to an advanced stage (Rozier *et al* 2003). An evaluation of children enrolled in the programme between 2000-2006 (up to 6 medical visits that included oral health advice / fluoride varnish), showed a 17% reduction in caries-related treatments up to 6 years of age compared to children who were not in the programme (Pahel *et al* 2011). In the policy document on 'Oral health risk assessment and establishment of the dental home', the AAPD state "*paediatricians and paediatric healthcare professionals should develop the knowledge base to perform oral health risk assessment on patients beginning at 6 months of age*" and these medical professionals should be directed to help establish a dental home for these patients by referral to dental practices before 1 year of age (AAPD 2010). Similarly in Ireland, in the document 'Strategies to prevent dental caries in children and adolescents', the guidance states that general practitioners, nurses and primary healthcare workers should be given training to identify children at high risk of dental caries (IOHSGI 2009). This is consistent with the statement in the Scottish guidance that the dental team should work collaboratively with other agencies especially nurse, health visitors and general medical practitioners (SDCEP 2010).

8.3.5.1: Oral health training for medical professionals

Several descriptive studies have explored the knowledge levels of medical practitioners and paediatricians regarding early childhood oral health. A national survey of paediatric specialty trainees in the UK found that respondents overwhelming believed they should play an important part in promoting better oral

health for young children, yet almost two thirds reported a lack of training and up-to date information (Kalkani and Ashley 2013). In a survey of over 500 hundred paediatricians and family physicians in Canada regarding their knowledge of oral health in children under 3 years of age, most were aware of the importance of the primary teeth, the significance of ECC and its relationship with feeding practices (Prakash *et al* 2006). Although most believed that they had an important role in oral health promotion, few felt confident about giving oral health counsellng. Only 3% recommend visiting the dentist by 1 year. Most of these practitioners got their oral health knowledge through experience while working in practice, not during their medical training. Those with more than three hours of postgraduate training were more than twice as likely to give oral health counselling. Most practitioners in this study reported that they needed training in oral health and most wanted written guidelines. In Brazil, a survey of 182 paediatricians found oral health knowledge insufficient in over two thirds of the sample (Balaban *et al* 2011). Most knew about the dental visits by one year and screened for dental problems. Despite this, only 30% of these doctors always advised use of fluoride toothpaste and few reported receiving oral health training during their postgraduate training.

These studies indicate a need for oral health training beyond what most have received in undergraduate/postgraduate medical programmes, to enable them to be competent at giving evidence-based preventive oral health counselling for families with infants and preschool age children. Such training could be delivered a modules incorporated into the curriculum for general paediatric training (Kalkani and Ashley 2013).

The more important aspect of oral health counselling by paediatricians and other primary care medical practitioners may be with respect to appropriate referral for dental care. Using case scenarios, Ismail *et al* (2003) reported that over 90% of family physicians and paediatricians would refer a child with high caries risk for dental care to a dentist but few would routinely refer a child at low risk for a first dental visit, indicating some confusion as to guidance regarding the importance of the dental home for young children.

8.3.5.2: The primary healthcare team and shared care

A qualitative study of maternal and child health nurses, general medical practitioners, paediatricians and dental professionals in Australia explored views on the concept of 'shared care' for early childhood oral health (Gussey *et al* 2006). Although all these

providers agreed that dental caries could have a serious impact on young children and families, the dental professionals in this study did not believe they had a primary role in the oral health of preschool aged children, whereas the child health nurses felt that that was within their remit. A general lack of confidence in delivering oral health promotion for families with very young children was common to all the providers in this study and all agreed roles and responsibilities needed to be developed. Similarly in another study in Australia, family health nurses considered dental caries to be a significant health issues for young children and their families, particularly in disadvantaged groups and attempted to give them anticipatory guidance with respect to feeding and weaning behaviours (Arora *et al* 2012). These studies again support the view that the wider primary healthcare team can have an important role in oral health promotion for preschool aged children.

The concept of '*shared care*' as an approach to oral health promotion for preschool children was proposed and evaluated (Maher *et al* 2012). This model proposes shared responsibility between primary care providers to deliver oral health advice and prevention to families with young children, the *New South Wales Early Childhood Oral Health* programme (ECOH). This programme had two main aims:

1/ To support child health professionals capacity to incorporate oral health into regular child health checks involving oral health information for parents.

2/ To support oral health professionals to focus on early management of ECC and incorporate prevention for preschool children into their routine services.

The programme attempted to address early childhood oral health in the community at two levels, firstly by including all families and with young children that were accessing services and secondly, those families with children at high-risk for ECC. This approach required the promotion of screening and early identification of disease and early referral to dental professionals. To achieve this, efficient referral pathways were built into the programme to help direct families with children at high caries risk toward dental clinics in the public sector. The oral health promotion for families included information brochures and talks based on a 'stages of change' model. Importantly all health providers in this programme received training in Motivational Interviewing (MI) to support behaviour change among the parents/caregivers. At a three-year evaluation, 85% of child health nurses reported that they used the 'lift- the-lip' method to check their child's teeth from 6 months of age, gave advice and the

brochure to families about oral health. The majority had included oral health in the routine list of health checks for young children.

Several other efforts have been made by Australian dental services to involve the wider health team in oral healthcare of preschool children such as 'Lift the Lip' by The New South Wales Department of Health (An educational resource for Child Health Professionals to support the incorporation of early childhood oral health into general health interventions) and Caring for your Child's Smile by the South Australian Dental Service (Australian Research Centre of Population Health 2013). For greater dissemination these resource have been made available both in-print and on-line.

A '*change strategy*' for primary care involving incorporating oral health into the healthcare duties of Public Health Nurses in Ireland was evaluated by Al'Arami (2012). The three-hour oral health training used in this approach was based on evidence-based guidance from Irish guidance (IOHSGI 2009) and was well received by nurses indicating its appropriateness. An oral health intervention by nurses in Belgium was less successful when evaluated for intended oral health outcomes (reduction of clinical caries and plaque levels of the preschool children and improved oral health behaviour of mothers) with the authors suggesting this was due to lack of fidelity to the training programme and the lack of cultural appropriateness in relation to educational levels of the mothers (Declerk *et al* 2011).

8.3.5.3: Summary of non-dental professionals in oral health promotion

A report by the Robert Wood Johnson Foundation (Revels *et al* 2013) that reviewed preventive oral healthcare for infants and young children in primary care settings concluded that it is of benefit, being in effect the first point of entry into dental care. The report states that factors that can improve effectiveness include:

- Use of evidence-based preventive interventions (e.g. fluoride varnish)
- Oral health training for the primary care team
- Good referral protocols (for dental care).

Further evidence for the effectiveness of this approach to oral health promotion for preschool children has been provided by the 'Into the mouth of babes' (IMB) project in the US provided further support for this (Rozier *et al* 2003, Pahel *et al* 2011) and the 'shared care' model used in Australia (Maher *et al* 2012).

Although the research evidence is largely from descriptive studies, findings from several different international settings suggests that implementing an oral health preventive programme involving paediatricians, family physicians and other primary care medical professionals has the potential to be part of a wider public health strategy aimed at preventing and managing ECC.

8.3.6 Alternative approaches (brief counselling–MI)

In their protocol for risk assessment, prevention and management of ECC in young children, Ramos-Gomez *et al* (2012) acknowledge that traditional generic recommendations such as 'brush your child's teeth twice and day and reduce consumption of sweet snacks and drinks' have limited success. This therefore suggests the need for alternative approaches that aim to elicit positive and sustained oral health behaviours and reduce the caries risk for young children. This would include more supportive, brief parent counselling techniques such as Motivational Interviewing (MI) (Ramos-Gomez *et al* 2012).

MI has been defined as "*a person-centred counselling style for addressing the common problem of ambivalence about change* (Miller and Rollnick 2013). In a systematic review of oral and general health interventions, MI was the most effective method of altering health behaviours in a clinical setting Yevlahova and Satur (2009). The effectiveness of oral health promotion for ECC utilising MI was demonstrated in longitudinal studies of preschool children from South Asian communities in Canada (Weinstein *et al* 2006, Harrison *et al* 2007). At the two year follow-up a 46% lower caries prevalence was observed in children whose mothers had received MI compared to families that had received traditional dental health education.

Hirsch *et al* (2012) used systems dynamics (i.e. A computer modelling approach to understand complex behaviours), to indentify the most appropriate interventions for different ages among populations with varying prevalence/severity of ECC. Their model showed that interventions including MI and fluoride varnish application or combined interventions were the most cost-effective, particularly when targeted at children at high-risk for ECC. The model also showed that interventions targeting the youngest children take 2 to 4 years longer to affect the entire population of preschool-age children but ultimately exert a greater benefit in reducing ECC (Hirsch *et al* 2012)

Importantly, MI has also shown promise as part of community-based oral health preventive programmes involving a mix of different professionals who engage with

families with young children. This is illustrated among Head Start staff (teachers, nurses, nutritionists and family service workers) in Denver who had received training in MI to promote family adherence to oral health care recommendations. They perceived that it was valuable and were willing to use the approach (Cook *et al* 2012). Among these MI trainees, experienced teachers said MI improved parent-teacher relationships and believed it increased adherence to oral health advice compared to other counselling methods they had used.

8.4: Improving access to dental care

Improving access to dental care for preschool children should form part of oral health promotion strategies. The New Zealand Public Health Advisory Committee states that oral health inequalities are more pronounced during the preschool period and recommend that all children should have access to quality oral health services (National Health Committee 2003).

Access to dental care is often limited by the location of dental practices, with the majority of dentists usually practicing in affluent suburbs and few in rural or inner-city areas. Difficulties in access to dental care for young children may also arise from practice orientations with paediatric dentistry not being a focus due to issues of remuneration and / or clinical experience of the clinicians (Nash 2009).

A socio-behavioural model of access to healthcare was proposed by Anderson (1968). This model suggests that some individuals are more likely to use health services than other and this can be explained by contextual factors:

(I) *Predisposing factors* (e.g. social class, education)

(II) *Enabling factors* (e.g. cost of health care, health insurance)

(III) *Need* (perceived and normative)

With respect to oral health some individuals may therefore be predisposed to seek treatment but there must be enabling factors such affordable / available dental care and a perceived the need for care, for use of services to take place (Baker 2009).

The concept of access to healthcare was explored by Penchansky and Thomas (1981) who considered that the term is interpreted differently with the issue of entry into the health system being distinct from actual use of the service. They proposed a model of access encompassing five dimensions as summarized by Kent and Croucher 1998):

- *Availability* - the relationship between volume and type of service with the clients volume and type of need

- *Accessibility* - the relationship between the location of the supply of services and location of the client including transport, distance and travel costs.
- *Accommodation* - The relationship between the service characteristics and the clients' ability to relate to these factor (e.g. opening hours, physical access, staffing).
- *Affordability* - the relationship of the cost of services to the clients' ability to pay.
- *Acceptability* - the mutual perceptions of providers and clients with respect to personal attributes (age, sex, and ethnicity).

The concept of access has also been explored from the perspective of potential barriers to dental care and how these affect uptake and use of services. For instance Finch *et al* (1988) describe the three main barriers to dental care as being related to anxiety, cost of treatment and aspects of the dental visit. Freeman (1999a&b) proposes that a better understanding of barriers to accessing dental services can be provided by a psycho-social model of access. These psycho-social factors relate to life experience and personal histories that influence an individual's dental health beliefs and attitudes and include SES, age, gender, perceptions of need and dental anxiety. Psycho-social factors do not act independently but combine to act in unison and can therefore affect access and acceptance of dental care. Based on a model proposed by the Federation Dentaire Internationale (FDI), Freeman (2002) describes a classification of accessibility factors operating at three levels: (a) patient factors (lack of perceived need, anxiety and fear, financial considerations), (b) dental profession factors (inappropriate manpower resources, uneven geographical distribution, inappropriate training and insensitivity to patients attitudes and needs, (c) societal factors (poor attitudes toward health, inadequate health care facilities, inadequate health manpower and lack of support for research). As the 'Inverse care law' proposed by Tudor-Hart (1971) states that availability of health care tends to vary inversely with the need for it in the population served, the above classification can provide a framework for improving access to dental care developing more equitable dental services, i.e. making dental health services available to the those most in need of care.

Harris (2013) states that despite previous theories being helpful in understanding access these conceptual models are abstract and difficult to measure and therefore

presents dental access as a construct comprising four components with measurable parameters:

- Opportunity access (*service availability*) – measurement examples: proportion of population (by age group) who are able to access a dentist within 30 minutes from home or place of work, proportion of population for whom publicly funded care is available or dentist : population ratios.
- Realised access (*utilisation of services*) – measurement examples: proportion of population who have visited a dentist in the last 12 months, reason for dental visit (i.e. routine or emergency care).
- Equity – measurement example: Utilisation rates, Horizontal Inequity Index (based on standardized data that graphically compares distribution of care by income, to a *need-expected* distribution, producing a value ranging from -1 to +1).
- Outcomes of care – measurement example: patient reported outcome measurements such as oral health quality of life indices.

In a global context, in high income countries, access may relate more to equity and quality of care issues, whereas in low income countries in parts of the developing world, access may be defined by availability of services. Nunn *et al* (2008) suggest that addressing equity in educational and training opportunities for dental providers from underserved communities, could improve service availability. Importantly an FDI, WHO and IADR working group endorsed increasing the proportion of the population with access to oral health care as a global goal for oral health by 2020 to reduce disparities in oral health between different socio-economic groups within countries and oral health inequalities across countries, (Hobdell *et al* 2003). Global goals for access should be made locally relevant by determining by local needs and priorities so targets should take account of disease prevalence and severity, socio-environmental conditions, cultural factors and the legislative context (Hobdell *et al* 2003).

8.4.1: Dental therapists and children's dental care

In many settings across the world dental therapists have been used to extend dental services resulting in greater equity in service provision (Robinson *et al* 2012). In general the impetus for adopting dental therapists as part of the oral health workforce

has typically been to improve access to care and improve the oral health of children (Nash *et al* 2014).

Dental therapists were based on the dental nurse model originally developed in New Zealand (NZ). To address the shortage of dental professionals and meet the oral health needs of children, NZ pioneered the introduction of a dental provider specifically assigned to the care of children. These dental nurses were high school graduates who underwent 2 years of dental training, following which they were deployed to schools across the country. In the 1980's the terminology changed from dental nurses to 'Dental Therapists'. Based on the success of the NZ model, the use of dental therapists has since gained popularity globally with their deployment in over 50 countries, focusing mainly on dental care for children (Nash 2009).

Worldwide, their scope of practice generally includes: examinations, x-rays, diagnosis, prophylaxis, topical fluoride applications, oral health education, sealants, local analgesia, simple restorations (not involving the pulp), Traumatic Restorative Treatment (ART) i.e. restorative care without use of rotary instruments, pulp therapy in primary teeth, stainless steel crowns, simple extractions (Nash 2009, Math Muja, *et al* 2013). With respect to early dental attendance, dental therapists also have a key role in establishing a 'dental home' enabling improved access to care and prevention in preschool children Nash (2009).

In a review of the literature, Nash *et al* (2014) report an international trend of dental nurse/therapist programmes having expanded from school-based services to community health centres, hospitals and mobile clinics, with evidence of increased access to dental care for young children and reductions in untreated decay. Some of the main findings of the review were that dental therapists:

- Work primarily in the public sector.
- Typically practice under general supervision of a dentist.
- Improve access to care for children.
- Provide safe treatment of good quality

Dental therapists practice in 54 countries mainly those within the Commonwealth of Nations (formerly the British Commonwealth), (Nash *et al* 2014). Recently the potential to decrease the cost of dental care for children, and perceived lack of access to dental care in underserved populations, has fuelled the movement for mid-level

providers such as dental therapists in the US (Harris 2013), who are currently only licensed to practice in two states.

Although most of the reports on dental therapists refer to their role in improving access to care for school-aged children, they have been utilized in the dental care of preschool children. For instance, as part of the Yukon Children's Preschool Dental Programme in Canada, a 'preschool dental therapist' is available for consultations / examinations for children under 5 years-old, as well as making visits to remote communities (Yukon Health and Social Services 2013).

8.4.2: Acceptability and cost effectiveness of dental therapists

In their systematic review Shariata *et al* (2013) state that although there is reasonable evidence to support the claim that dental therapists can provide good quality dental care comparable to a dentist, there is less evidence for cost-savings achieved by this type of service delivery.

In countries with dental therapist-led school-based dental services (e.g. NZ, Australia, Hong Kong, Malaysia) evaluations show high utilization rates and economic value. For example the average cost of care for child in the NZ dental service (including examination / cleaning/ preventive and restorative treatment) would be $99 US, compared to $99 US for a simple filling alone in the private sector. Similarly, in Hong Kong, the average cost per child in the school dental service would be approximately $78 US per year if provided by therapists (Nash *et al* 2013).

This difference is largely attributable to the salary differential between dental therapists and dentists with dental therapists typically earning less than half the salary of dentists in the public or private sector.

Robinson *et al* (2012) reported that at the levels of disease seen in many countries, dental therapists who are able to provide direct restorations, have a skillset appropriate to child population needs and that overall, dental therapists provide a quality service in terms of relevance to need, effectiveness, increasing access and equity. However, their efficiency is sensitive to local legislative and remuneration systems, in particular, their efficient utilization is improved where supervisory requirements are lower (Robinson *et al* 2012) but the social acceptability of increasing their independence is less clear.

In the context of the changing work-force, skill-mix in dentistry, Gallagher *et al* (2013), state that 70% of routine dental treatment falls within the scope of dental

therapists and based on workforce modelling dental therapists provide a valuable contribution with the a potential for reduced costs. However Freeman *et al* (2013) state that presently there is insufficient literature concerning the most appropriate work-force skill-mix for dental therapist / dentist to population in relation to remote areas, to enable sustainable and cost-effective use (remote areas being defined as a drive time of greater than 30 minutes from the nearest settlement with a population of greater than 10,000). This would be the situation encountered in several developing countries.

Importantly, Wright *et al* (2013) in their systematic review, concluded that in a populations receiving dental care from teams that included mid-level providers such as dental therapists, there was a consistent reduction in caries severity and the prevalence of untreated dental caries was reduced over time.

In a recently published report Kim (2013) stated that the salary of dental therapists employed in a US public health service (Alaska and Minnesota) accounts for only 30% of the revenue they generate, making them economically viable. The majority of care provided was preventive (fluoride varnish, sealants, prophylaxis and dental health education), with restorative care representing a quarter of their work. Also, their patients were children who were generally publicly insured (Medicaid), low-income families living in underserved communities. Based on a model that considered the following factors: amount of time employed (full-time equivalent), average salary, clinical setting (urban/ rural), clinical procedures, revenue generated, age groups treated and payment types (Medicaid, private insurance, other methods), this study concluded that dental therapists working as part of the dental team were economically viable with a potential for improving access to underserved communities (Kim 2013). Furthermore, rates of coverage for young children seen by dental therapists in school-based progammes were twice that of those seen in private practice in the US, supporting the view that these mid-level providers can improve access to dental care (Mathu Muju *et al* 2013)

8.4.3: Role in of dental therapists in Trinidad and Tobago

Trinidad and Tobago legislated for the practice of dental nurses, the equivalent of dental therapists, in the 1980 Dental Act (Republic of Trinidad and Tobago 1980), which specified that "a dental nurse is qualified to treat children (12 years and under) only, and such treatment shall be carried out in facilities or services operated by

government or under the direct or indirect supervision of a dentist in private clinics". The original dental nurse training scheme in Trinidad and Tobago was modelled on the New Zealand programme and began a training programme in 1976, producing its first dipolmates in 1978. The aim of the programme was to improve the dental operator to population ratio in Trinidad and Tobago and improve access to dental services, particularly in the rural areas of the country (Steele 1988).

All forty-nine dental nurses are currently employed in the public sector, 27 in the Ministry of Health and 22 in the Regional Health Authorities with a dental nurse to child (under 12) population ratio of 1:48. Their current range of treatment includes: examination, simple restorations (amalgam and composite), temporary restorations, extractions (primary and permanent teeth), fissure sealants, fluoride therapy, oral health education (Ministry of Health 2010).

In a survey of their working practice and job satisfaction, the most positive aspect of their job was found to be working with families and children and providing oral health education (Naidu *et al* 2002) suggesting they could play a key role in oral health promotion for preschool children in Trinidad and Tobago.

No dental nurses have been trained since the closure of the dental nurse's training school over ten years ago. In response to the resulting depletion of dental nurses in the public sector, the University of the West Indies enrolled its first cohort of twenty students in 2013, into the combined BSc degree in Dental Hygiene and Therapy (DHDT) in Trinidad. This four-year course includes a one year clinical internship. Graduates will be able to treat patients under the prescription of a registered dentist and their range of skills will include: *Intra and extra oral assessment, scaling and polishing, applications of fluoride, fissure sealants, exposure of dental radiographs, provision of dental health education, restoration of primary and permanent teeth, extraction of primary teeth under local anaesthesia, pulp therapy for primary teeth, recording of impressions and provision of emergency care/ temporary restorations.*

With respect to the future availability of these dental professionals in the local workforce and to address necessary legislative amendments to the Dental Act, discussion between the Trinidad and Tobago Dental Council, the Ministry of Health and the University are ongoing. These amendments will need to address issues relating to their employment in both the public and private sector and formally regulate their practice.

8.5: Regional and local oral health policy

The Pan American Health Organisation's regional policy document '*Oral health for the Caribbean*' (PAHO 2005) states: "Oral health screening in early childhood (preschool stage) must be part of public health policy as well as standardized surveillance to determine risk behaviours for development of ECC. This issue was also indentified in relation to addressing oral health needs of vulnerable population groups. The problem of oral health Inequalities among young children in the Caribbean was also recently highlighted at the First Caribbean Oral Health Summit in Puerto Rico (Trinidad Express Newspapers 2013). Bringing together professional associations, academia, ministries of health and corporate dentistry, the goal of this summit was to reach agreement on priority oral health needs in Caribbean countries and establish collaborative work plans to leverage resources for oral health promotion. Preliminary findings from this current research were presented by the author (RN), to highlight the issue of ECC as part of a keynote address.

Reducing oral health inequalities among young children was identified as a policy objective by the Steering Committee for the draft *Oral Health Policy and Oral Health Plan for Trinidad and Tobago* (Ministry of Health 2010). Underscoring the need to integrate non-dental health professionals into oral health promotion, the report recommends that all medical and dental health providers discuss oral health with new mothers and the importance of the role they play in keeping their babies' teeth healthy. These regional and local policy objectives require implementation through an appropriate and effective oral health promotion strategy drawing on international best practice and informed by the findings of this local research.

8.6: An oral health promotion strategy to address early childhood caries in Trinidad

Based on the research findings reported in this thesis, the international evidence-base and best-practice guidelines, the following sections describe an oral health promotion strategy for ECC in Trinidad. Where possible, the outlined strategic aims have been aligned with regional and local oral health policy. This strategy proposal is presented under the five principle of health promotion (WHO 1986):

9.6.1: Building healthy public policy

Public health policy should support healthy living environments in the home, preschools and the wider community, making healthy choices for families with young children, the easier choices.

Evidence-based oral health policy for preschool children should be disseminated to all interest groups and stakeholders for input and advocacy. This dissemination could occur through meetings with professional groups (e.g. Dental Association of Trinidad and Tobago (DATT), The Dental Nurses Association of Trinidad and Tobago, The Trinidad and Tobago Medical Association, parents groups, preschools administrators and staff, community organisations and NGO's).

To further support these initiatives, relevant research finding should be published in the scientific literature, along with reports in the print and on-line media.

- **Dietary advice and guidance.**

  Consistent with the literature, the present research found higher rates of ECC associated with frequent intake of sugared snacks. This can be addressed through development of national and institutional policies that can influence the availability of foods containing non-milk extrinsic sugars for children in preschools (Watt 1999). This will require introduction of policy to limit the marketing of high sugar foods, drinks and confectionary for preschool children to support efforts to change dietary practices related to snacking on confectionary and sweetened soft drinks.

8.6.2: Creating supportive environments

From the qualitative arm of this present research, most parents and caregivers wanted more contact with health professionals outside of clinical settings along with practical help with prevention at home and at preschool. Efforts should therefore be made to meet these expressed needs by helping with overcoming barriers to oral healthcare. Preschool and day-care centres are appropriate settings for interaction and parental involvement can enhance effectiveness of interventions (Watt 1999).

- **Consistency of information**

Oral health information must include advice on safe breastfeeding, bottle use / comforter use, weaning and guidance on low cariogenic diets for infants and preschool aged children, prevention at home and the value of early dental attendance.

This advice must be evidence based but clear and easy to understand, taking account of levels of health literacy and use culturally appropriate terms and language to enable understanding by people with lay knowledge of oral health (Arora 2012). This is particularly important for disadvantaged communities that may have lower levels of health literacy and face more barriers to dental care (Williams *et al* 2013).

- **Involvement of the primary care team and shared care**

Along with dental professionals, oral healthcare for families with infants and preschool children can be supported through shared-care models (Gussy *et al* 2006) utilising professionals from across health disciplines, e.g. antenatal care teams, community nurses, family physicians and paediatricians. Again this approach must be underpinned by the dissemination of consistent, evidence-based oral health information

8.6.3: Strengthening community action

Approaches must take account of the wider social environment and engaging with local communities in Trinidad to support oral health initiatives for preschool children.

- **Preschool-based preventive programmes**

As recommend in the UK and US (Watt 1999, APPD 2013), effective oral heath programmes can be delivered through preschools /day-care centres. Based on other successful national programs such as Childsmile (Macpherson *et al* 2013) this should include dental health education for preschool teachers, parents and caregivers and the implementation of supervised tooth brushing programmes with fluoride toothpaste. Based on the work with Canadian preschool children (Weinstein *et al* 2004, 2006) and as suggested by findings from the present research this should also include oral health promotion using an MI approach to facilitate positive behaviour change. This must be coupled with practical means of registering children with a dentist / government dental

clinic for the topical fluoride application and on-going dental care (i.e. establishing a dental home for all young children).

- **Preventive messages at community events**

As well as preschool venues, preventive advice for families with preschool children could also be delivered at health fairs, open days at health centres, and community outreach events at churches, mosques and temples. These initiatives can be developed through strengthening collaborations between the University, dental professional bodies, NGOs (e.g. service clubs and religious groups), who currently provide dental outreach to selected preschools and primary schools (as junior classes include 5-year-olds). This has involved dental nurses, dental students and academic clinical staff delivering health education through talks and interactive events for children and parents.

8.6.4: Developing personal coping skills

Achieving positive oral health behaviours requires developing and strengthening efforts to empower parents and caregivers to take control of oral health issue related to their preschool aged children.

- **Motivational interviewing (MI)**

Beyond dissemination of oral health information through dental health education talks and printed or on-line resources, parents and caregivers require hands-on approaches that develop oral health skills and preventive behaviours related to diet, brushing and dental care. Oral health promotion for parents and caregivers of preschool children should include brief-counselling (Scottish Intercollegiate Guideline Network 2014).

Based on the finding of the current research, the brief-counselling approach MI appears be effective and culturally acceptable for parents and caregivers in Trinidad. An MI-based approach should be implemented to enable and sustain positive changes in oral health behaviours. This could occur in group-settings or one-to-one in clinical dental settings depending on resources and availability of trained personnel.

8.6.5: Re-orienting health services

Dental services for preschool aged children should be delivered from a preventive rather than curative perspective, but also be able to meet oral health needs of children with poor oral health.

- **Availability of emergency / general anaesthesia services.**

All complex care and treatment of anxious children in the public sector is managed by referral to the island's only dental hospital at the Eric Williams Medical Sciences Complex. Currently, low availability of theatre time for GA cases results in long waiting list times unless there is an acute need for treatment by extractions. Management of children with complications from untreated ECC requires increased availability of dental care under sedation and GA. In-patient and day-surgery, services should be made available to address this need.

- **Improved access to dental treatment**

Access to routine dental care and prevention for preschool-aged children can also be addressed through greater availability and wider deployment of dental nurses in the public sector dental services (health centres and hospital clinics). This is achievable with new cohorts of dental nurses being trained but will need a concerted campaign to raise public awareness of the government-funded dental service and what it offers.

- **Dental screening programmes**

Screening programmes should be implemented to identify children at high risk for ECC children and early detection of caries. Using standardized protocols and screening tools this can aid in prevention and management before cavitation, thereby avoiding such as pulpal involvement, pain and need for emergency dental treatment under in-patient GA care.

The development of a screening tool for preschool children can be based on European and US protocols for children such as the Caries Risk Assessment Checklist (IOHSGI 2009) or a tool specific for preschool aged children such as the Caries Assessment Tool (CAT) for age 3-5 years (AAPD 2013). Adding greater utility, the CAT also has a version of the tool for non-dental health professionals. To make the tool appropriate for this Caribbean population, some modification would be required to account for local resources (e.g.

removal of bacterial count data from criteria as a risk indicator). Screening programmes can be delivered through, dental health centres, private dental practices, preschools and day care centres by dentists or dental nurses or by suitably trained non-dental health professionals in medical clinics.

- **Early dental attendance and establishing a dental home**

To ensure delivery of preventive care and advice, efforts must be made to facilitate early registration with a dental provider (in private practice or the public sector) and establish a dental home for all preschool children. Ideally by one year of age but at least before age 3. Changes in public dental health services protocols will be required as currently children under 2 ½ year-old cannot register in Trinidad public sector dental service.

- **Fluoride varnish programmes**

At least twice -yearly fluoride varnish application (NaF varnish at 22000ppm) for preschool children is effective for preventing ECC (Marhino *et al* 2009). Development of a fluoride varnish programme for preschool children in Trinidad can be achieved through appropriate training and wider deployment of dental nurses.

- **Training in preventive oral healthcare in early childhood.**

As demonstrated internationally, utilising the available human resources of professional groups that have contact with infants and preschool aged children can greatly expand access to oral healthcare preventive advice for families. This can be achieved by continuing professional development (CPD) courses (lectures / seminars/ on-line resources) for family physicians, paediatricians, nursing staff. This can be supported by including dental modules in undergraduate/postgraduate medical programmes). These approaches have been found to be effective when implemented for medical staff working in primary care in the US and Ireland respectively (Revels *et al* 2013, Al Arami 2012). The Irish programme used a 'change strategy' to reduce resistance, ease communication and secure commitments and was able to achieve substantive buy-in for the programme from the stakeholders (Public Health Nurses). Teaching topics in this programme were delivered through talks, slides and written material and included: age of tooth eruption, causes of

dental decay, brushing and cleaning methods, diet, eating and feeding habits, health versus decayed teeth, dental emergencies.

8.6.6: Strategic framework

Table 8.5 presents a strategic framework for delivering the proposed oral health promotion strategy for prevention and management of ECC in Trinidad. In the development of this strategic framework engagement has so far occurred through the following:

- Discussion with Ministry of Health Dental Services and the Department of Health Policy and Planning (as part of the Development Committee for the Draft Oral Health Policy and Plan). This has led to preschool children being recognised as a vulnerable group with respect to oral health in the draft national policy and a need for the development of oral health promotion strategies for early childhood caries.
- Development and delivery of Continuing Professional Development (CPD) seminars for dental nurses on the topic of early childhood oral health. Proposal for dental nurses to receive training in MI.
- Request for formal dissemination of these research findings within the Ministry of Health, to aid the development of the National Oral Health Policy and Plan (**Appendix 8.1**) In particular a review of Standard Operating Procedures (SOPs) for preventive oral healthcare in infants and young children by dental nurses. This includes the use of Caries Risk Assessment, fluoride varnish application for high risk preschool children and use of the MI approach in dental health education for parents and caregivers.
- Publication of research findings in the scientific literature and at research conferences (**Appendix 8.2**).
- Development of a local *prevention toolkit* for use by dental and non-dental professionals. This is being developed by a working-group that includes dental nurses representing the four health service regions, the manager of dental service and a university representative (RN). The toolkit will incorporate best-practice guidelines and findings from the current research. Also in the context of health literacy the guidance will include local experience from the dental nurses, in particular use of local terms and preferred modes of community engagement such as health fairs and talks in preschools.

Table 8.5: Strategic framework for prevention of ECC in Trinidad

STRATEGIC FRAMEWORK FOR PREVENTION OF ECC
CARIES RISK ASSESSMENT AND DENTAL ATTENDANCE • Child to register at a dental clinic ideally by age one. • Establish a Dental Home for the child. • Clinical caries risk assessment based on standardized assessment tool and criteria. • Careful and thorough follow-up diagnosis using bitewing radiographs if possible. • Detection of caries before cavitation and pulpal involvement. • Interval for follow-up radiographs based on caries risk assessment. • Chair-side delivery of preventive advice on tooth brushing and diet in dental clinics. • Dental health teams to deliver caries prevention in conjunction with– 2.2% fluoride varnish • Recommend twice yearly fluoride varnish application (three times a year if high risk).
CLINICAL MANAGEMENT OF ECC • Management of decayed primary teeth – appropriate to child's ability to cope (avoid treatment that induces dental anxiety). • Develop courses to meet clinical training needs of clinicians for management of ECC. • Resin and GIC / stainless crowns for decayed primary molars or Hall crown technique • If complete caries removal not possible use indirect pulp capping for primary molars? (Consider use of ART where appropriate). • Referral protocols for sedation/ GA if multiple extractions required.
TOOTH BRUSHING ADVICE AND INSTRUCTION • Child to have supervised tooth brushing at least twice a day (ideally last thing at night and one other occasion). • Pea size amount of toothpaste (1350-1500 ppm Fluoride). • Child to spit out excess but no rinsing (to maintain topical fluoride contact time) • Advise use of manual or powered toothbrush as both effective.
DIETARY ADVICE • Dental professionals should advise on dentally safe breastfeeding taking account of local policy on breastfeeding from mother and child clinic / community nurses. • Parents and caregivers not to put child to bed with sweetened feeding bottle. • Parents and caregivers should be advised to minimise frequency of foods containing NMES – (restrict to mealtime) • Advise against drinks containing NMES in feeding bottles. • Recommend low sugar snacks e.g. cheese, fruits. • Snacks containing sugar substitutes preferable to those containing NMES
COMMUNITY BASED PREVENTION • Develop and implement supervised tooth brushing programmes in preschools and day-care. • Brushing with toothpaste containing fluoride at 1000ppm+ • Create supportive environment for healthy oral health behaviour in preschools (lunchbox policies, break time snacks, tuck shop policies on availability of non-sugar snacks • Programmes on oral health for pregnant mothers – following on to peri / post-natal period • Involvement of non-dental health professionals in oral health promotion for families with young children. e.g. GPs, Paediatricians, nurses , preschool teachers, community workers and lay educators should be involved • Develop training and use of Motivational Interviewing (MI) as part of oral health promotion for parents and caregivers.

8.6.7: Evaluation

Evaluation in health promotion refers to measuring the extent to which objectives set have led to desired outcomes' (Naidoo and Wills 1996). Nutbeam (1999) states the evaluation should form a key aspect of policy development and planning, providing feedback on intervention effects and justify use of limited resources. Furthermore, evaluation of health promotion programmes should be integral to the planning process and requires the use of evaluation frameworks (Watt 2001).

Nutbeam (1998) suggested that effectiveness of health promotion programmes has been challenging within the current approach of evidence based healthcare, where the randomised controlled trial (RCT) is considered the gold standard in intervention evaluation, stating 'For community-based and community wide programmes utilizing multiple interventions, RCTs are generally too restrictive'. This position is supported by Singh (2012) who states that health promotion activities cannot easily be measured using biomedical paradigms or expressed as quantitative outcomes. Similarly, Freeman (2005) suggests that although the RCT approach is useful for treatment-based interventions it may not be appropriate for community development interventions due the effects of external (environmental) and internal (psycho-social) factors.

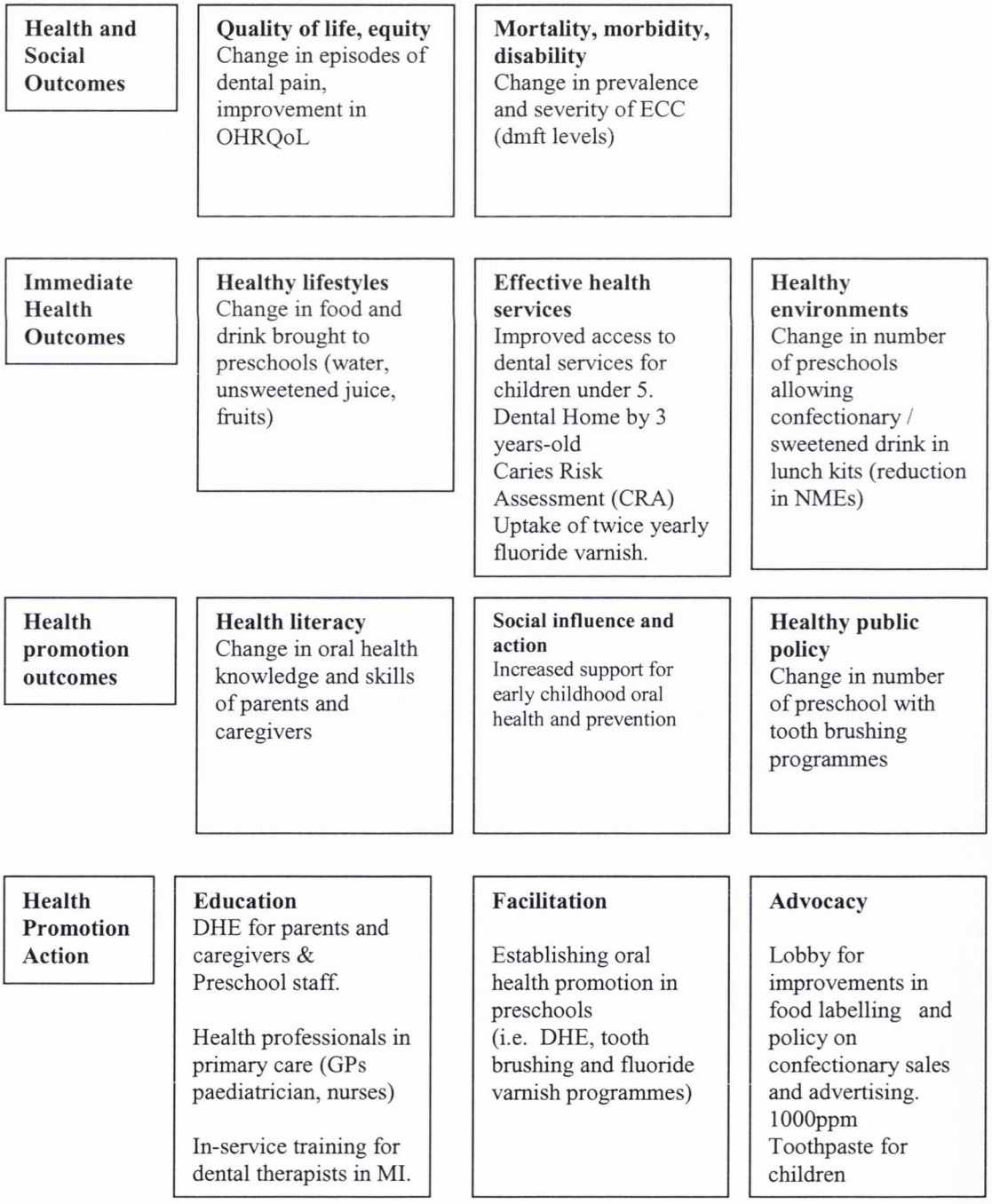
A more realistic evaluation of health promotion for community-based programmes may therefore require pluralistic methodologies, involving a mixture of quantitative and qualitative approaches that measure both process and outcomes of the intervention (Raphael 2000, Watt *et al* 2001, Singh 2012).

Watt (2001) suggests that to enable evaluation, programme objectives should have the following elements: be *Specific* (have a precise focus), *Measurable* (easily assessed), *Appropriate* (relevant to the needs of the population group), *Realistic* (achievable), *Time-related* (based on specified timescales). Hence the acronym SMART.

Nutbeam (1998) proposed a hierarchical model for health promotion evaluation (Figure 8.1), that takes into consideration different types of activity and outcome, these being: *health and social outcomes, intermediate health outcomes, health promotion outcomes and health promotion actions.* The model also acknowledges that each action requires specific types of evaluation measure and the importance of using measures that recognise timescales required to achieve changes in health status or health promotion actions (Watt *et al* 2001).

Underpinning the model are three main elements: *Education* (creation of opportunities for learning, intended to improve health literacy and the capacity of individuals and communities to improve their health, *Facilitation* (actions taken in partnership with individuals or social groups) and *Advocacy (*actions taken on behalf of individuals and communities to overcome structural barriers to achieving health) (Nutbeam 1998).
The model has been adapted by Watt *et al* (2001) for oral health promotion evaluation, with specific relevance for children's oral health. The model is therefore useful as an evaluation framework for the preventive strategy for preschool children.

Figure 8.1: Health promotion evaluation model for an ECC preventive strategy in Trinidad (adapted from Watt *et al* 2001)



8.6.8: Conclusion

The research presented in this thesis has identified social and behavioural factors associated with inequalities in oral health among preschool children in Trinidad, mainly with respect to the prevalence and severity of early childhood caries. This disease is largely untreated and where present, shown to have negative impacts on the quality of life of the child and family.

Parents and caregivers were found to be in need of information and practical support to maintain the oral health of their children. Based on these findings the proposed oral health promotion strategy and prevention framework draws on best-practice guidelines. These include caries risk assessment, early dental attendance and clinical prevention along with approaches for improving access to care. In particular, the strategy includes the use of brief-counselling (MI) to improve oral healthcare in the home and improve outcomes.

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APPENDIX 3.1: Ethics approval for oral health survey.

THE UNIVERSITY OF THE WEST INDIES
St Augustine, Trinidad and Tobago, West Indies
FACULTY OF MEDICAL SCIENCES
OFFICE OF THE DEAN
Telephone: (868) 645-2828 Ext. 3011 Fax: (868) 663-9826 e-mail: deanfms@tt.uwi.edu

May 26, 2009

Dr Rahul Naidu
School of Dentistry
Faculty of Medical Sciences
The University of the West Indies

Dear Dr Naidu

Re: The Oral Health of Pre-School Children in Trinidad & Tobago

Further to my letter dated May 6, 2009 and upon receipt of the additional information, I write to inform you that approval has been granted for you to proceed with your research as captioned.

Sincerely

Professor A. O. Adogwa
Chairman
Ethics Committee
Faculty of Medical Sciences

AOA/dap

APPENDIX 3.2: Parent/caregiver covering letter for oral health survey.

THE UNIVERSITY OF THE WEST INDIES
ST. AUGUSTINE, TRINIDAD AND TOBAGO, WEST INDIES
FACULTY OF MEDICAL SCIENCES
SCHOOL OF DENTISTRY
Telephone: (868) 645-2640/50 Ext. 4112/4115 Fax: (868) 645-3823

February 2010

Dear Parent / guardian,

Dental Health of Young Children

We are conducting a research project on the dental health of preschool children in Trinidad and Tobago to help to develop preventive dental care for young children in this country. This research involves finding out about your child's experience of dental care through a questionnaire that we would like you to complete and also a dental examination of your child.

The dental examination will take place at your child's preschool and involve a dentist taking a quick look at the teeth and gums, using a 'one-use' disposable dental mouth-mirror. The information we gather will be kept confidential by the research team and stored securely. No treatment will be undertaken but in the event your child is found to have any urgent dental problems we will inform you.

If you agree to your child having the dental examination please read and sign the enclosed consent form and return it to your child's preschool together with the completed dental health questionnaire.

If you have any further questions I can be contacted at 868-645-3823 ext 4144 / 4141.

Sincerely,

Dr. Rahul Naidu BDS, MSc, DDPH (RCS Eng), MFDS (RCS Edin)
Senior Lecturer Community Dentistry
Survey coordinator

APPENDIX 3.3: Parent / caregiver consent form.

THE UNIVERSITY OF THE WEST INDIES
ST. AUGUSTINE, TRINIDAD AND TOBAGO, WEST INDIES
FACULTY OF MEDICAL SCIENCES
SCHOOL OF DENTISTRY
Telephone: (868) 645-2640/50 Ext. 4112/4115 Fax: (868) 645-3823
School e-mail: dentalsh@trinidad.net

DENTAL HEALTH OF YOUNG CHILDREN

CONSENT FORM

I agree to take part in this research and hereby give consent for my child (name) ..... to have a dental examination at their preschool.

I understand that I will be advised of the need for immediate dental treatment if required.

Signed_____ Date _____

Name of Parent/Guardian

_____

Please return this form to the pre-school along with the completed questionnaire as soon as possible.

APPENDIX 3.4: Oral health survey questionnaire

DENTAL HEALTH OF YOUNG CHILDREN

QUESTIONNAIRE

Through this survey we are asking for your thoughts and opinions about your child's dental health. We would also like to know about your own use of dental care.

This information will help us learn about the dental health of young children in Trinidad and Tobago and to develop dental services that care for them effectively.

Please answer all the questions in this survey as best as you can.

After you have completed this survey please return it to your preschool

---

PLEASE START HERE

1/How old is your child? _____

2/What is your child's date of birth?_____

3/What gender are they (please tick)? **Boy** ☐1 **Girl** ☐2

4/Which ethnic group are they (please tick)?

☐1 African
☐2 Indian
☐3 Mixed
☐4 White
☐5 Other _____

5/ Does your child have problems or difficulty with any of the following?

☐1 Sight
☐2 Hearing
☐3 Movement
☐4 Speech
☐5 Learning
☐6 General health (Please describe)_____

6/ For the questions below please tick the answer that best describes your thoughts about dental health

Parents should start cleaning their child's teeth as soon as the first by tooth comes in.	☐1 Agree	☐2 Disagree	☐3 Don't know
Bacteria and germs in the mouth can cause cavities (tooth decay)	☐1 Agree	☐2 Disagree	☐3 Don't know
Fluoride helps prevent tooth decay.	☐1 Agree	☐2 Disagree	☐3 Don't know
Putting a child to bed with a bottle containing juice can cause vities in the teeth.	☐1 Agree	☐2 Disagree	☐3 Don't know
Tooth decay runs in families.	☐1 Agree	☐2 Disagree	☐3 Don't know

7/ When should you take a child to the dentist for the first time?

☐1 When they get their first tooth
☐2 When they have all their baby teeth
☐3 When they get their first adult teeth
☐4 Only when they get pain or have a problem
☐5 Not sure

THE DENTAL HEALTH OF YOUR CHILD

8/ How would you rate your child's dental health?

☐1 Excellent
☐2 Very Good
☐3 Good
☐4 Fair
☐5 Poor

9/ Has your child ever visited a dentist or dental nurse?

☐1Yes ☐2 No

If **Yes**, How old was your child at his or her first visit? _____ years

10/ Have you ever had difficulty in finding dental care for your child?

☐1 Yes ☐2 No

11/ For each of the following questions please tick in the box next to the response that best describes your child's experience or your own. Consider your child's whole life from birth until now when answering each question

		Never	Hardly ever	Occasionally	Often	Very often	Don't know
a	How often has your child had **pain** in the teeth or jaws	☐1	☐2	☐3	☐4	☐5	☐6
b	How often has your child had difficulty drinking hot or cold drinks because of dental problems or dental treatment	☐1	☐2	☐3	☐4	☐5	☐6
c	How often has your child had **difficulty eating some foods** because of dental problems or dental treatment?	☐1	☐2	☐3	☐4	☐5	☐6
d	How often has your child had **difficulty pronouncing words** because of dental problems or dental treatment?	☐1	☐2	☐3	☐4	☐5	☐6
e	How often has your child **missed preschool** because of dental problems or dental treatment?	☐1	☐2	☐3	☐4	☐5	☐6
f	How often has your child had **trouble sleeping** because of dental problems or dental treatment?	☐1	☐2	☐3	☐4	☐5	☐6
g	How often has your child been **irritable or frustrated** because of dental problems or dental treatment?	☐1	☐2	☐3	☐4	☐5	☐6
h	How often has your child avoided **smiling or laughing** because of dental problems or dental treatment?	☐1	☐2	☐3	☐4	☐5	☐6
i	How often has your child **avoided talking** because of dental problems or dental treatment?	☐1	☐2	☐3	☐4	☐5	☐6
j	How often have you or another family member **been upset** because of your child's dental problems or dental treatment?	☐1	☐2	☐3	☐4	☐5	☐6
k	How often have you or another family member **felt guilty** because of your child's dental problems or dental treatment?	☐1	☐2	☐3	☐4	☐5	☐6
l	How often have you or another family member taken **time off work** because of your child's dental problems or dental treatment?	☐1	☐2	☐3	☐4	☐5	☐6
m	How often has your child had dental problems that had a **financial impact** on your family.	☐1	☐2	☐3	☐4	☐5	☐6

12/ If your child had decay in a baby tooth that was not causing pain what treatment would you want?

☐1 None
☐2 Have it filled
☐3 Take it out
☐4 Not sure

13/ How often does your child brush their teeth?

☐1 Never
☐2 Once a day
☐3 Twice a day
☐4 More than twice a day

14/ How often do you help your child to brush their teeth?

☐1 Sometimes
☐2 All the time
☐3 Never

If you do help to brush your child's teeth, in what position do you do it from?

☐1 In front of them
☐2 Behind them
☐3 At one side

what size of brush do they use?

☐1 small
☐2 medium
☐3 large
☐4 don't know

15/ Does your child use toothpaste?

☐1 Yes
☐2 No
☐3 Don't Know

If you answered Yes how much toothpaste do you place on the brush?

☐1 Enough to cover the whole brush head
☐2 Enough to cover half the brush head
☐3 Pea size
☐4 Don't know

Does the toothpaste contain fluoride?

☐1 Yes
☐2 No
☐3 Don't Know

16/ Besides toothpaste, has your child used any of the following other form of fluoride?

☐1 Fluoride drops or tablets
☐2 Fluoride varnish or gel applied by a dentist or dental nurse
☐3 Fluoride mouthwash

17/ Was your child breast fed?

☐1 Yes ☐2 No

If **Yes,** at what age did they stop breast-feeding?_____

18/ Has your child ever used a sweetened baby bottle or infant feeder at night?

☐1 Yes ☐2 No

19 / How often does your child have sweet drinks (e.g. colas, juice etc)

☐1 More than twice a day
☐2 Twice a day
☐3 Once a day
☐4 Rarely
☐5 Never
☐6 Don't know

20/ How often does your child eat fruits ?

☐1 More than twice a day
☐2 Twice a day
☐3 Once a day
☐4 Rarely
☐5 Never
☐6 Don't know

21/ How often does your child have sweet snacks (e.g. chocolates, candy, biscuits)?

☐1 More than twice a day
☐2 Twice a day
☐3 Once a day
☐4 Rarely
☐5 Never
☐6 Don't know

ABOUT YOU

22/ How often do you visit a dentist?

☐1 Never been
☐4 Only when in pain
☐2 Every 6 months
☐3 Once a year
☐5 Other _____

23/ Have you ever had difficulty in finding dental care for yourself?

☐1 Y ☐2 N

24/ How would you rate <u>your</u> overall dental health?

☐1 Excellent
☐2 Very good
☐3 Good
☐4 Fair
☐5 Poor

25/ How often do you feel your child is making too many demands on you?

☐1 Always
☐2 Often
☐3 Sometimes
☐4 Occasionally
☐5 Never

26/ How often do you need to have someone help you read instructions, leaflets or other written material from your doctor or pharmacy?

☐1 Always
☐2 Often
☐3 Sometimes
☐4 Occasionally
☐5 Never

27/ To which age group do you belong?

☐1 18 – 24
☐2 25 –34
☐3 35 –44
☐4 45 –54
☐5 55 – 64
☐6 over 65

28/ What gender are you?

☐1 Male ☐2 Female

29/ Which ethnic group best describes you?

☐1 African
☐2 Indian
☐3 Mixed
☐4 White
☐5 Other _____

30/ What is the occupation of the head of your household?_____

31/ What is you highest level of education?

☐1 None
☐2 Primary
☐3 Secondary
☐4 Technical college
☐5 University
☐6 Other_____

THANK YOU

APPENDIX 3.5: Oral examination indices and codes.

Dentition status

Criteria for caries diagnosis and recording for this survey were adapted from the WHO (1997) but without the use of an explorer. The criteria and codes for primary tooth status were as follows:

WHO dentition status codes

tooth code	Condition	Criteria
A	Sound	Crown shows no evidence of treated or untreated clinical caries. Tooth recorded as sound is showing early caries which is non-cavitated is not recorded. Also white, chalky , discoloured or rough spots, stained pits and fissure that do not have undermined enamel or softened wall, dark, shiny hard and pitted areas showing signs of fluorosis and those that are due to tooth wear.
B	Decayed	Tooth recorded as decayed when lesion in pit or fissure or smooth surface has a visible softened floor or wall or undermined enamel of where a temporary filling present.
C	Filled and decayed	Tooth recorded as filled when it has one or more permanent restoration and one or more decayed areas. No distinction between primary or secondary caries.
D	Filled no decay	Tooth recorded as filled with no decay when one or permanent restorations present but no other caries anywhere in the tooth. Includes a tooth crowned for previous decay.
E	Missing due to caries	Primary teeth that have been extracted due to caries. Only if the subject is ay an age where normal exfoliation would not explain for absence.
F	Fissure sealant	This code used for teeth with occlusal fissure sealants or preventive resin restoration. If tooth with sealant has decay, should be coded as B.
G	Bridge abutment or crown	Can be used crowns placed on primary for reasons other than caries.
T	Trauma	A crown is scored as fractured when some of its surface is missing as a result of trauma and there is no evidence of caries.
9	Not recorded	Tooth than cannot be examined for any reason

Individual tooth treatment need

Treatment need was based on WHO (1997) criteria and recorded for each tooth immediately after assessment of dentition status and before proceeding to next tooth.

0 None
P Preventive care
F Fissure sealant
1 One surface filling
2 Two surface filling
3 Crown
4 Veneer
5 Pulp care
6 Extraction
7 Other
9 Not recorded

Details of criteria for treatment need

0 - None

This code is recorded if the tooth is considered sound and no treatment required.

P / F, 1 and 2

The above codes can be used to indicate treatment required for

- primary or secondary caries
- discolouration due to developmental defect
- lesions due to trauma, abrasion, erosion or attrition
- replace unsatisfactory fillings or sealants (defective margins, overhangs, fracture)

3 - Crown

This code would indicate need for stainless steel crown

4 - Veneer

As only primary teeth ebbing assessed this would indicate need for composite veener.

5 - Pulp care

This code indicates the need for pulp therapy such as pulpotomy or pulpectomy prior to restoration due to deep caries / abscess or exposure of pulp due to trauma or tooth wear.

6 - Extraction

This code to be use for teeth in need of extraction due to:

- Caries destroyed the tooth such that it cannot be restored
- Tooth loose , painful and functionless
- Only roots remain

7 - Other

Treatment indicated to be specified by examiner

9 - Not recorded

Unable to assess tooth for treatment (missing or not adequately visible)

Enamel opacities / hypoplasia:

The modified Developmental Defects of Enamel index as described by the WHO (1997) was used to record enamel opacities and hypoplasia. A further modification being that probe was not used to aid diagnosis.

Codes and criteria for enamel opacities and hypolasia:

0 - Normal.

1 - Demarcated opacity. In enamel of normal thickness and with an intact surface, there is an alteration in the translucency of the enamel, variable in degree. It is demarcated from the adjacent normal enamel with a distinct and clear boundary and can be white, cream, yellow or brown in colour.

2 - Diffuse opacity. Also an abnormality involving an alteration in the translucency of the enamel, variable in degree and white in colour. There is no clear boundary between the adjacent normal enamel and the opacity can be linear or patchy or have a confluent distribution.

3 - Hypoplasia. A defect involving the surface of the enamel and associated with a localized reduction in the thickness of the enamel. It can occur in the form of: (a) *pits* –single or multiple, shallow or deep, scattered or in rows arranged horizontally across the tooth surface; (b) *grooves* – single or multiple, narrow or wide or (c); *partial of complete absence of enamel*. The affected enamel may be translucent or opaque.

4 - other defects.

5 - Demarcated and diffuse opacity.

6 - Demarcated opacity and hypoplasia.

7 - Diffuse opacity and hypoplasia.

8 - All three.

9 - Not recorded

Index teeth used for the recording of these codes were:

54, 53, 52, 51, 61, 62, 63, 64

Index teeth examined on buccal surfaces only, if missing, box left blank. Gross plaque or food deposits removed with a guaze but teeth examined in a wet condition. Entire buccal surface examined. If doubt about the presence of abnormality tooth scored as 'normal'. Any abnormality that cannot be readily classified into one of the three basic types should be scored as 'other defects'. A tooth is regarded as present once any part has penetrated the mucosa. If more than two thirds of the tooth is restored or badly decayed or fractured it should not be examined (code 9).

Dental Erosion

Criteria for erosion was that used in the UK National Diet and Nutrition Survey of children aged 4-18 was used (Walker *et al* 2000): (Modified to exclude permanent teeth and extent of erosion):

Index teeth: Upper - 55, 54, 53, 52, 51, 61, 62, 63, 64, 65

Lower – 85, 84, 74, 75

Evidence of erosion recorded on the buccal and palatal surfaces of the incisors of the primary teeth dentition in the upper arch and the lower primary molars. Erosion into the enamel surface was taken as evidence of erosion (not incisal edge):

Criteria and codes for dental erosion

Dental erosion was recorded using visual assessment of index using the following criteria:

Code 0: Normal- no tooth surface loss.

Code 1: Enamel only – on incisor teeth there is loss of the developmental ridges resulting in a smooth or 'ground glass' appearance. On occlusal surfaces the cusps appear rounded and there cusps appear rounded and there may be depressions producing 'cupping'.

Code 2: Enamel and dentine – there is loss of enamel exposing dentine. On incisors this may resemble a 'shoulder preparation' parallel to the crest of the gingivae, particularly on palatal surfaces. The incisors may appear shorter and there may be chipping of the incisal edges. On occlusal surfaces 'cupping' or rounding-off of cusps is evident. Restorations may be raised above the level of the adjacent tooth surface

Code 3: Erosion involving enamel, dentine and pulp – loss of enamel and dentine resulting in pulp exposure.

Code 9 – Assessment cannot be made

Criteria for Plaque and gingival health

Criteria used in this study were those as defined in the UK National Diet and Nutrition survey (Walker 2000). Each jaw divided in three segments as follows:

The middle segment: extending forward from the distal surface of the canine on the one side to the distal surface of canine on the other side.

The left and right segments: extending backwards from the distal surfaces of the canines to the distal surfaces of the most posterior teeth present.

The examiner will look at each of these segments in the prescribed order (upper right, middle, upper left, lower left, middle, lower right, twice, once for the assessment of the gingival condition and once for the presence of visible plaque. The average condition of the plaque and gingivae in the segment to be recorded and not the worst score. When there is doubt a lower category is to be recorded.

Codes for gingival health

Each segment was examined both bucally and lingually and its gingival condition recorded as one of the flowing categories.

Code 0 – The gingivae appear healthy

Code 1 - Gingivitis present*

Code 9 – Assessment cannot be made

(*Code 1 includes both gingivitis that can be reversed by prophlyaxis and improve oral hygiene as well as more severe redness and swelling of the gingivae).

Codes for plaque levels

Each segment examined both bucally and lingually and its state recorded as one of the flowing categories.

Code 0 – The teeth appear clean

Code 1 – Plaque visible without probing

Code 9 – Assessment cannot be made

(Only plaque to be considered – recent food debris from meal or snack to be ignored)

APPENDIX 3.6: Oral examination record form.

ORAL EXAMINATION RECORD FORM

Preschool_____ **Region** _____ **ID number**_____

Age_____ **DOB**_____ **Sex** (M=1 F=2)_____

Ethnic Group (A, I, M, W, C, O) _____ **Examiner**_____

Duplicate Exam Y / N Date_____

1/ ENAMEL HYPOPLASIA (labial and buccal surfaces)

54	53	52	51	61	62	63	64

Code:
0=None, 1=Demarcated opacity, 2=Diffuse opacity, 3=Hypoplasia, 4= Other defects, 5= Demarcated and diffuse, 6= Demarcated and hypoplasia, 7= Diffuse and hypoplasia, 8= All three, 9=Not recorded

---

2/ PLAQUE (jaw segments divided at distal of canines)

UR	UA	UL
LR	LA	LL

Code: 0=Appear clean, 1=Visible plaque without probing, 9= Not recorded

3/ GINGIVA (jaw segments divided at distal of canines)

UR	UA	UL
LR	LA	LL

Code: 0= Healthy, 1=gingivitis (mild or severe), 9= Not recorded

---

4/ CLEFT LIP AND / OR PALATE ☐ Code: 0= None 1= Present

5/ ANY OTHER ANOMALY: ☐ Code 0= None 1= Present

(specify)_____

6/ BEHVIOUR MANAGEMENT INDEX ☐

Code: 1=Definitely negative 2=Negative
3 =Positive 4=Definitely Positive

7/ DENTITION STATUS AND TREATMENT NEED

	55	54	53	52	51	61	62	63	64	65
Status										
Need										
	85	84	83	82	81	71	72	73	74	75
Status										
Need										

Code:

Status	Treatment need
0 = Sound	0 = none
1 = Decayed	P = preventive care
2 = Filled with decay	F = Fissure sealant
3 = Filled no decay	1 = One surface filling
4 = Missing due to caries	2 = Two surface filling
5 = Missing any other reason	3 = Crown for any reason
6 = Fissure sealant	4 = Veneer
7 = Crown	5 = Pulp care
8 = Unerupted tooth	6 = Extraction
T = Trauma	7/8 Other (specify)
9 = Not recorded (unable to assess)	9 = Not recorded (unable to assess)

8/ EROSION (Anterior- labial and palatal surfaces, Molar- occlusal)

55	54	53	52	51	61	62	63	64	65
85	84							74	75

Code: 0= Normal, 1= Enamel only, 2= Enamel and dentine,
3= Enamel-dentine-pulp, 9= Not recorded

9/ NEED FOR URGENT CARE AND REFERRAL ☐ Code:Yes=1 No=2

APPENDIX 6.1: Bristol qualitative research course certificate.

University of BRISTOL

Department of Social Medicine

Certificate of Course Completion

Rahul Naidu

COMPLETED THE SHORT COURSE IN

Introduction to Qualitative Research Methods

26/04/2010 - 30/04/2010

Educational Hours: 26

Course Organisers

Head of Department

In accordance with Faculty of Public Health policy, short courses are no longer formally accredited for Continuing Professional Development (CPD). Individuals are advised to assess the content of the course and make a judgement about their CPD value.

APPENDIX 7.1: Ethics approval for intervention study.

THE UNIVERSITY OF THE WEST INDIES
ST AUGUSTINE, TRINIDAD AND TOBAGO, WEST INDIES
FACULTY OF MEDICAL SCIENCES
ETHICS COMMITTEE
Telephone: (868) 645-2640 Ex. 3025 Fax: (868) 663-9869 e-mail: deanfms@sta.uwi.edu

March 25, 2011

Dr. Rahul Naidu
School of Dentistry
Faculty of Medical Sciences
The University of the West Indies
St. Augustine

Dear Dr. Naidu

Re: The effect of motivational interviewing combined with dental health education on parental attitudes and dental health of preschool children

I am pleased to inform you that Ethics Committee reviewed and approved your research proposal subject to the following amendment:

(i) Section 3. B. (ii) – the actual starting and ending dates for the research is required.

Kindly submit your response to the above amendment by memorandum as soon as possible.

Yours sincerely

Shivananda Nayak (Dr)
Chairman
Ethics Committee
Faculty of Medical Sciences

/erf

APPENDIX 7.2: Letter to head teachers – Intervention study.

THE UNIVERSITY OF THE WEST INDIES
ST. AUGUSTINE, TRINIDAD AND TOBAGO, WEST INDIES
FACULTY OF MEDICAL SCIENCES
SCHOOL OF DENTISTRY
Telephone: (868) 645-2640/50 Exts. 4144/4141 Fax: (868) 645-3823

The Head Teacher / Manager

Dear Sir/Madam,

RE: Dental health education for parents of young children.

We are conducting a research project looking at the effect of dental health education on how parents take care of their young children's teeth. This research has received ethical approval from the Faculty of Medical Sciences, ethics committee and is being undertaken in collaboration with Dr. Elizabeth Prayman, Manager Dental Services Ministry of Health.

Parents who agree to take part would receive dental health education from a dental nurse. All parents in the study will also be asked to fill out a questionnaire on dental health at the start of the study and again a few weeks later. We hope to start this research in the new term – (September /October 2011).

If you are interested in your preschool being involved we will give you letters to be distributed to parents inviting them to take part and outlining the aims of the study. I can be contacted for further information at 746-4130 (cell) or e-mail: rahul.naidu@sta.uwi.edu

Yours faithfully,

Dr. Rahul Naidu
Senior Lecturer, Community Dentistry

APPENDIX 7.3: Parent / caregiver letter – Intervention study

THE UNIVERSITY OF THE WEST INDIES

ST. AUGUSTINE, TRINIDAD AND TOBAGO, WEST INDIES

FACULTY OF MEDICAL SCIENCES

SCHOOL OF DENTISTRY

Telephone: (868) 645-2640/50 Exts. 4144/4141 Fax: (868) 645-3823

Dear Parent/ Guardian,

Re: Dental health education research project

We are undertaking a research project looking at the effect of dental health education on parents of young children. This involves you receiving some dental health education from a dental care professional. This may also involve some follow-up telephone calls to provide further information.

At the beginning of the project you will be asked to fill out a short questionnaire and again a few weeks later. There will be no names on the questionnaires, all information will remain confidential and you may withdraw from the study at anytime

If you are interested in taking part in this research please sign and return the attached form to your preschool.

Sincerely,

Dr Rahul Naidu
Senior Lecturer, Community Dentistry

APPENDIX 7.4: Consent form – Intervention study.

DENTAL HEALTH EDUCATION FOR PARENTS OF PRESCHOOL CHILDREN.

Consent to participate

I hereby agree to take part in this research. I understand that strict confidentiality will be maintained and that I may withdraw from the study at anytime.

Name_____

Signature_____

Preschool_____

Date_____

APPENDIX 7.5: Oral health questionnaire – Intervention study.

PRESCHOOL_____ **no:**_____ **(for office use)**

DENTAL HEALTH OF YOUNG CHILDREN

We are interested in understanding how you as a parent and caregiver, manage to look after your child's teeth and dental health. Please answer the questions on all 8 pages of this form, by placing a tick in the box (or boxes) that apply.

SECTION 1: DENTAL SERVICES

Q1. When did you last visit a dentist or dental nurse?

☐1 6 months ago or less
☐2 more than 6 months but not more than 1 year ago
☐3 more than 1 year ago
☐4 more than 2 years ago
☐5 more than 3 years ago
☐6 more than 5 years ago
☐7 never been to a dentist (*go to Q3*)

Q2. What was the main reason for your last visit for dental care? (*tick all that apply*)

☐1 Regular check up
☐2 Teeth cleaning
☐3 To have teeth filled
☐4 To have teeth pulled or other surgery
☐5 Toothache or tooth pain
☐6 To have a denture made or repaired
☐7 Bleeding gums or gum disease
☐8 Loose teeth
☐9 Problems with wisdom teeth
☐10 Jaw pain
☐11 Some other reason– please explain_____

Q3. If you didn't go to a dental clinic in the past 5 years, why was that?

☐1 I had no dental problems so did not need to go
☐2 I am afraid of going for dental treatment
☐3 I thought the dental problem would go away
☐4 Unable to take time from work
☐5 Lack of transport
☐6 Dental treatment is too expensive
☐7 I was unable to get an appointment
☐8 I was unable to leave my child/children, so I could not go
☐9 Other reasons, please specify_____

Q4. Have you ever taken your child to see a dentist or dental nurse?

☐1 Yes
☐2 No – (*Go to Q7*)

Q5. Why did you take your child to see a dentist/ dental nurse?

Reason: _____

Q6. Does your child have a regular dental clinic that he/she goes to?

☐1 Yes
☐2 No

Q7. If your child needs dental care in the next year, where would you go?

☐1 Health Centre ☐2 Private Dentist ☐3 Dental Hospital ☐4 Not sure

Q8. Overall how do you rate the availability of dental services to you and your family?

☐1 Excellent
☐2 Very good
☐3 Good
☐4 Fair
☐5 Bad
☐6 Very bad

Q9. Do you have any health insurance that covers dental care for your family?

☐1 Yes
☐2 No
☐8 Do not know

Q10. In the area where you live, comparing finding a dentist with finding a medical doctor, do you think that:

☐1 It is easier to find a dentist than to find a medical doctor
☐2 It is easier to find a medical doctor than a dentist
☐3 It is NOT easy to find a dentist or a medical doctor
☐4 It is easy to find both

SECTION 2: YOUR AND TEETH AND MOUTH

Q11. How would you describe the condition of your teeth and mouth? (Including false teeth and dentures)?

☐1 Excellent
☐2 Very good
☐3 Good
☐4 Fair
☐5 Poor

Q12. During the past 3 months, how much pain have your teeth and gums caused you?

☐1 A great deal of pain
☐2 Some pain
☐3 A little pain
☐4 No pain at all

Q13. How many times did you brush your teeth during the last week?
_____ times

Q14. Did you brush your teeth before going to sleep at night during the last week?

☐1 Yes, (If yes, how many times during the last week? _____ times)
☐2 No

SECTION 3: YOUR CHILD'S TEETH AND MOUTH

Q15. How would you describe the condition of <u>your child's</u> teeth and mouth?

☐1 Excellent
☐2 Very good
☐3 Good
☐4 Fair
☐5 Poor

Q16. How many times did your child brush his (or her) teeth during the last week? _____ (insert number).

Q17. Did your child brush at bedtime during the last week?

☐1 Yes, (If yes, how many times during the last week? _____times)
☐2 No

Q18. During the last week, how many times did you or someone else help brush your child's teeth? _____(times)

Q19. For each situation in the table, please indicate <u>how confident</u> you are, that you can get your child's teeth brushed at bedtime.

Situation	4 Very confident	3 Moderately Confident	2 Somewhat confident	1 Not at all confident
1.When under a lot of stress	☐4	☐3	☐2	☐1
2.When feeling low	☐4	☐3	☐2	☐1
3.When feeling anxious	☐4	☐3	☐2	☐1
4.Feeling like you do not have the time (too busy)	☐4	☐3	☐2	☐1
5.When feeling tired	☐4	☐3	☐2	☐1
6.Worrying about things	☐4	☐3	☐2	☐1
7. Bothered because your child doesn't stay still when you want them to brush their teeth	☐4	☐3	☐2	☐1
8. When told by your child that he/ she does not feel like brushing right now	☐4	☐3	☐2	☐1

Q20. For each statement please indicate how you feel by ticking one of the boxes

Statement about dental health	5 Strongly Agree	4 Agree	3 Neither Agree or Disagree	2 Disagree	1 Strongly disagree
1/ I would take my child off the bottle if a healthcare professional told me to do so.	□5	□4	□3	□2	□1
2/ I get advice on taking care of my child from TV, Radio, Magazines, Internet.	□5	□4	□3	□2	□1
3/ I feel comfortable asking a healthcare professional about ways to care for my child's teeth.	□5	□4	□3	□2	□1
4/ It is easy for me to get answers about ways to take care of my child's teeth from a healthcare professional.	□5	□4	□3	□2	□1
5/ Keeping my child's teeth healthy is important to me.	□5	□4	□3	□2	□1
6/ My child benefits a lot when I clean his/her teeth.	□5	□4	□3	□2	□1
7/ I like the idea of a dentist or dental nurse putting fluoride on my child's teeth to protect them from cavities.	□5	□4	□3	□2	□1
8/ I believe using fluoride toothpaste every day would help my child's teeth.	□5	□4	□3	□2	□1
9/ It would be hard to give my child less sweets.	□5	□4	□3	□2	□1
10/ My child gives me a hard time when I try to brush his/her teeth.	□5	□4	□3	□2	□1
11/ It is not easy to use fluoride toothpaste every day.	□5	□4	□3	□2	□1
12/ I am unable to put my child to sleep without feeding him/her.	□5	□4	□3	□2	□1
13/ Food and drinks that are not sweet don't taste good to my child.	□5	□4	□3	□2	□1
14/ I feel like a bad parent if I don't give my child sweets.	□5	□4	□3	□2	□1
15/ My child is happier when I give him/her something sweet in the bottle.	□5	□4	□3	□2	□1
16/ It makes me feel good to give my child something sweet to eat.	□5	□4	□3	□2	□1

Q21. For each statement please indicate how you feel by ticking one of the boxes

Statement	5 Strongly Agree	4 Agree	3 Neither Agree or Disagree	2 Disagree	1 Strongly disagree
1/Most children eventually develop cavities	☐5	☐4	☐3	☐2	☐1
2/ Cavities in baby teeth don't matter since they fall out anyway	☐5	☐4	☐3	☐2	☐1

For each of these questions please tick one of the boxes on the left:

Q22. Bacteria (germs) on the teeth of young children can cause cavities?

☐1 Yes
☐2 No
☐3 Don't know

Q23. What size of brush is best for a young child?

☐1 Small
☐2 Medium
☐3 Large
☐4 Don't know

Q24. How much toothpaste should be placed on the brush?

☐1 Enough to cover the whole brush head
☐2 Pea size
☐3 A smear
☐4 Don't know

Q25. How should you help brush your child's teeth?

☐1 From in front of the child

☐2 From behind the child

☐3 From the side of the child

☐4 Don't know

Q26. How much fluoride should the paste contain?

☐3 Not less than 1000ppm fluoride

☐2 450-600ppm fluoride

☐1 Don't know

Q27. fluoride varnish should be put on the teeth of young children every six months by a dentist or dental nurse to prevent cavities?

☐3Yes

☐2 No

☐1 Don't know

Q28. To avoid cavities, when is it safer to let children have sugary snacks or drinks

☐5 In the morning

☐4 At night

☐3 At mealtimes

☐2 Between meals

☐1 Don't know

Q29. When should a child first visit the dentist or dental nurse?

☐5 When they get all their baby teeth

☐4 When they start to get some adult teeth

☐3 By the time they are 1-year-old

☐2 Only when/if they get a problem with their teeth

☐1 Don't know

SECTION 4: ABOUT YOU

Q30. How many children under 5-years-old do you care for? _____

Q31. To which age group do you belong?

☐6 18 – 24
☐5 25 –34
☐4 35 –44
☐3 45 –54
☐2 55 – 64
☐1 over 65

Q32. Are you? ☐1 male ☐2 female

Q33. Which ethnic group best describes you?

☐5 African
☐4 Indian
☐3 Chinese
☐2 Mixed
☐1 Other

Q34. What is your occupation?_____

Q35. What is your level of education?

☐5 Primary
☐4 Secondary
☐3 Technical College
☐2 University
☐1 Other.....

THANK YOU VERY MUCH

APPENDIX 7.6: Dental health information leaflet.

Q **How can I prevent tooth decay in my child?**

A The main cause of tooth decay is not the amount of sugar in the diet, but how often it is eaten or drunk. The more often your child has sugary foods or drinks, the more likely they are to have decay. It is therefore important to keep sugary foods to mealtimes only. If you want to give your child a snack, try to stick to cheese, vegetables and fruit, but not dried fruit.

It is also worth remembering that some processed baby foods contain quite a lot of sugar. Try checking the list of ingredients: the higher up the list sugar is, the more there is in the product. Sometimes, these are shown as fructose, glucose, lactose, or sucrose.

Thorough brushing, twice a day, particularly last thing at night, will help to prevent tooth decay.

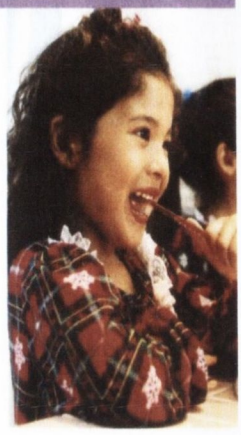
Q **What if my child is very nervous about going to the dentist?**

A Children can sense fear in their parents, so it is important not to let your child feel that a visit to the dentist is something to be worried about. Try to be supportive if your child needs to have any dental treatment. If you have any fears of your own about going to the dentist, don't discuss them in front of your child.

Regular visits to the dentist are essential in helping your child to get used to the surroundings and what goes on there. A child can be much more anxious if it is their first visit to a dental practice. Pain and distress can happen at any time and it is important to prepare your child with regular visits.

British Dental Health Foundation

Children's teeth



The British Dental Health Foundation is an independent, UK-based charity dedicated to promoting the benefits of good oral health to the public throughout the world.

The Foundation promotes three key messages:

- brush your teeth twice a day with a fluoride toothpaste
- cut down on how often you have sugary snacks and drinks
- visit your dentist at least once a year.

APPROVED

plain English approved by the word centre

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Printed 0406

British Dental Health Foundation

APPENDIX 7.7: Training in Motivational Interviewing (MI) course certificate.

Possibilities Life Coaching

Certificate of Completion is hereby granted to

Rahul Naidu

to verify completion of a full-day Level 1 workshop
applying Motivational Interviewing and Coaching
skills for health professionals

22 October 2010

APPENDIX 7.8: MI telephone script (2 week follow-up)

TELEPHONE SCRIPT: TWO WEEKS AFTER MI COUNSELING

Hello, this is _____.

Pleasantry, e.g., *It's good to hear your voice again. How are you and* (Name of child)?_____

I am calling to go over your plan to (fill in the benefit/motivation, e.g., keep your child from having dental pain; straight teeth, control dental expenses, etc)

Let's go over each part of the plan.

Tell me how is _____*(look at plan) working?*

Tell me more. Take notes._____

_____

_

Go over each part of the plan, asking for as much information as possible and taking notes._____

_____

_

If all is going well, tell mom how much you enjoyed talking to her and that you would like to call her again in a MONTH. Identify date and time and prepare postcard to mail.

If there are problems.....

"Let's go over the part(s) of the plan that are a problem. Sometimes a small adjustment can make a big difference."

Usually the plan is too ambitious—suggest a scaled down version of a particular strategy or break it into smaller steps.

Problems with TOOTH CLEANING usually are associated with child resistance, as the child may not be comfortable with someone else putting something into his/her mouth. Suggestions include: make a game of it—perhaps touching hand nose with brush, while singing favorite song. Keep brush in mouth for very short time, then slightly longer and longer over time. Begin to clean later, when parental control of brush is accepted. The basic principle is to break the problem into small parts and to make progress in one or more of the parts.

APPENDIX 7.9: Coding from MI focus group (thematic analysis).

Codes

1. Knowledge reinforcement / learning.
2. Contemplating changes / motivation.
3. Attempts at supervised tooth brushing.
4. Attempts at new brushing position.
5. Tooth brushing times and frequency.
6. Difficulty with night-time brushing / making routines.
7. Fluoride varnish awareness.
8. Changes to diet and feeding.
9. Adding fruits /juice to child diet.
10. Moving from bottle to cup.
11. Types of drinks.
12. Difficulty and barriers to making changes.
13. Effects of extended family.
14. Dental visiting & finding a dentist.
15. Feelings about MI group talk.
16. Thoughts on telephone contact.
17. Sharing dental experiences.
18. Talk versus written information.
19. Where best to get dental information

APPENDIX 8.1: Letter from Ministry of Health.

MINISTRY OF HEALTH Government of the Republic of Trinidad and Tobago

DENTAL SERVICES
T: (868)-627-0010/12/14 Ext: 629, F: (868)-623-9528

March 19, 2014

Dr. Rahul Naidu
Senior Lecturer
School of Dentistry
Facility of Medical Sciences
University of the West Indies
Eric Williams Medical Sciences Complex

Re: Oral health in early childhood in Trinidad

Dear Dr. Naidu

I would like to express my gratitude to you on sharing the findings from your research conducted by The University of the West Indies on the oral health of preschool children.

The findings of the study represents a step in the direction of bridging the data gap that presently exists with respect to the oral health of young children and would indeed impact on the National Oral Health Policy.

Coming out of our meeting on the research findings on February 10, 2014, it became apparent that there exists many areas that your expertise and input would be most valuable, namely the development of the dental component of the Child Health Policy presently being developed by the Ministry of Health and the development of an oral health prevention toolkit that would be used by the Dental Nurses in the public oral health sector in the school oral health programme that targets pre-school, primary and secondary school children.

As such I kindly seek to meet with you at your convenience to plan the way forward for the above mentioned projects.

I am looking forward to our partnering on these projects which represents key strategic interventions in bringing about much needed improvements in oral health of the nation's children.

Sincerely,

Dr. Elizabeth Prayman
Manager, Dental Services.

20/03/14
MANAGER, DENTAL SERVICES
MINISTRY OF HEALTH

www.health.gov.tt

63, Park Street, Port of Spain, Trinidad. T: (868) 627-0010/12/14

APPENDIX 8.2: Published research articles (attached).

- Naidu, R., Nunn, J. and Forde. M. (2012): Oral healthcare of preschool children in Trinidad: a qualitative study of parents and caregivers. *BMC Oral Health* **12**, 27. http://www.biomedcentral.com/1472-6831/12/27

- Naidu R., Nunn. J. and Kelly A. (2013): Socio-behavioural factors and early childhood caries: a cross-sectional study of preschool children in central Trinidad. *BMC Oral Health* **13**, 30. http://www.biomedcentral.com/1472-6831/13/30

Naidu et al. BMC Oral Health 2012, 12:27
http://www.biomedcentral.com/1472-6831/12/27

BMC Oral Health

RESEARCH ARTICLE Open Access

Oral healthcare of preschool children in Trinidad: a qualitative study of parents and caregivers

Rahul Naidu[1*], June Nunn[2] and Maarit Forde[3]

Abstract

Background: Little is known about oral health in early childhood in the West Indies or the views and experiences of caregivers about preventive oral care and dental attendance The aims of this study were to explore and understand parents and caregivers' experience of oral healthcare for their preschool aged children and how, within their own social context, this may have shaped their oral health attitudes and behaviours. These data can be used to inform oral health promotion strategies for this age group.

Method: After ethical approval, a qualitative study was undertaken using a focus group approach with a purposive sample of parents and caregivers of preschool children in central Trinidad.
Group discussions were initiated by use of a topic guide. Audio recording and field notes from the three focus groups, with a total of 18 participants, were transcribed and analysed using a thematic approach.

Results: Despite some ambivalence toward the importance of the primary teeth, the role of fluoride and confusion about when to take a child for their first dental visit, most participants understood the need to ensure good oral hygiene and dietary habits for their child. Problems expressed included, overcoming their own negative experiences of dentistry, which along with finding affordable and suitable dental clinics, affected their attitude to taking their child for a dental visit. There was difficulty in establishing good brushing routines and controlling sweet snacking in the face of many other responsibilities at home. Lack of availability of paediatric dental services locally and information on oral health care were also highlighted. Many expressed a need for more contact with dental professionals in non-clinic settings, for oral health care advice and guidance.

Conclusion: Parents and caregivers in this qualitative study showed generally positive attitudes towards oral health but appear to have encountered several barriers and challenges to achieving ideal preventive care for their child, with respect to healthy diet, good oral hygiene and dental attendance. Oral health promotion should include effective dissemination of oral health information, more practical health advice and greater access to dental care for families with preschool children.

Keywords: Preschool children, Oral health, Parents, Caregivers, Qualitative, Focus groups, West Indies

Background

Early childhood oral health

Poor oral health in early childhood is one of the most serious and costly health conditions in young children [1]. The main concern is that of decay in the primary dentition. Early childhood caries (ECC), decayed teeth in children under 6 years of age, is a multi-factorial childhood disease with sociocultural and socioeconomic determinants [2]. Untreated ECC and its more rampant subtype Severe Early Childhood Caries (S-ECC) are associated with negative health outcomes. These include, poor feeding and eating, increased irritability due to pain and discomfort, reduced weight gain, slowed cognitive development and poorer quality of life [3-7]. Furthermore invasive treatment for caries in preschool children may be distressing for the child and family. Internationally prevalence of ECC has been reported to range from 6-90%, with most developed countries in the lower end and most developing countries in the middle to higher end of this range.

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Dental services and children's oral health in Trinidad and Tobago

Approximately 300 registered dentists practice in the island giving a dentist population ratio of about 1: 4,000. Most work privately in practices generally clustered in urban areas. Free dental care is available in the sector for children and adults in Regional Health Centres mainly for emergency care and exodontias, Currently 20 dentists work in the government sector supported by approximately 40 dental nurses (the equivalent of dental therapists in the UK). These dental nurses were trained using the New-Zealand model in the 1970's and provide the mainstay of dentistry in the public sector for children up to 12 years of age. Paediatric dental services (emergency and routine care) are also available at the University dental clinic, for children up to the age of 16 years.

There is currently no published epidemiological data on preschool children's oral health in Trinidad, however, the available information about oral health of children in this age group, suggests that ECC may be a problem in the region [8,9]. Also, the persistence of untreated caries in the primary dentition of school-aged children can be considered a public health problem, as a national survey in Trinidad reported almost two thirds of 6–8 year-olds had caries experience [10] and acute problems arising from decayed primary teeth were the most frequent cause of emergency dental visits in a dental hospital clinic [11]. Risk models have indicated that decayed primary teeth presenting in the primary school age indicate these children were at high risk for caries during their pre-school years [12].

Role of parents and caregivers

In their conceptual model Fisher-Owens *et al.* [13], recognized multilevel influences on children's oral health at the individual, family and community levels. These family level influences are mediated mainly through parents and caregivers with whom preschool children spend most of their time. During this period of primary socialization, routine dietary and health behaviors being established are directly and indirectly influenced by the oral health knowledge, attitudes, beliefs and practices of their parents and caregivers [14]. The influence of community level cultural factors and health-beliefs was also highlighted in the model proposed by Adair *et al.* [15]. Oral health knowledge and self-efficacy among mothers of preschool children are also important influences on oral health habits and routines in the home [16]. Parents and caregivers of preschool children attending a dental hospital clinic in Trinidad had inaccurate factual knowledge and low awareness of preventive care [17], indicating the need for a more in-depth understanding of their health beliefs and practices with respect to their children's oral health care.

Qualitative research

Qualitative research can be considered the study of human actions and activities or a way of witnessing human events in the context in which they occur [18]. By the use of a 'naturalistic approach', qualitative research attempts to study phenomena in a real-world setting [19,20].

Until relatively recently there have been few studies using qualitative methods to investigate oral health in infants and young children. In-depth interviews with parents of Finnish preschool children showed that significant barriers to dental care were the lack of oral health information, difficulties in making oral care part of the daily routine and finding time to make dental appointments. [21]. Dental and non-dental healthcare professionals in a focus group study revealed that they believed early childhood caries was an important problem which could cause significant pain and long term problems for children, such as low self esteem and the need complex orthodontic care [22].

Lack of awareness of the importance of primary teeth was a common finding in a focus group study with parents and caregivers in a multiethnic community in the US [23]. Qualitative studies of low-income families in Head Start programs in the US report that parents often saw the primary dentition as temporary teeth whose condition had little bearing on the future dentition [24] and though aware of some of the problems that could arise felt that general life demands made oral care a low priority [24]. Daly *et al.* [25] found that parents in their study (white mothers attending a Sure-Start program in the UK), viewed the primary dentition as important and were keen to establish good oral health habits. These reports suggest that social and cultural factors play a part in parental attitudes, as dental attendance for preventive dental care was not seen as necessary, rather only if problems arose.

Even where general knowledge and awareness was found to be good, a focus group study with pregnant mothers found that several had misconceptions about oral health such as the role of fluoride and integrity of the teeth during pregnancy [26]. Another common issue arising in these studies was the lack of availability and access to information on dental health for young children and specific advice on how to effectively translate this information into daily routines [25].

No qualitative investigation of the oral health of preschool children has been reported in the Caribbean. Research using a qualitative approach may identify specific oral health concerns among this population group and identify opportunities for oral health promotion and oral health policy development.

The aim of this study was to therefore gain understanding of parents' and caregivers' influence on preschool

children's oral health in a Trinidadian community, in the West Indies. In particular, to explore and understand parents' and caregivers' experiences of oral health and oral healthcare and how, within their own social context, this may have shaped their oral health attitudes and behaviours. Such information can help to guide the development of appropriate oral health promotion strategies to prevent ECC.

Objectives

- To explore the oral health beliefs of parents / caregivers of preschool children.
- To describe parent / caregiver experiences of accessing dental care for themselves and their preschool children.
- To explore parent / caregiver attitudes and behaviours toward oral care for preschool children and opportunities for oral health promotion to prevent ECC.

Method

Focus groups were chosen as the qualitative research methodology for this investigation. This method was selected as it was considered to be the appropriate research design to provide in-depth understanding of the issues under investigation and be an efficient means to attain such data with respect to available time and resources.

A focus group session can be considered an unstructured interview with a group of people who are encouraged to interact with each other and the facilitator [27]. The session uses group dynamics to stimulate discussion, gain insights and generate ideas to explore a chosen topic in depth. They are able to produce a large amount of information in a relatively short space of time. Kitzinger [28] states that "focus groups can help people explore their views and generate questions in ways they would find difficult in face-to-face interviews and when group dynamics work well the participants work alongside the researcher, taking the research in new and often unexpected directions." They have been found to work particularly well for groups discussing health priorities [27]. As a data collection technique focus groups are particularly sensitive to cultural variables by enabling analysis of shared identities and common knowledge operating within the group along with humor, consensus, and dissent used in their narratives [28].

Sampling and recruitment

A non-probabilistic, purposive sampling method was used to recruit subjects to the study. The aim of this method was to obtain a sample representative of parents and caregivers of children attending preschools in the Caroni Education District.

Letters were sent to three preschools from a list used for a previous epidemiological study in the area, explaining the nature and purpose of the study. These letters were addressed to the head-teachers inviting them to have their school take part. Upon agreement, they were given letters to send to parents individually inviting them to be a member of a focus group and explaining what this would entail. When enough parents had responded, ideally four to eight participants per group, final arrangements were made to run the group session. In each school one teacher assisted in the organising of the focus group meeting with respect to co-ordinating the time, venue and requirements of the study investigators and liaising with the parents.

Approval and consent

Individual written consent was obtained from all participants in the study.

The study had received ethical approval from The University of the West Indies, Faculty Research Ethics Committee.

Conduct of the focus groups

The focus groups were run by a facilitator trained in the use of focus group methodology. The specific areas of interest for the discussion were introduced using a semi-structured topic guide (Table 1). This was a short set of pre-selected topics that comprised open-ended questions based on previous work with similar groups in other countries [23,24,29,30]. These questions were revised so that they would be culturally compatible and reflect the Trinidadian context. This was achieved through discussion between the researchers and from views of teachers/staff in the chosen preschools who were shown the topic guide. Questions were open-ended and probing, using terms such as 'who', 'what', 'when', 'how' and 'why'. This guide was flexible and during the course of the discussions, not always asked in the same order and modified when needed, to explore emerging themes in greater depth. The focus groups lasted 45 to 50 minutes. The sessions took place in a quiet area of the preschools after the school day. During and after the session, light refreshments were made available to the participants to encourage a relaxed atmosphere and put participants at ease. Small gift bags (oral hygiene product samples, pamphlets and tokens), were also handed to each participants after the sessions as a courtesy for giving their time.

During the group session, participants were encouraged to respond to each others' comments and engage in an open discussion rather than just talk to the facilitator. As well as shared perspectives and consensus, unusual experiences and differing viewpoints on topics were welcomed, to gain a full range of opinions, feelings and

Table 1 Focus group topic guide

Topic guide
• What does it mean to you to have a healthy mouth?
• What are the kind of problems people might get with their mouths?
• What are some of your experiences of going to the dentist?
• Would you say that these experiences have affected you taking your child for dental care?
• What would be the reasons for taking or not taking your child for dental care?
• Which health professional would you feel most comfortable with for getting a dental check-up for your child?
• How do you feel about your child's first set of teeth?
• How important do you think they are and why?
• When do you feel is the best time to take your child to the dentist for the first time?
• Are there things you know about that can prevent your child getting cavities?
• How easy or difficult to do you find it to have your child brush their teeth?
• Are there foods or drinks that you know may be good or bad for your child's teeth?
• Who makes the decisions about your child's dental care?
• Do other people (friends or family) influence these decisions?
• What things would make going for dental care for your child easier or more comfortable?
• What would make it easier for you to look after your child's teeth?

insights. The discussions were recorded using a digital audio recording device and an audio cassette recorder. 'Back-up' field notes (including non-verbal communication), were also made by an assistant researcher who was present for all the discussions but took no part in them. Data were collected from 3 focus groups, in three different preschools between November 2010 and January 2011.

Data analysis

A thematic content analysis was used to analyse the data. This was an iterative process that involved several readings of the verbatim transcripts, field notes and listening to the audio recordings. Initial analysis was based around the discussion topics used in the question guide (these having been developed from earlier studies on similar population groups).

Key early themes (proto-themes) that emerged from the transcripts were labelled and coded. These proto-themes were flexible categories which, following further study of the transcripts, were expanded and modified to encompass the issues that arose from within the data upon comparison of segments of text. These initial codes were developed with an assistant (RB) who also took field notes and checked the transcription. The codes were marked on the margins of the transcripts against corresponding areas of text, to enable retrieval and further sorting of the text.

Emerging themes were reviewed by an academic anthropologist (MF) at the University of the West Indies. Using 'MS Word' software, further refinement of the themes was achieved by placing segments of similarly coded text next to each other to explore deeper meaning and context. Final themes were developed and reported with a description and related quotations to underline their meaning.

Respondent validity

The subjects were invited to comment on the focus group discussion (off-record) to consider whether they felt that it covered important/relevant issues and if it had fairly represented their feelings and thoughts. The participants of all three groups agreed that this had been the case.

Reflexivity

The facilitator of the three focus groups was an academic dentist (RN) working in a teaching hospital and this was known to the participants. This did not appear to compromise the discussion and in some respects enabled participants to express concerns in detail, with respect to issues of access and barriers to care.

Results

Socio-demographic information

A total of 18 parents and caregivers participated across the three focus groups (FG1, FG2, FG3) with 5, 9 and 14 in each group respectively. These participants were mainly female (89%) with a mean age of 28 (ranging from 23 to 49 years-old). Just over two thirds (67%) were of Indian ethnicity, with the others being of African (28%) or Mixed ethnicity (5%). The majority were in manual/semi-skilled occupations or housewives, 33% and 39% respectively. Twenty eight per cent were in non-manual or professional occupations.

Perceptions of oral health

Participants had reasonably clear thoughts on what constituted good oral health, with some expressing the view that this would include healthy gums and good breath and no cavities. Along with absence of disease, some felt that good oral health included having a nice appearance that aided self confidence:

Plenty of clean looking teeth. (FG3)

Gums that are not bleeding. (FG3)

Well umm... people with healthy teeth have no cavities and umm good breath. (FG2)

Helps your confidence in umm interacting with people. (FG2)

Pain and reduced function were mentioned by participants when describing an unhealthy mouth and not paying attention to oral hygiene could cause this. Also some felt that not taking good care of the teeth when young and heeding preventive advice could result in poor oral health later in life:

You wouldn't be able to eat properly, with pain from sensitive teeth. (FG3)

Being able to chew...

Yes, you wouldn't be able to chew or bite. (FG3)

Dental care experiences

When discussing reasons for attending dental care, a recurring issue raised was that dental treatment was often unpleasant and that going to the dentist was something largely to be avoided, unless there was current pain or problems. However, some believed that this irregular attendance would result in more problems and were concerned by this happening to their child. Reasons for avoiding dental care were largely due to bad experiences, often during childhood. Fear was often related to the procedures, in particular dental extractions:

Toothache for sure...if you have a little cavity or so and it doesn't trouble you then you find you wouldn't really take care of it until you start to get pain, then you know okay, yeah you ready to reach to a dentist. (FG1)

it's only when problems come then you well in my case that's only when you know, have a problem then you would find yourself going to the dentist and you of course don't want that for your children you want them to do the right thing carry them to the dentist. (FG2)

The environment of the dental clinic, that is, the smells, sights and sounds of the equipment and procedures were common issues of concern together with the chair-side manner of the dentist. Fear of reprimand for not doing a better job of looking after their mouth was also mentioned. Some participants described putting off taking their children for dental care due to their own negative experiences.

...I took too long to take them.....and it's because of my own experience, the trauma that you've been through, you know as children going to a dentist, I mean, so I transferred that. (FG2)

big as I am, I would really have to make up my mind to go to that dentist. If I don't have pain, I not going for anything. Just to hear the machines, you know that ringing, buzzing thing in your ear. (FG1)

they will always find something wrong to tell you. You need a filling, you not flossing, you always, so you know, its not like you have any confidence going.. you going because the dentist have something to tell you not doing good enough. (FG2)

Differences between private and public dental care were mentioned by several participants, who related this to their personal experiences and reasons for making choices as to which service to attend. In particular, some felt that private dental care would be safer and more comfortable for their child so having to pay for that was a worthwhile expense.

I prefer to pay your money and leaving it as that. You pay your money, you get your comfort, I believe in that. (FG1)

I am sure they have good workers (in government clinics). I mean they are all qualified people but umm the little extra to put out you know yeah, the little extra care, the little extra smile. (FG2)

You would pay so much just for somebody to be nice to you. (FG3)

to extract a tooth for your little one and there's a needle going into the gum to numb the gum, you want that somebody who will take that extra care with your little one, that's your little one you know. (FG2)

the way they going to treat your children, the way they going to treat you when you reach you know, I think, you know, hear what, I may be safer by a private dentist. (FG2)

Some participants felt that private dental practitioners were aware of the lack of services available in the public sector and tended to exploit the situation and also felt they had little information of the government services available:

I guess the dentist knows that there is no other reputable treatment available for children or otherwise, so they make their money. (FG1)

could sometimes be unfair too.. the professionals know that the health service is bad whether it be dentistry, maternity whatever so you know what.. they know you're gonna pay for it. So they call their price and they will get their patient. (FG2)

and I also didn't know about the Government. I didn't know, cause if I knew that, I think I would have taken my children there. (FG1)

Dental care for children

Participants were clear in knowing what they would like the dental visit for their child to be like. The personality of the dental care provider was the focus, with several stating that they would want someone who could put the child and ease and communicate well with them. The environment of the clinic was important to most participants and making it less intimidating and 'child-friendly' by reducing the clinical sounds and smells and having tokens and rewards for the child was seen as very helpful.

Somebody pleasant who would make them feel comfortable and not amm not put them down too much even though they have cavities, you know explain to them how they get the cavities but how they could also help prevent it you know and take care of their teeth, some encouragement you know. (FG1)

A room that is ....not scary.....not too sterile, a room that is fun like .... (FG2)

It could be sterile clean but not smell you know the scary smell that you get in the hospital. . .there should be some brightly coloured pictures (FG2) *they should never ever hear that. . .'zzzzzzzzz'. . .that sound, that sound alone is scary* (FG2)

Friendly, yes, friendly person. . .not just come out and say 'Your turn' you know.

Somebody to talk to the child .. talk to the child and be friendly (FG3)

The first dental visit

There was not much awareness of when to take a child for the first dental visit (other than if there were pain or problems in need of attention). Getting them checked around the time the child would have a full set of primary teeth or preschool age seemed to be the general view:

I'm going to take her for the first dental check-up, she will be four. I don't know if that is right but you know. (FG2)

My son was probably about five or six, but they didn't really do anything major, they just looked at his mouth. (FG3)

My dentist is so warm and so nice that I even told her okay my baby girl is going to come here, right because next month she is going to be four you know you tell me when, what age is good, and I want her to come (FG1)

Importance of "baby" teeth

There were mixed opinions about the importance of the primary teeth. Several participants felt that as the teeth were temporary they were not too concerned about them getting cavities and would focus more on the permanent teeth once they came in. However others believed that problems with the primary teeth could affect the permanent successors and were worried about decay or infections causing pain and problems.

Although aware of their temporary nature, some participants felt that the primary teeth could help the child to enjoy their food allowing variety in their diet and also provide an opportunity to learn good oral hygiene habits.

I not too worried about because I know the teeth will fall out as is baby teeth and they would get the adult teeth and you know. (FG1)

I don't think they so important, because I find they just drop off then you get adult teeth you know. (FG2)

I feel I have more concern about the permanent teeth.. well I mean after that baby teeth come out it's the permanent teeth coming in and when that come out no other teeth coming in so you wanna protect them. (FG3)

Well I think if this teeth, the first set of teeth bad, it will affect the next one not so, the new ones? That is what I always thought it was like that. (FG3)

is like their trial teeth you teach them to brush and take care of it you know and show them if they get that little bit of pain in that set, you could imagine in the permanent set how much more the pain could be. (FG3)

Diet and food choices

With respect to healthy diets for their children, participants were aware of the risk posed by sweets and chocolates but also conscious of providing a generally nutritious

diet. In terms of preventing cavities, more emphasis was given to brushing than the diet.

you have to kind of teach them from early and groom them into what you want them to get into, good eating habits, good hygiene, you know you start them from now. (FG3)

they have to eat everything to get all the proteins and calcium and all these things, its just to brush. (FG1)

I think brushing is more important. (FG1)

Use of the bottle and breast feeding

Participants felt bottle feeding before bed-time had a role to play in providing comfort for the child and aided in getting them to fall asleep. During the day bottle feeding would allow housework or other activities to get done by the caregiver. There was a generally good level of awareness that falling asleep with the bottle and not brushing the teeth at night might result in cavities, with advice on this received from dental professionals. Some participants felt the child took more food via the bottle rather than the cup and being concerned about overall nutrition, favoured continuing that approach. Breast feeding was seen as beneficial by most of the participants and several had continued into preschool age. The issue of breast milk causing tooth decay was known but caused considerable confusion as several participants had received conflicting messages from dental and medical professionals:

One thing about the bottle feeding, it is a source of comfort for the child that they find, you know they even fall asleep with the bottle in their mouth... (FG1)

I think it's a concern because parents sometimes doing their chores and sometimes just for them to do their chores at home and to make baby comfortable, same time they give them a bottle and sometimes they fall asleep with the bottle in their mouth. (FG1)

Yes, well I give him in a cup nah because he drinks from the cup.. just he drinks more if he drinks from the bottle. (FG3)

Yes, a dentist told me that, so I was shocked (breast feeding can cause cavities) *and the doctor saying breast is the best thing.* (FG2)

Tooth brushing

The importance of tooth brushing for their children was appreciated by many of the participants, particularly brushing last thing before bedtime. Concerns about leaving sticky sweet foods or milk on the teeth during the night was understood to be a risk for cavities. Difficulty in achieving night-time brushing was often due to the child falling asleep soon after the last meal.

Supervision of brushing was seen as important due to an understanding that the child lacked manual dexterity and brushing on their own would be somewhat ineffective. However, some participants mentioned that they wanted to encourage the child and build their confidence and not make them feel that they couldn't do it for themselves, so they would let them brush their own teeth.

Especially your child brushing before you go to sleep is important because you have that chocolate and things stuck in your teeth overnight given that time the cavities form and whatever. (FG2)

brushing is a big thing too. The night brushing .... they kind of now starting it, they do it now and then I have to be there.

Umm...but I am trying to get them to do it now on a daily basis the night brushing. (FG1)

That was the downfall not brushing in the night...you go to the dentist and he said make sure and get him to brush his teeth, when he drink his tea let him stay up and go to brush his teeth before he go to bed. (FG3)

She wouldn't want me to help her because she would think that she's not brushing clean enough. (FG2)

Toothpaste and concerns with fluoride

Considerable confusion was evident among participants around the issues of fluoride and its role in dental health. Being unable to get clear information and advice on its use in young children was apparent. Some were not using fluoride toothpaste due to concerns about young children swallowing excess paste and its toxic effect on their bones. Articles seen on the internet, news and published media about harmful effects were a general concern. Some participants were using non-fluoride / herbal toothpaste for themselves and the availability of non- or low-fluoride children's toothpaste, from established brands, seem to confirm fears of using fluoride toothpaste for their children.

You know you see a lot of advertisements that fluoride toothpastes are not good for small children because they swallow it, they say its not good for their bone

development. I want to know if that is true because I still use a non-fluoride toothpaste. (FG1)

. . ..I have switched. . . (XXXX) bring out their new toothpaste, a non-fluoride baby toothpaste. This is from ages zero to two, they normally recommend that for children who can't spit yet, well at least I think so, but I still give him the non-fluoride. (FG1)

Yes, on the internet you see its bad.

I don't want to use it, I use a herbal one. (FG2)

It was on the news, on the news and alternative books also talk about fluoride, how bad fluoride is, you know alternative medicine and all that.... (FG2)

Influence of family and friends

A common issue among the participants was the lack of control, bordering on frustration over their child's diet, due to other family influences and environments outside of the home where snacking on sweets / sodas was encouraged. On the whole, the giving of sweets by grandparents and family was acknowledged as an expression of caring, however, participants felt pressured by their child demanding sweet snacks from them because of having seen their friends at school or in the neighbourhood getting them. Keeping sweets snacks in the home was also problematic as children would not be able to self-limit:

Grandparents say- when you were small you use to eat lollipop too and why can't they have it now (FG1) *the Grandparents don't have a problem giving her soft-drink but I have a problem giving soft-drink* (FG2) *when the children live like with grandparents they would have a greater influence than the parents who live by themselves you know, when you brush teeth, is either morning or night so the Grandparents if they don't really live with you they don't really have that impact.* (FG2)

It's a bit difficult, like if you go anywhere and they see you know like if you go to somebody house and they have like the chubby and snacks and stuff like that, Mummy I want, and when you tell them no you can't get that, you know they still want it. (FG3)

Sources of dental health information

Information on dental care for young children was sought from a variety of sources. Those who had contact with dental professionals were able to obtain it more easily whereas others relied on friends and family. Dental care information during the perinatal period and infancy was particularly difficult to access even in the nursing home environment. Participants appeared to trust government sources but felt that much more could be done to help educate them via written material or the broadcast media.

So you're kind of working on your own wondering like okay when is it good to start brushing . . ...what type of toothbrush to use, what kind of toothpaste. (FG2)

Yeah you're kind of on your own and your probably asking you know friends who have kids or whatever. (FG2)

We did not always have the internet so easily accessible for everybody so you depend on these reading materials. (FG1)

Yeah hopefully it would be from a reliable source whether it be government institution you know the Ministry of Health you would feel comfortable. (FG2)

Even brochures, when you go to the clinic (health centre), you can always find ones on diabetes or hypertension things you can sense before. Yes they have them, so brochures on dental health would be nice. (FG2)

Main caregiver responsibilities

Making decisions about dental care for the child was largely seen as the mother's responsibility with male partners not sharing this role equally. Mothers felt under pressure to control food choices and implement preventive approaches to dental care in addition to the general demands of childrearing and home care.

It's mummy who have the problem. . .. . .Mummy who have to wake up whole night. (FG1)

Yeah I have the same thing. I make most of the decisions concerning my sons, their daddy he's like a chocolate and a ice-cream freak. (FG3)

No we are the ones who have to call and say ok you have to go for a check up. . . (FG2)

I think my son's father is concerned about the children's teeth, but he does be like 'You brush this child teeth yet? I'm like 'No, why you don't go and brush it'. (FG3)

amm. think not being able to control my children to tell them not to eat the sweets, and you feel terrible, imagine that you can't control your child from eating the sweets. We are the adult, they are the child, it means, you are not in control of. That's, that's, that's

what is hard. So you know, you kind of go on a guilt trip, you know, okay. It's in the choices that we make you know. (FG2)

Suggestions to improve dental care for young children

For them to maintain their children's oral health, the participants felt that better access to dental services, largely through reducing the cost factor would help them. More mention was made of having more readily available information and education, both through written material and face-to-face scenarios with dental professionals, such as workshops and programmes in schools via the parent/teacher networks. It was felt that the Ministry of Health could do more to support these kinds of activities.

Check-ups so that your child is monitored throughout and then also a less prohibited cost when doing so because we want to do it but because of the cost we can't do it. (FG1)

..a dentist or you know.. somebody who comes with some information to the schools and let the teachers know. (FG3)

Having a Parent Teacher Meeting, let somebody come and advise them listen you know you have to help at the school as well as the parents have to help at home. (FG3)

workshops. . ...so even though you have a pamphlet to read and something have the professional to ask and see if I really understand, if I am doing the right thing you know whatever questions you want to ask you could ask. (FG3)

you know if we have to start taking care of children's teeth as early as this age then we need to get help and information from this age or at least earlier to be prepared. (FG3)

Well I would like if amm the Ministry of Health could get some more workshops in the schools for parents, let different dentists come in. . ..you know meet parents give us some sort of information where we could help our children from early to take care of their teeth to take better care. (FG1)

Discussion

The majority of caregivers in this study were female, in manual work or housewives, in their mid to late thirties and predominantly of Indian ethnicity. The ethnic composition reflects that of the county of Caroni, a former agricultural area and home to the majority of indentured labourers brought from India to Trinidad, during British colonial rule, to work on the sugar estates. The older than expected age of the group may reflect the fact that several of the participants were not first time parents and cared for older children along with those of preschool age. Although not formally recorded, several participants appeared to care for more than one infant or preschool child.

As reported in the results the three focus groups yielded considerable comment and discussion. The following list provides an overview of the main findings:

- Participants generally valued good oral health.
- Negative dental experiences were common and affected dental attendance.
- Difficulty in accessing dental care for young children was common due to issues of affordability and availability.
- Ambivalence toward the role of primary teeth.
- Confusion over the role of fluoride and timing of child's first dental visit.
- Bottle-feeding was seen to play a role in caring for the preschool child.
- Difficulty in managing external influences when trying to control child's exposure to sweet snacks and drinks.
- Toothbrushing and oral hygiene were felt to be more important than diet in preventing decay.
- Problems with accessing oral healthcare information and a need for more practical advice.

Participants' views of oral health in the main referred to a mouth free from pain and cavities, clean teeth, and healthy gums that did not bleed. Along with these issues were aspects of function and aesthetics. In particular, being able to chew and eat comfortably and having a nice smile that would allow one to socialise and make a good impression, were highlighted. Good oral health therefore appeared to be valued and contributed to quality of life, which is similar to findings from other adult populations where most people felt oral health affected their social and psychological well-being [31,32].

Views of oral health are known to be influenced by social and cultural norms [33]. The paucity of data on this issue in the Caribbean suggests the majority of adults perceive their oral health as very important to them [34] which is supported by the findings of this present study. Negative views of oral health or oral health fatalism (i.e. belief that poor oral health was inevitable and cannot be avoided), did not appear to be a major factor, as participants in the present study felt that taking preventive action such as having dental check-ups and following advice on care of the mouth would help avoid future problems.

Several participants recalled unpleasant experiences during dental treatment that they had received in the past, which is consistent with other, similar qualitative studies [23,25,26] some also admitted transferring their dental anxiety to their child and this is likely to have affected their attitude toward dental care for children. In some cases, these were events that occurred during their own childhood. Mothers' fear of dental treatment is known to be a factor influencing routine dental care for their children [35]. Mothers of preschool children in the UK [25], reported that dental anxiety, along with cost of treatment were their main barriers to seeking dental care.

Some participants in this Trinidadian study also felt an element of guilt in not being more proactive in seeking dental care for their child due to these negative perceptions of dental care, again similar to views expressed by mothers in the UK [36]. Interestingly, even where a child has had a recent good dental care experience, the parent may still be unable to separate between their past bad experiences and their child's potentially positive one [21,23]. Based on personal experiences of dental care, most expectant mothers in the US would not seek dental even if they had a problem [26] and were anxious about what would happen to their child if they took them to a dentist.

Fear of dental local anaesthetic (LA) injections and having teeth extracted were commonly cited by participants in the present study, which is similar to findings from a previous study of Trinidadian adults attending a dental hospital clinic, where over two thirds of the sample had avoided dental treatment in the past because they were too anxious and over half still had anxiety about LA injections or extractions [37]. This is therefore an important public health issue, as dental anxiety can result in worse oral health, compared to dental patients who are not anxious. For instance, people highly anxious of dental care have been found to have more missing teeth, fewer filled teeth and more likely to be in need of urgent care [38,39].

The general opinion in the present study was that better quality care was available for those who could afford it and some indicated that they would seek private dental care for their children in order to make the visit as comfortable as possible even if it involved considerable financial sacrifice. There was a certain level of acceptance that this was just part of the norm in health-care in Trinidad and a reflection of an established 'two-tier' health system. There was also a general feeling that government dental services e.g. health centres and the Dental Hospital, were not well advertised and information on location and services offered were hard to come by, which increased the barriers to dental care for the children. Some participants also believed that dentists were aware of this situation but unwilling to challenge it, as it resulted in more people having to seek private care suggesting a degree of mistrust of the system.

Invasive dental treatment of preschool age children can sometimes be challenging for both patient (their caregiver) and the clinician. Pine [40] reported that young children not being able to cope with dental treatment was one of the main barriers to care contributing to health inequalities in childhood dental caries.

Most comments about making the child's dental visit pleasant and productive related to the clinic having a non-threatening atmosphere. This included not having a hospital smell and image but rather a colourful and happy environment, ideally with the child receiving toys and tokens (stickers / toothbrush etc.) after a visit. The dentist having a friendly and warm personality and able to put the child at ease, was also highly valued. These findings echo those of Finch [41] where similar aspects of the dental visit and the personality of the dentist were some of the main barriers to care for adults in the UK and in an ethnographic study of parents of preschool children in rural California there was general dissatisfaction with what they perceived as an insensitive attitude of dentists in the management of children who were anxious and/or uncooperative during treatment [42].

The importance of the primary teeth and timing of the child's first dental check-up suggested there was considerable confusion among the participants on this issue. Consistent with other similar studies a view that the 'baby teeth' were temporary and hence not vital to maintain was common [23,24,29]. Participants were somewhat unsure of the role the primary teeth play in oral health and the development of the permanent dentition. Similar to caregivers in the US [24], there were a variety of views as to when to take a child for their first dental check-up. Most felt that this would be around the time the child had all the primary teeth, about age three to four years. This is of concern as both the British Society for Paediatric Dentistry (BSPD) and the American Academy of Paediatric Dentistry [43,44] state that dental attendance should ideally occur by the time the first teeth erupt or by one year of age. Early dental attendance can also enable the delivery of anticipatory guidance from a dental health professional about the child's growth and development, preventive dental care and the establishment of a 'dental home' [45]. Early dental attendance has also been shown to increase the likelihood of being caries-free later in childhood [46].

Participants were aware of the role of sugary foods and drinks in the child's diet and the importance of trying to limit their intake to prevent dental caries. Participants seemed aware of the issue of giving a child a healthy and balanced diet which included fruits and vegetables. Cultural factors may play a role in the giving

of sweets snacks and confectionary. This seems very much part of normal family life and social interactions in the Caribbean, there being something of a 'positive value' ascribed to sweet foods. In this respect the availability of sweet snacks and drinks provided by grandparents, other family members, neighbours and school parties was also seen as quite challenging. This was similar to mothers in the UK who felt pressured when their child wanted snacks they had seen other children have [25]. The pervasive availability of sweets and sugary snacks also presented difficulty for parents and caregivers despite their being aware of the importance of good dietary habits for their children, a finding also reported in the US [24]. Regularly receiving sweets snacks and confectionary from grandparents was a common finding among preschool children undergoing caries related tooth extractions in the UK [47].

Participants in the present study also connected bottle-feeding and breastfeeding to good nutrition, as well as being a comforting and practical part of childcare. Some therefore found weaning from the bottle quite difficult, similar to US caregivers [24],

More emphasis was placed on diet compared to oral hygiene, as tooth-brushing habits were relatively easier to establish but these parents were already part of a health promotion programme (Sure Start), in the UK [25]. Similarly diet, more than lack of brushing, was perceived to be the main cause of caries in a qualitative study health professionals (dental and non-dental), who had early contact with mothers of preschool children in Australia [22]. The present findings also differ somewhat from those from parents of preschool-aged children attending a dental hospital clinic In Trinidad, who had lower awareness and some confusion regarding the importance of oral hygiene and other caries preventive measures for their children [17].

Oral health behaviours and parental involvement in children's oral health has been linked to the concept of self-efficacy. Self-efficacy refers to a person's conviction that they can successfully execute the behaviour required to produce the desired outcomes [48] that is the belief in his or her ability to carry out and succeed at a specific task [49]. In an investigation of the relationship between ECC with familial and cultural perceptions and beliefs in a 17 - country study, parental self-efficacy was the strongest predictor in the establishing of tooth-brushing habits and controlling sugar snacking [15] Maternal oral health self-efficacy (OHSE) was also strongly related to tooth brushing frequency in a study of African-American mothers of 1–5 year-olds in low income families [16]and mothers who had more knowledge about their children's oral hygiene needs felt more efficacious, indicating the importance of imparting oral health information early in the life of the child.

There was a surprisingly high level of concern and confusion as to the value of fluoride and its safety in young children, similar to previous a study in Trinidad [17] and to some data in the US [26]. It is therefore imperative that information about fluoride needs to be imparted to parents and caregivers in a clear and accessible medium, to counter negative perceptions and fears and to support self-efficacy. Anticipatory guidance must include the message that children should have optimal exposure to fluoride to prevent caries as Adair *et al.* [15] state "children are more likely to be caries-free if their teeth are brushed twice daily with fluoride toothpaste, with parental involvement and in an environment where sugar is controlled". Furthermore, there is no clear evidence that toothpastes containing less than the standard concentration of 1000 ppm are effective in preventing caries in young children and hence low concentrations are no longer advised for preschool children and infants [50]. Avoiding fluorosis in the permanent dentition, due to over-ingestion of fluoride is however, an important issue. Current evidence-based guidelines recommend only a 'smear' of toothpaste on a small toothbrush for a child up to age 3 years, covering no more than three quarters of the brush head and a 'pea size' amount for children up to the age of 7 [51].

Most participants appeared to rely heavily on family and friends as sources of health information, including advice for children's oral health. These traditional social networks seem to have compensated for what appears to be a lack of information from more 'official' sources locally. Some of these findings also relate to the issue of 'health literacy'. The WHO describes health literacy as "the cognitive and social skills which determines motivation and ability to access and understand health information" [52]. Health literacy is critical to empowering people to promote and improve their health [53] as it can influence access to health information, managing personal health, those cared for and utilisation of health services [54]. This also extends to oral health, with 'oral health literacy' defined as *'the degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate oral health decisions'* [53]. In the present study, the request for more written material suggests that level of health literacy among the participants was quite high, hence more information on dental services may improve uptake and preventive care. This is encouraging but may not be representative of communities where oral health literacy is lower, so other forms of imparting information on early childhood oral health would need to be considered, such as face-to-face delivery through talks and workshops etc. Lack of daily tooth brushing and night-time bottle use were associated with lower health literacy among female caregivers in the US

and appears to be independent of SES factors, including education [55].

Despite some ambivalence about the role of the primary teeth, most participants understood the need for maintaining good oral health for their preschool aged children, the importance of healthy nutrition and oral hygiene. However, similar to Daly [25], they seem to want more practical help in how to translate this knowledge into effective dental health care on a day-to day basis for their children.

Recommendations

Participants wanted clear and explicit information on brushing, use of fluoride and when best to take a child for a dental examination. These issues are in fact at the core of dental health educational messages for preschool children and therefore need more effective dissemination and delivery in Trinidad.

Dental health education in the preschool and primary school setting could be considered. Encouragingly, primary school teachers in Trinidad have shown positive attitudes towards including dental health in the school curriculum, provided they receive support and training [56]. Other dental public health strategies that should be considered include anticipatory guidance and motivational interviewing. These counselling-based approaches can encourage early dental attendance (e.g. age 1 dental visit), establishment of a dental home and appropriate use of fluoride, which can reduce risk of ECC [57,58].

Increasing the availability of dental care for children needs to be addressed as problems with access to care were common. This may be possible with increased training and deployment of Dental Nurses/ Therapists in the country. These mid-level dental providers in Trinidad have previously indicated enthusiasm for providing dental health education and out-of-clinic interaction with young children [59] and globally been shown to be effective in increasing access to care for children [60]. Improving early childhood oral health and prevention of ECC in Trinidad should involve discussion of research findings and potential public health strategies with key stakeholders such as parents, caregivers, teachers, health professionals and policy makers, to enable delivery of appropriateness interventions.

Limitations of the study

As the qualitative method used was not designed to produce data to be extrapolated to the population, a limitation might be whether these findings represent the average views of parents and caregivers in Trinidad. The participants in this study came from an ethnically diverse, mixed urban /rural community which is common to most of the island. The views shared by them are therefore likely to be relevant to parents and caregivers across Trinidad.

Although all three groups received all the questions on the topic guide, some received it in a slightly different order. Though this was done with the aim of being responsive to the participant's views and encourage the flow of the discussion, a possibility of bias may have arisen from not standardizing the sequence of questions. The order of questions may have influenced some responses, for instance asking about the 'importance of baby teeth' after asking the question on 'reasons for not taking a child for dental care' might have produced a different response if asked in the reverse order. Also no specific question was asked about dental visit by one year of age.

Some debate exists around minimum sample sizes required in qualitative studies, with respect to achieving data saturation. A minimum of 15 has been cited [61] and Guest [62] states that where there is a high degree of homogeneity in the study population, data saturation can occur with very small samples (less than 10), with data quality being measured by value rather than sample size. In the present study, the main themes described arose in all three focus groups suggesting that these were relevant and important issues for these participants.

Since the facilitator was a dentist, this might have inhibited some disclosure on personal experiences of dental care or views of dentistry, yet the perception was that the discussions appeared honest and uninhibited.

Conclusion

This qualitative study provides the first information of its kind on the experiences of parents and caregivers with respect to oral health of preschool children in Trinidad and reveals some important issues for the development of oral health promotion strategies.

The participants showed generally positive attitudes towards oral health but appear to have encountered several barriers and challenges to achieving ideal preventive care for their child, with respect to maintaining a healthy diet, good oral, hygiene and dental attendance. Dental attendance for young children appeared to be influenced by participants own negative dental experiences. Oral health promotion should include effective dissemination of oral health information, more practical assistance and greater access to dental care for families with preschool children.

Abbreviations

ECC: Early childhood caries; OHSE: Oral health self efficacy; AAPD: American academy of paediatric dentistry; BSPD: British society of paediatric dentistry; WHO: World health organisation.

Competing interests

The authors declare that they have no competing interests in this research. No financial or non-financial interests influenced the interpretation of the data or presentation of the information.

Authors' contributions
RN conducted the fieldwork and data acquisition. RN, JN and MF contributed to the design of the study, data analysis / interpretation and preparation of the manuscript. All authors read and approved the final manuscript.

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Socio-behavioural factors and early childhood caries: a cross-sectional study of preschool children in central Trinidad

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Abstract

Background: Early childhood caries (ECC) is a public health problem due to its impact on children's health, development and well being. Little is known about early childhood oral health in the West Indies or the influence of social and behavioural factors on the prevalence and severity of early childhood caries in this preschool population. The aims of this study were to describe the prevalence and severity of ECC in preschool children in a region of central Trinidad and to explore its relationship with social and behavioural factors.

Method: A cross-sectional survey was undertaken on children aged 3-5 years-old from a random sample of preschools in central Trinidad. Oral health examinations were conducted for children for whom parental consent was given, using WHO criteria (visual diagnosis / cavitation at d3). A self-reported questionnaire was distributed to all parents and caregivers. Variables included socio-demographics, oral health knowledge, attitudes and behaviours, visible caries experience and treatment need.

Results: 251 children were examined, 50.2% were male with a mean age of 3.7 years (SD 0.67) and 71% were of Indian ethnicity. The prevalence of ECC was 29.1% and the prevalence of severe early childhood caries (S-ECC) was 17.5%. 29.9% of children had some treatment need, with 12% in need of urgent care or referral. Poisson generalized linear mixed model analysis found a higher rate of visible caries experience for children who ate sweet snacks more than twice a day ($p < 0.001$), had poorer parental dental health ratings ($p < 0.0001$), a previous dental visit ($p < 0.0001$) and difficulty finding dental care ($p < 0.001$).

Conclusion: The prevalence and severity of ECC in central Trinidad was related to oral health behaviours and access to dental care. Oral health promotion should include more supportive and practical advice for parents and caregivers of preschool children along with improved access to dental care to enable primary prevention and management of ECC.

Keywords: Early childhood caries, Preschool children, Oral health behaviour, West Indies

Background

Early childhood caries (ECC) has been defined as 'the presence of one or more decayed, missing due to caries, or filled tooth surfaces in any primary teeth in children under 6 years of age' [1,2]. In its more rampant form it is now described as severe early childhood caries (S-ECC), which is defined for 3–5 year-olds as one or more cavitated, (missing due to caries) or filled smooth surface in primary maxillary anterior teeth or a decayed, missing or filled tooth score of ≥ 4 (age 3), ≥ 5, (age 4), or ≥ 6 (age 5) [2]. This replaces older terms such as 'nursing-bottle caries' and 'baby-bottle-tooth decay'. There is still some variation due to differences in case-definitions. Internationally, the prevalence of ECC has been reported to range from 6-90%, with most developed countries in the lower end, and most developing countries, in the middle to higher end of this range [3]. Within-country disparities are also common, with preschool children from disadvantaged communities generally experiencing higher levels of disease than the general population [4,5].

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Due to its high prevalence, impact on quality of life, potential for increasing risk of caries in the permanent dentition and role in oral health inequalities, ECC is recognised as a serious public health problem [5]. Socio-economic, socio-cultural and socio-behavioural determinants are believed to influence specific risk factors for ECC such as dietary and feeding practices, oral hygiene and dental attendance patterns [6,7]. These risk factors do not work independently but are likely to have a complex interplay. Fisher-Owens et al. [8] describe a multi-level conceptual model to explain influences at the child, family and community level. At the child level, risk factors include: genetic, biological, social and physical environment and health behaviours. At the family level, they include: socioeconomic status, family function and health behaviours, and at the community level: culture, social capital, fluoridation and the healthcare system.

ECC in the West Indies and children's oral health in Trinidad and Tobago

There is a paucity of data on ECC in the Caribbean region. In Anguilla, caries prevalence among children aged 36–71 months was 21% with S-ECC affecting 17% of the sample [9].

Trinidad and Tobago is a twin-island, English-speaking democratic republic in the West Indies. At the last census the total population was 1.3 million with 25% under the age of 15 [10]. Arising from its colonial history, the country has a multi-ethnic composition, with people of Indian, African and mixed descent being the main ethnic groups. Approximately one quarter of the population live in rural areas [10].

There are currently no published epidemiological data on the oral health of preschool children in Trinidad and Tobago. However, the persistence of untreated caries in the primary dentition of school-aged children can be considered a public health problem, as a national survey in Trinidad reported almost two thirds of 6–8 year-olds had caries experience [11]. Acute problems arising from decayed primary teeth were also the most frequent cause of emergency dental visits in a dental hospital clinic [12]. Risk models have shown that decayed teeth presenting at primary school-age indicate these children are likely to have been at high risk for caries during their pre-school years [13]. Furthermore, a preliminary Trinidadian-based study, among a sample of parents and caregivers attending a dental hospital clinic, exposed confusion, lack of accurate information and low awareness of preventive dental care for preschool children [14].

Determining the role of social and behavioural risk factors on oral disease levels and outcomes can help inform oral health policy and in particular, the development of appropriate oral health promotion strategies.

Aim

The aims of this study were to describe the prevalence and severity of ECC among preschool children in Trinidad and explore the relationship between ECC and social and behavioural determinants.

Methods

A cross-sectional oral health survey of preschool children was undertaken in the Caroni region of central Trinidad. The Caroni region can be considered one of the more populous regions of the island, and home to a mixture of urban and rural communities with a broad socioeconomic spectrum. The accessible population were children aged 3-5-years, attending preschools in the Caroni Education District, registered with the Trinidad and Tobago Ministry of Education. Preschools in the Caroni region are generally situated in urban centres however, children attending these preschools are drawn from across the education district catchment area, which includes children living in rural home addresses. Based on this list, there were 27 government/government-assisted and 57 non-government preschools in the District at the time of the survey, with an enrolled population of approximately 2000 children.

Sample selection

A required sample size of 250 was based on an estimated caries prevalence of 30% (using data from neighbouring islands) and a 6% level of precision. Assuming an average of 30 children per preschool and approximately 20% non–response rate, this required 10 preschools in the sample. Very small schools (enrolment <15) and very large schools (enrolment >60) were excluded from the sampling frame. This was done to include preschools of similar sizes in the sample and facilitate data collection by a single examiner. Drawn from the remaining list of preschools in the sampling frame, the final random selection resulted in a mix of 3 government/government-assisted and 7 non-government preschools.

Permission and liaison

Ethical approval for the study was obtained from the University of the West Indies Faculty of Medical Sciences, Research Ethics Committee. Permission was sought from the head teachers / administrators of each selected preschool, for their preschool to take part in the study. For preschools that agreed, individual parents and caregivers were invited by letter to complete a self-administered questionnaire and provide written positive consent for an oral examination of their child / children.

Instruments and variables

The self-administered parent/caregiver questionnaire was based on a previous instrument used in Trinidad [14].

Children were also assessed for behaviour rating using the Frankl Behaviour Rating Scale at the point of attempting oral examination [15].

The following variables were included.

Questionnaire variables: Parent/ caregiver age, sex, ethnicity, occupation of head of household, level of education, rating of child's dental health, oral health knowledge beliefs and practices, child age, ethnicity, sex, health and development.

Clinical variables: Dentition status and treatment need and need for urgent care or referral, based on WHO 1997 criteria [16]. Specific codes from the dentition status were subsequently used for calculation of the 'dmft' index score, to indicate caries experience. For the (d) component, this included dentition status: 'Decayed' and 'Filled with decay', for the (f) component: 'Filled, no decay' and for (m) component: 'Missing as a result of caries'. Primary teeth considered to have been lost due to trauma were coded separately and not included in the count for caries experience.

Treatment need was assessed for each tooth immediately after the tooth status was recorded. Treatment need categories included: no-treatment, preventive care, one-surface restoration, two or more-surface restoration, crown, pulp care, extraction. A child was recorded as in need of urgent care / referral for dental treatment if it was assessed that pain, infection or serious illness might have otherwise occurred in a short period of time (few days to a month).

Examination protocol

Oral examinations were undertaken by a single trained and calibrated examiner (RN) working with an assistant/data recorder. Dental caries was measured using WHO 1997 criteria but without the use of an explorer [16]. Caries was recorded at the d3 level (cavitation into dentine). Teeth were not dried but soft debris on tooth surfaces was removed with a cotton roll or gauze square and assessed visually, using a disposable mouth mirror. Children were examined in their preschool classroom using natural light, in a seated position on a small chair/bench with the examiner positioned behind. A second attempt was made to examine children who initially refused (this second attempt followed completion of oral examinations on compliant children whom the previously non-compliant children were able to observe). Before the examinations a dental health presentation was given in each preschool using puppets. After the oral examinations, all children were given colouring books and a toothbrush.

The questionnaire and clinical protocol were piloted in a single preschool not included in the final sample. Minor changes were made to the questionnaire following the pilot phase to improve question clarity. Data were processed and analysed using SPSS version 16 and R statistical program version 2.13.1.

Statistical analysis

Means, standard deviations and 95% confidence intervals were calculated for continuous variables and proportions with 95% confidence intervals for categorical variables. Pearson Chi-square was employed in the bivariate analyses comparing proportions with visible caries experience and no visible caries experience. Statistical significance was set at $p<0.05$.

In the multiple variate analyses, visible caries experience (dmft) was modelled both as a Poisson generalized linear mixed model (GLMM) for actual counts of dmft and a Logistic GLMM for presence and absence of visible caries experience. Children were considered nested within preschool clusters to control for similarities between children attending the same preschools. The analysis was conducted using the package lme4 in R [17]. Potential model predictors were recoded as required by collapsing sparsely populated levels. To achieve a parsimonious model, only model terms with confirmed significance at an alpha of 5% were retained in the final model based on changes in the Akaike Information Criterion [18]. However, for comparative purposes, the Logistic model results retained the same set of variables as for the Poisson model. Missing values were assumed to be missing completely at random and so were excluded from the modelling.

The Kappa statistic was used to assess intra-examiner reliability.

Results

Response to the survey

Nine preschools took part in the study. From an enrolment of 340 children, 314 parents gave consent for the oral examination (92% parental response rate). Of these children, 36 (11.5%) were absent on the day and 27 (8.6%) refused examination, being recorded as 'definitely negative' behaviour' on the Frankl Behaviour rating scale. Two hundred and fifty one children completed the oral examination having shown 'positive' or 'definitely positive' behaviour.

Demographics of children who completed the oral examination

The age range of the 251 children who completed oral examinations was 3 to 5 years with a mean age of 3.7 years (SD 0.67). One hundred and twenty six (50.2%) were male. Seventy per cent were of Indian ethnicity, 18% mixed and 9.6% of African ethnicity. Health or development concerns were reported in 14% of children, with issues regarding general health the most commonly

reported concern (8.4%) followed by problems with hearing and eyesight (as reported by parents/caregivers).

Examiner reliability

Examiner reliability was tested by re-examination of children at one preschool (25 children). Re-examinations took place on the same day as data collection, after an interval, having examined all the children once. The Kappa statistic for intra-examiner reliability (caries experience) was 0.9.

Visible caries experience (ECC)

The frequency distribution of caries experience was highly positively skewed with most children (70.9%) having no visible caries experience (dmft = 0). Seventy three children (29.1%) children had some visible caries experience (dmft > 0), with similar proportions among male and female children (29.4% and 28.8%, respectively). The mean dmft for the whole sample was 1.40 (SD 3.01, 95% CI: 1.03-1.78). When children with no visible caries experience (dmft = 0) were excluded, the mean dmft for the remainder of the sample (dmft > 0) was 4.82 (SD 3.83, 95% CI: 3.93-5.72) with the majority of this being untreated decay (dt) mean 4.71 (SD 3.80, 95% CI: 3.82-5.60).

Severe early child hood caries (S-ECC)

Forty four children (17.5%) had evidence of severe early childhood caries i.e. one or more cavitated, missing due to caries, or filled primary maxillary anterior teeth. This definition was adapted from the AAPD/AAP definition [2] to account for use of whole tooth score rather than surface score.

Treatment need

Seventy five children (29.9%) had some treatment need beyond routine preventive care. The majority of this need (88%) was for one or two surface restorations and 36% for pulp care or extraction. Children may have required more than one treatment type so the percentages do not total to 100. Thirty children (40% of those with some treatment need), were in need of urgent care, mostly due to caries and its sequelae (pulp infection and abscess).

Social and behavioural factors

Bivariate model

The null hypothesis used in these analyses was that there were no social and behavioural differences between the proportions of children with visible caries experience and those without visible caries experience. In the bivariate analyses no significant associations were found for proportions of children with/without visible caries experience and socio-demographic variables, socioeconomic status, oral health knowledge, oral hygiene and fluoride use, breastfeeding history and use of a feeding bottle.

Table 1 describes significant associations between the proportion of children with visible caries experience and socio-behavioural factors. The proportion of children with visible caries experience was significantly associated with parents who rated their child's oral health as fair to poor, the child having visited a dentist or dental nurse, those who had difficulty in finding dental care and children with more frequent intake of fruits and sweet snacks.

Table 1 Socio-behavioural factors and proportions of children with visible caries N = 251

Oral health knowledge, attitudes and dental attendance	No visible caries experience (dmft = 0) n (%)	Visible caries experience (dmft > 0) n (%)	p-value (Chi square)
How would you rate your child's dental health			
Excellent	41 (23.3)	7 (9.7)	
Very good	63 (35.5)	15 (20.8)	
Good	59 (33.5)	20 (27.8)	
Fair	12 (6.8)	19 (26.4)	
Poor	1 (0.6)	11 (15.3)	<0.001
Has your child ever visited a dentist or dental nurse			
Yes	50 (28.7)	37 (51.4)	
No	124 (71.3)	35 (48.6)	<0.01
Have you ever had difficulty in finding dental care for your child			
Yes	14 (8.5)	14 (20.3)	
No	151 (71.3)	55 (79.7)	0.02
How often does your child have fruits			
Never	2 (1.1)	0 (0)	
Rarely	11 (6.2)	5 (6.8)	
Once a day	93 (52.5)	22 (30.1)	
Twice a day	41 (23.2)	21 (28.8)	
More than twice a day	30 (16.9)	25 (34.2)	
Don't know	0	0	<0.01
How often does your child eat sweet snacks			
Never	2 (1.1)	1 (1.4)	
Rarely	48 (27.1)	10 (14.1)	
Once a day	80 (45.2)	26 (36.6)	
Twice a day	29 (16.4)	11 (15.3)	
More than twice a day	18 (10.1)	23 (32.4)	
Don't know	0	1 (1.4)	<0.01

Multiple variate models

The Poisson generalized linear mixed model of dmft counts (Table 2) shows the rate of visible caries experience (dmft) nearly doubles for children who have 2 or more sweet snacks daily as compared to those who never or rarely eat sweet snacks. As general dental health rating improves, the rate of visible caries experience drops significantly for dental health rating: average, good or excellent, compared to: fair or poor. Those children with no previous experience of dental care had only half the rate of visible caries experience compared to those with previous experience of dental care. The rate of visible caries experience also reduced considerably for children who had no difficulty in finding dental care as compared to those who did.

In the Logistic Poisson generalized linear mixed model for presence/absence of visible caries experience (Table 3), frequency of sweet snacks and difficulty in finding dental care were not significant. The remaining terms (dental health rating and previous dental experience) remained significant with results in good agreement with the Poisson model.

Table 3 Estimated odds ratio for presence versus absence of visible caries experience based on a Logistic generalized linear mixed effects model with children nested in preschools

Term	Estimated odds ratio	95% Confidence interval	p-value
Intercept	1.40	0.11 - 17.16	0.792
Frequency sweet snacks = 1 daily (base = rarely or never)	1.10	0.45 - 2.68	0.840
Frequency sweet snacks = 2 > daily (base = rarely or never)	2.13	0.86 - 5.25	0.102
Dental health rating by parent = average (base = fair or poor)	0.20	0.08 - 0.50	0.001
Dental health rating by parent = good (base = fair or poor)	0.12	0.05 - 0.30	<0.001
Dental health rating by parent = excellent (base = fair or poor)	0.11	0.03 - 0.34	<0.001
Previous dental visit = no (base = yes)	0.13	0.17 - 0.68	0.002
Difficulty finding dental care = no (base = yes)	0.47	0.19 - 1.20	0.115

Discussion

The response rate for the oral examinations was affected mainly by absence of children on the day of the visit, followed by non-compliance. Although designed for assessment of child behaviour during dental treatment, the Frankl scale [15] was used in this study to assess compliance with the oral examination. Non-compliance (Frankl score 'definitely negative') was considered an indication of Dental Behaviour Management Problems (DBMP). DBMP in preschool children can have implications for service provision with respect to choice of treatment, need for specialist referral and additional clinical resources. A measure of DBMP should therefore form part of the oral health assessment for young children [19].

Table 2 Estimated rate of visible caries experience based on Poisson generalized linear model with children nested in preschools

Term	Estimated rate of visible caries experience (dmft)	95% Confidence nterval	p-value
Intercept	2.58	0.95 - 7.00	0.06
Frequency sweet snacks = 1 daily (base = rarely or never)	0.98	0.67 - 1.41	0.90
Frequency sweet snacks = 2 > daily (base = rarely or never)	1.85	1.32 - 2.58	<0.001
Dental health rating by parent = average (base = fair or poor)	0.12	0.16 - 0.30	<0.0001
Dental health rating by parent = good (base = fair or poor)	0.22	0.08 - 0.17	<0.0001
Dental health rating by parent = excellent (base = fair or poor)	0.17	0.11 - 0.27	<0.0001
Previous dental visit = no (base = yes)	0.49	0.38 - 0.64	<0.0001
Difficulty finding dental care = no (base = yes)	0.65	0.48 - 0.86	<0.001

Comparison of the present data with international caries data for preschool children must take account of methodological differences such as use of national survey data versus sub-samples, differing age ranges, ECC definitions and examination criteria. Despite these considerations, some overall trends are apparent. The prevalence of ECC in the present study was similar to a neighbouring English-speaking Caribbean island [9] but much lower than that seen in some other developing countries around the world [20,21]. Interestingly, the prevalence of caries experience in Trinidad was also similar to recent data reported in the UK [22]. Almost a fifth of children in the present study showed evidence of S-ECC, again similar to previously-reported Caribbean data [9].

Consistent with most of this ECC experience attributable to decayed teeth (dt), the majority of children who were in need of treatment in the present study required restorative care, with a smaller proportion needing pulp-care or extraction. Importantly, over a third of children with unmet treatment need required urgent care, to address problems resulting from untreated caries such as dental abscess.

Debate has arisen over the most effective and appropriate methods for addressing untreated caries in the

primary dentition of young children. Some research has shown that the majority of un-restored carious primary teeth remain symptomless until exfoliation [23]. However, the carious primary teeth most likely to go on to cause pain, are molars affected soon after eruption, which progress rapidly to large cavities [24]. In addition, the risk of young children experiencing pain and sepsis increases with higher caries experience, suggesting that children at high risk for ECC would benefit the most from dental intervention [25].

Data from the last national oral health survey of schoolchildren in Trinidad and Tobago indicated that the majority of treatment need was for restorations and extractions in the primary teeth of 6–8 year-olds [11]. This again suggests that much of the ECC that develops in the preschool period remains untreated into the early school years. This situation can lead to a 'downward spiral' of delayed care-seeking for ECC and symptom-based attendance for dental care [25], as evidenced by ECC related problems being the most frequent reason for attendance at emergency departments [26]. Based on the analysis in the present study, both having difficulty in finding dental care and having attended a dentist were related to a higher rate of visible caries experience. This finding may suggest problems with access to dental care as well as some children attending due to a caries-related problem, as symptoms such as pain or infection would be more likely in children with a higher rate of caries experience. This would be consistent with the issue of symptom-based dental visits for ECC [25,26].

Prevention and management of ECC should therefore involve early dental attendance, that is, by 12 months of age, to establish a 'dental home' early in a child's life. The 'dental home' can enable 'anticipatory guidance' caries risk assessment and early intervention for dental problems [27-29].

Although there is a well-established link between lower SES and higher caries experience in young children [30] this was not a finding of the present study. This may have been due to the sample size and/or lack of sensitivity with respect to the proxy variables, 'highest level of education' and 'parent/ caregiver occupation'. Use of household-income may have been more discriminating but collection of this information was considered too intrusive. However, consistent with the literature on dietary practices was the finding of a significantly greater proportion of children with visible caries experience among those who ate sweet snacks 'twice' or 'more than twice' a day, Greater frequency of sweet snacks was also associated with a higher rate of visible caries experience in the Poisson regression model.

Lower oral health ratings were associated with a higher rate of caries experience in the Poisson regression model. This generally accurate parental perception of the child's oral health status is consistent with the literature, as parental oral health ratings of their children have been shown to correlate with actual clinical status and need for dental treatment [31].

In a recent systematic review it was concluded that parental oral health behaviour was an intermediary in the development of ECC, being the result of their oral health knowledge, attitudes and beliefs, which in turn are influenced by education, socioeconomic status and culture [32]. This was found to be consistent with the findings of the present study where parent/caregiver oral behaviours such as dental attendance and dietary habits were associated with a higher rate of visible caries experience in the Poisson regression model. To be effective, oral health promotion should therefore include an understanding of parent and caregiver knowledge and attitudes [33] and oral health advice must be clear and appropriate [34].

Adopting a more client-centred approach, which considers underlying social determinants of health, may help to motivate parents and caregivers to adopt healthier dental health behaviours for their families. One such approach is motivational interviewing (MI), a counselling method that attempts to elicit behaviour change by resolving ambivalence and increasing self-efficacy [35].

Limitations of the study

The possibility of selection bias must be considered in this study. Not all children in this age group attend preschools or day-care facilities and their socio-demographic / behavioural characteristics may have differed from those children sampled through preschool enrolment. Also, caries experience and socio-behavioural factors among children who refused or were not present on the day for the oral examination (almost of fifth of those for whom parental consent was given), may have differed from those who were examined. Bias may also have arisen from exclusion of very small and very large preschools from the sampling frame. Furthermore, although possibly representative of preschool children in the Caroni education district of central Trinidad, these data may not reflect the oral health of all preschool children across the nation. Associations between caries experience and socio-behavioural factors may have differed if non-cavitated lesions were included.

Being cross-sectional in design the context and temporal effect of the identified risk factors is not clear. This may have also resulted in apparent paradoxes in the final regression model which included theoretical antecedent events (frequency of sweet snacks), concurrent events (parental assessment of child oral health) and downstream events (dental attendance).

Conclusions

The prevalence and severity of ECC in this sample of preschool children in Trinidad suggest the need for improved

access to dental care and more effective oral health promotion for this population group. This should include primary prevention and interventions that offer more practical advice and support for parents and caregivers, including counselling type approaches that consider the social determinants of oral health.

Abbreviations

AAPD: American Academy of Paediatric Dentistry; AAP: American Academy of Paediatrics; DBMP: Dental behaviour management problems; Dmft: decayed, missing and filled teeth; ECC: Early childhood caries; S-ECC: severe early childhood caries; WHO: World Health Organisation.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

RN conducted the fieldwork and data collection. RN and JN contributed to the design of the study, RN, JN and AK contributed to data analysis / interpretation and preparation of the manuscript. All authors read and approved the manuscript.

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Abstract

Oral health of preschool children and relationship to social and behavioural determinants in Trinidad

Background: Early childhood caries (ECC) is a public health problem due to its impact on child health, development and well-being. Little is known about oral health in early childhood in the West Indies and there are no data for preschool children in Trinidad.

Aim: To describe the prevalence and severity of ECC, other oral conditions and their impact on quality of life among preschool age children in Trinidad. Explore and understand the views and experiences of parents and caregivers about oral healthcare and assess the effect of Motivational Interviewing (MI) on parent and caregiver oral health beliefs, attitudes and behaviour.

Method: A cross-sectional survey was undertaken on children aged 3-5 years-old from a random sample of preschools in central Trinidad. Oral examinations were conducted using WHO criteria. Variables: socio-demographics, parent/caregiver oral knowledge, attitudes, behaviours, caries experience (dmft), oral hygiene, prevalence of erosion, enamel developmental defects, traumatic dental injury and dental/facial anomalies, oral health related quality of life. Focus groups were conducted with a sub-sample of parents and caregivers. A randomized controlled trial with a sample of parents in Eastern Trinidad was designed to assess the effect of MI compared to traditional dental health education.

Results: 309 parents and caregivers responded to the questionnaire and 251 children were examined. Of these children, 50.2% were male with a mean age of 3.7 years (sd 0.67) and 71% were of Indian ethnicity. The prevalence of ECC was 29.1 %. The mean dmft for the whole sample was 1.40 (95% CI: 1.03-1.78) and for those children with some caries experience (dmft>0) 4.82 (95% CI: 3.93-5.72). Treatment need was recorded for 75 children (29.9%), with 12% in need of urgent care or referral. Poisson generalized linear mixed model analysis found a higher rate of visible caries experience for children who ate sweet snacks more than twice a day ($p<0.001$), a low parental dental health rating ($p<0.0001$), having had a previous dental visit ($p<0.0001$) and difficulty finding dental care ($p<0.001$). A greater severity of ECC was associated with more quality of life impacts for child and family. Thematic analyses identified difficulty in establishing good brushing routines and controlling sweet snacking in the face of many other responsibilities at home. Lack of availability of paediatric dental services locally and information on oral health care were identified as barriers to dental care. Use of MI improved oral health attitudes and tooth brushing behaviour and this brief-counselling approach was acceptable to parents and caregivers.

Conclusion: The study identified social and behavioural factors associated with inequalities in oral health among preschool children in Trinidad, mainly with respect to the prevalence and severity of early childhood caries. Caries was largely untreated and where present, shown to have negative impacts on the quality of life of the child and family. Parents and caregivers were found to be in need of information and practical support to maintain the oral health of their children. Based on these findings and best-practice guidelines, an oral health promotion strategy and prevention framework was developed. This includes caries risk assessment, early dental attendance and clinical prevention along with approaches for improving access to care. In particular, the strategy includes the use of a brief-counselling approach (MI), to improve oral healthcare and improve outcomes.