Growing Up in Ireland
National Longitudinal Study of Children

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OVERWEIGHT AND OBESITY AMONG 9-YEAR-OLDS

CHILD COHORT

REPORT 2

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OVERWEIGHT AND OBESITY AMONG 9-YEAR-OLDS

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Richard Layte **Cathal McCrory**

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1

INTRODUCTION

1.1. INTRODUCTION

There is now good evidence that the prevalence of overweight and obesity among school-age children and adolescents has increased in recent decades across all countries for which data are available (Popkin et al. 2006;Wang & Lobstein 2006), including Ireland. A comparison by Perry et al (Perry et al. 2009) of children's heights and weights in Ireland between 1948, 1970 and 2002 shows that the height and weight of children across age groups increased over the period but that average weight increased disproportionately faster, leading to increasing overweight. They found that, whereas average height at age 14 among boys had increased by 16% on average between 1948 and 2002, average weight had increased by 65% over the same period. Whelton and colleagues (Whelton et al. 2007) surveyed 19,617 school-age children and adolescents aged between four and 16 years in Northern Ireland and the Republic of Ireland in 2002 and found that almost one in four boys (23% RoI and NI) and over one in four girls (28% RoI, 25% NI) were either overweight or obese.

1.2 THE HEALTH CONSEQUENCES OF OVERWEIGHT AND OBESITY

The rise in childhood overweight is a serious health concern. Excess non-lean body mass, known as adiposity, at a young age is associated with both immediate and long-term health risks. In childhood, excess adiposity is associated with a higher prevalence of asthma, eczema (Von Mutius et al. 2001) and type two diabetes (Fagot-Campagna et al. 2001), but it has also been associated with increased middle-age mortality regardless of the child's adult weight status (Gunnell et al. 1998a). This suggests that childhood adiposity can have permanent effects on the risk of illness and disease, even if the excess weight is shed in adulthood. Obese children are significantly more likely to become an obese adult than non-obese children (Gunnell et al. 1998b) although it is unclear at present whether this pattern stems from the 'programming' of both child and adult physiology early in life – i.e. through breastfeeding patterns or exposure to deprivation in utero (Karaolis-Danckert et al. 2008) – or persistence in patterns of physical activity, diet and nutrition from childhood into adulthood. It is clear, on the other hand, that obesity in adulthood is associated with an increased risk of cardiovascular disease (Manson et al. 1990), diabetes (Perry et al. 1995) and some forms of cancer (Josefson 2001).

1.3 SOCIO-ECONOMIC INEQUALITIES

Findings are not consistent but there is growing evidence that children from lower socio-economic households (Stamatakis et al. 2005;Stamatakis, Wardle, & Cole 2010) are more likely to be overweight and obese than their more advantaged peers. Research shows marked socio-economic inequalities in health status and mortality rates across both adults (Kelleher et al. 2003; Barry et al. 2001; Balanda & Wilde 2001) and children (Institute of Public Health in Ireland 2006; Layte & Clyne 2010) in Ireland; there is particular concern that current differentials in overweight and obesity in childhood will lead to a widening of adult inequalities in the years to come. Stamatakis and colleagues (Stamatakis, Wardle, & Cole 2010) have shown that the upward trend in childhood obesity may have reached a plateau among higher social-class groups in England but that it has continued to rise among lower class groups.

1.4 THE PSYCHOLOGICAL IMPACT OF OVERWEIGHT AND OBESITY

The associations between overweight and physical health are a cause for concern but research also suggests that overweight can be detrimental to the emotional and psychological health of young people as well. Research suggests (Goodman & Whitaker 2002; Sjöberg, Nilsson, & Leppert 2005) that obesity is associated with depression and depressive symptoms among adolescents, and a greater prevalence of emotional and behavioural problems, and that obese children and adolescents are both more likely to bully and be bullied by their peers (Janssen et al. 2004).

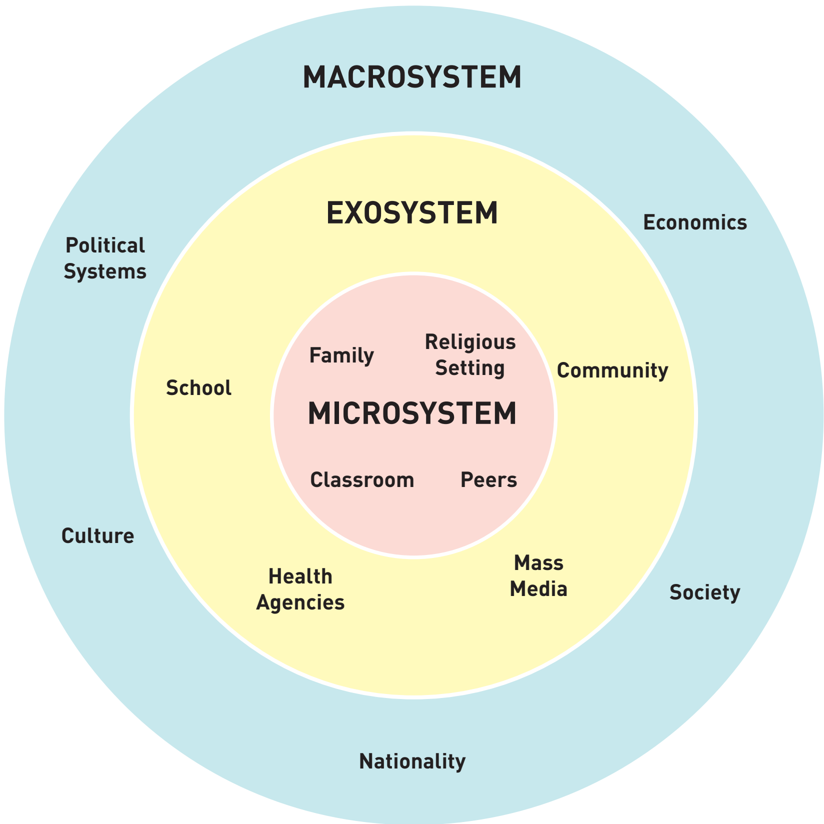
The impact of obesity on the life-course of the child can also extend beyond health issues. A number of research papers have indicated that body weight and shape among young adults can influence college admission rates (Canning & Mayer 1966) and both initial and later income and occupational attainment (Sargent & Blanchflower 1994).

The immediate and long-term effects of overweight and obesity both for the individual and society and the upward trend in prevalence suggest that researchers and policymakers require a better understanding of both the factors that lead to overweight among children and adolescents and their implications for possible interventions. The data available in the ***GUI*** study provide an important source of information to improve our understanding of these issues. However, the cross-sectional nature of the data means that our ability to make causal inferences is limited.

1.5 THE CONCEPTUAL FRAMEWORK OF THE STUDY

The ***Growing Up in Ireland*** study adopted a bio-ecological model (Bronfenbrenner 1979) of child development and well-being in the design and methodology of the survey. This bio-ecological model places the child at the centre of a system of reciprocal influences, represented *(see Figure 1.1*) as a set of concentric rings.

Figure 1.1: The Bio-Ecological Model of Child Development



The child, at least in early development, is most influenced by the immediate context in which they live; this is represented in the ecological model as the micro-system made up of influences such as the family (parents, siblings and near relations such as grandparents), peers, school and neighbourhood. The child is an active participant in these interactions and influences the nature of the micro-system to a greater or lesser extent. The elements of the micro-system interact themselves in turn with the exo-system of the extended family, social-welfare services and economic system. Lastly, these concentric systems lie within the outer ring of the macro-system which represents the attitudes, ideologies and culture of the society in which the child lives as well as the economic, political, legal and regulatory structure of the society. This conceptual system provides the analytical structure both for the ***GUI*** study as a whole and this report in particular.

1.6 DATA AND MEASURES

The analysis in the report is based on the data collected as part of the Child Cohort (at 9 years) of the ***Growing up in Ireland*** study. The sample contains information on 8,568 children, their parents and the principals and teachers in the children's school. The sample was generated through the national-school system in 2007 and early 2008, when the children involved were nine years of age. A nationally representative sample of 1,105 schools was selected from the total of 3,326 primary schools in RoI at that time. Just over 82% of these (910 schools) were successfully recruited into the survey. The sample of children and their families was then randomly generated from within those schools. The response rate at the family level was 57%. The data used throughout the report were re-weighted, or statistically adjusted, in line with the sample design to ensure that the information is representative of the population of nine-year-olds in Ireland.[1] Because the sample selection was clustered within schools, all statistical analyses in this report adopt robust standard errors.

The sample design was chosen so as to facilitate data-collection in the school from principals, teachers and the children themselves. The study was carried out in two phases. The first was carried out in the school where questionnaires were completed by the school principal, the study child and their teacher. The teacher completed a questionnaire in respect of both themselves and the study child. On completion of the school-based phase of the project, interviewers visited the families of the nine-year-olds in their homes and administered questionnaires to the study child and his/her caregivers.[2]

1.7 MEASURING OVERWEIGHT AND OBESITY

GUI collected high-quality, measured information on the heights and weights of the children and their parents at the time of the household interview. Height and weight measurements allow us to compute the body mass index (BMI) of the child and his/her parents (weight in kilograms/height in metres squared). This provides a generally accepted measure of adiposity (i.e. body fat) since higher weight for any given height is one indicator of a high proportion of non-lean (i.e. adipose) mass. BMI is an indirect measure of adiposity (as opposed to a direct measure such as skin fold measurement, x-ray absorptiometry or body electrical conductivity) and is not infallible as it assumes an 'average' body composition. Since larger musculature brings with it higher weight, this can also increase the weight/height^2 ratio and increase BMI. Notwithstanding these caveats, BMI in children has been shown to correlate highly with measures of body fat obtained using direct physiological assessment (cf. Lindsay et al 2001). Other indirect measures are also used such as waist measures/height ratios, but BMI remains an accepted measure of adiposity and has been used widely.

Weight measurements of parents and children were recorded to the nearest 0.5 kilogram using a SECA 761 medically approved flat mechanical scales which graduated in one-kilogram increments and had an upper capacity of 150 kilograms. Parents and children were asked to wear light clothing for weight measurement.

1 The data were reweighted using a minimum information loss algorithm based on the fitting of column marginals to external totals. For a discussion of sample design, recruitment, response and reweighting of the data, see Williams & Thornton, 2010.
2 A copy of all questionnaires administered to the nine-year-old cohort in the school and home can be found at http://www.growingup.ie/index.php?id=62

Height was recorded to the nearest millimetre using a Leicester portable height stick. Valid height and weight measurements were obtained in respect of 94.5% of the sample of children. Measures of parental height and weight were collected in respect of 91% of primary and 79% of secondary caregivers (98% of primary caregivers were mothers). As parental height/weight measurement was missing more often for those with particular characteristics, variables are entered into analysis to control for missing data.

BMI scores are usually transformed into categorical groups for analysis. Among adults, four groups are usually used to define body weight in Europe and North America: underweight (BMI<18.5), healthy (BMI 18.5-24.9), overweight (BMI 25-29.9) and obese (BMI 30+). The choice of thresholds among children is complicated by changes in body composition that accompany maturation, so BMI cut-offs have to be standardised for age and gender. The International Obesity Task Force (IOTF) guidelines for thresholds among children are increasingly being used to guide analysis and policy. The IOTF thresholds for children of nine and a half years of age are applied in this report. They define healthy weight as a BMI of less than 19.46 for boys and 19.45 for girls (there is no underweight category). Overweight is defined as a BMI of 19.46 to less than 23.38 (for boys) or 19.45 to less than 23.46 (for girls) and obesity as a BMI of 23.38 or over (for boys) and 23.46 or over (for girls).

1.8 THE STRUCTURE OF THE REPORT

The next chapter of this report, ***Chapter Two***, uses ***GUI*** data to measure the overall pattern of overweight and obesity among nine-year-old children in Ireland. Data from previous studies in Ireland are used to examine trends in the prevalence of overweight and obesity among children in Ireland over time. The chapter also compares the pattern in Ireland to that found in other countries, using published results. Chapter Two examines three questions:

- Has overweight and obesity increased in Ireland among children?
- How high are rates of overweight and obesity among children in Ireland relative to other European countries?
- Does Ireland have social-class inequalities in overweight and obesity among children?

The ***GUI*** study gathered detailed information on a large number of factors that may be associated with the risk of overweight and obesity, including the child's diet, level of physical activity, 'sedentary' activities such as watching television and playing computer games, plus a number of other indicators of dietary and physical behaviour. ***Chapter Three*** uses bivariate and multivariate analyses to examine the relationship between these risk factors and the child's measured weight status. Chapter Three examines four questions:

- Do children from lower social-class households have more risk factors for overweight and obesity?
- Are patterns of diet, physical exercise and sedentary behaviours associated with the risk of overweight and obesity?
- Can the social-class inequalities in overweight and obesity be accounted for by patterns of diet, physical exercise and sedentary behaviours?
- Do patterns of diet, physical exercise and sedentary behaviours cluster together among some children?

Chapter Four examines different factors that shape the quality of the child's diet. It assesses the effect of maternal characteristics, such as age and education, as well as family factors, such as income and social class, on a measure of the quality of the child's diet. Past research has found that different geographic areas vary in terms of number and types of food shops available and that this can have an independent effect on dietary quality. Given this, Chapter Four examines the effects on the quality of the child's diet of both maternal/family characteristics and distance to local food outlets from the child's household. The chapter examines two questions:

- Do lower socio-economic communities have fewer and smaller food outlets?
- Is the quality of the child's diet influenced by the distance to the nearest food outlet?

Chapter Five studies the social and emotional impact which overweight and obesity have on children in Ireland. It analyses the extent to which overweight and obesity is recognised by the children and their parents, and the effect this has on the child's perception of their attractiveness and popularity with other children. The chapter also examines the association of weight status with child emotional and behavioural problems and the mediating role of child's self-concept in this. Chapter Five examines four questions:

- How accurate are parent and child assessments of the child's weight status?
- Is the mismatch between perception and actual weight status associated with particular parental and household characteristics?
- Does the child's weight status influence their level of self-esteem?
- Does the child's self-esteem mediate the relationship between child weight status and psychological adjustment?

Finally, ***Chapter Six*** draws out the implications of the findings from the previous chapters for policy development in the area of child overweight and obesity in Ireland.

Chapter 2

LEVELS, TRENDS AND SOCIAL CLASS INEQUALITIES IN OVERWEIGHT AND OBESITY AMONG CHILDREN IN IRELAND

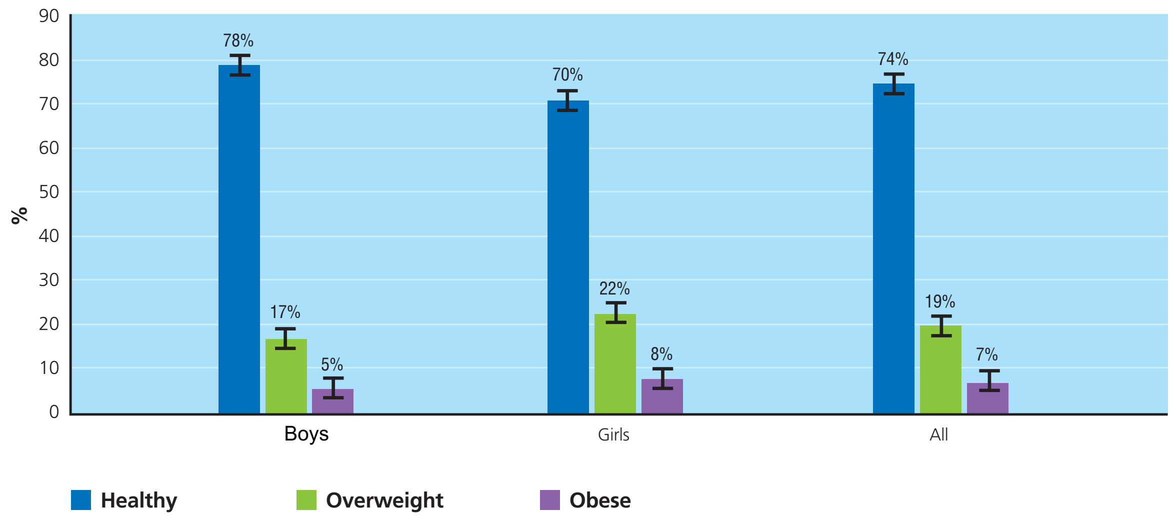
2.1. INTRODUCTION

This chapter describes the overall pattern of overweight and obesity found among the 8,568 children who participated in the Child Cohort. Data from previous studies in Ireland are used to examine trends in the growth of overweight in Ireland. Evidence is also presented on the prevalence of overweight in Ireland compared to other European countries using published results from existing studies.

2.2 OVERWEIGHT AND OBESITY AMONG CHILDREN IN IRELAND

Applying the IOTF thresholds (see Chapter 1), Figure 2.1 gives the proportion of boys and girls in the ***GUI*** Child Cohort in each of the three BMI categories.

Figure 2.1: Proportion of Healthy, Overweight and Obese GUI Children 2007 – using IOTF Thresholds
(Error bars represent 95% confidence intervals.)



A total of 75% of nine-year-olds in ***GUI*** were defined as being of healthy BMI, 19% were overweight and 7% obese. Girls were more likely than boys to be defined as being overweight (22% v 17%, P<0.001) and obese (8% v 5%, P=0.002), leading to a higher proportion of girls than boys being defined as overweight or obese (30% for girls v 22% for boys, P<0.001).

2.3 IS THE PREVALENCE OF OVERWEIGHT INCREASING AMONG CHILDREN IN IRELAND?

Although measured data on heights and weights of Irish children are comparatively rare, a number of studies have collected data over the years and these provide some evidence of trends. The first large-scale survey of the heights and weights of Irish children was carried out in 1948 in the 'Irish Nutrition Survey'. This measured the heights and weights of 14,835 children nationally and provides the earliest remaining data. More data were collected in the 1970s to provide data for Irish growth charts, but further data-collection did not occur until 2002 when Helen Whelton and colleagues from UCC collected data on 19,617 children aged from 4 to 16 years across the island of Ireland (Whelton et al 2007). By combining results from a paper by Perry and colleagues (Perry, Whelton, Harrington, & Cousins 2009) on heights and weights between 1948 and 2002 with those from the ***GUI*** project, it is possible to create a record of trends in height and weight among Irish nine-year-olds across a 60-year period.

Figure 2.2: Mean Height (cm) by Sex of Children Aged 9 – 1948-2007

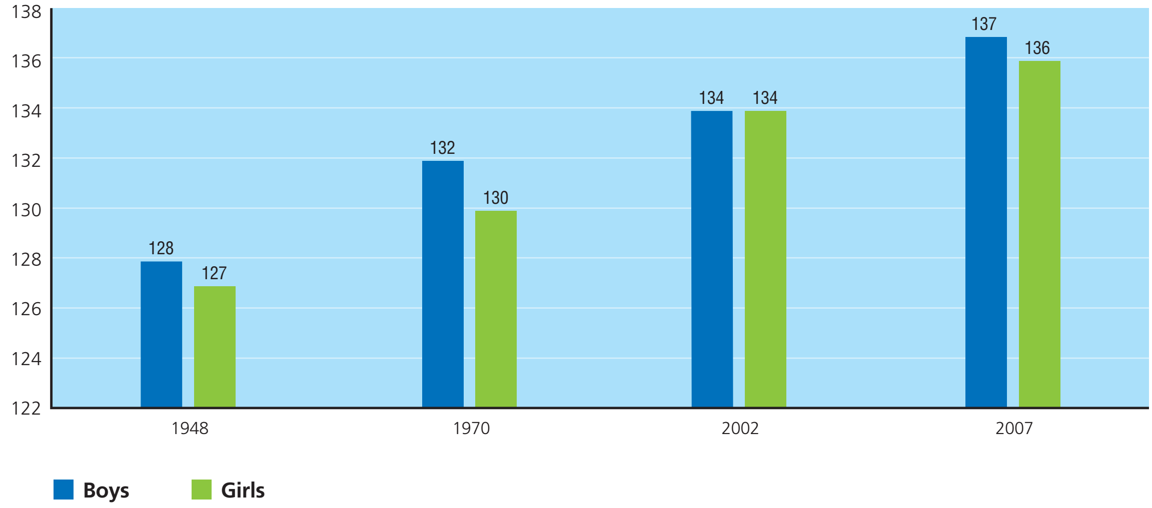
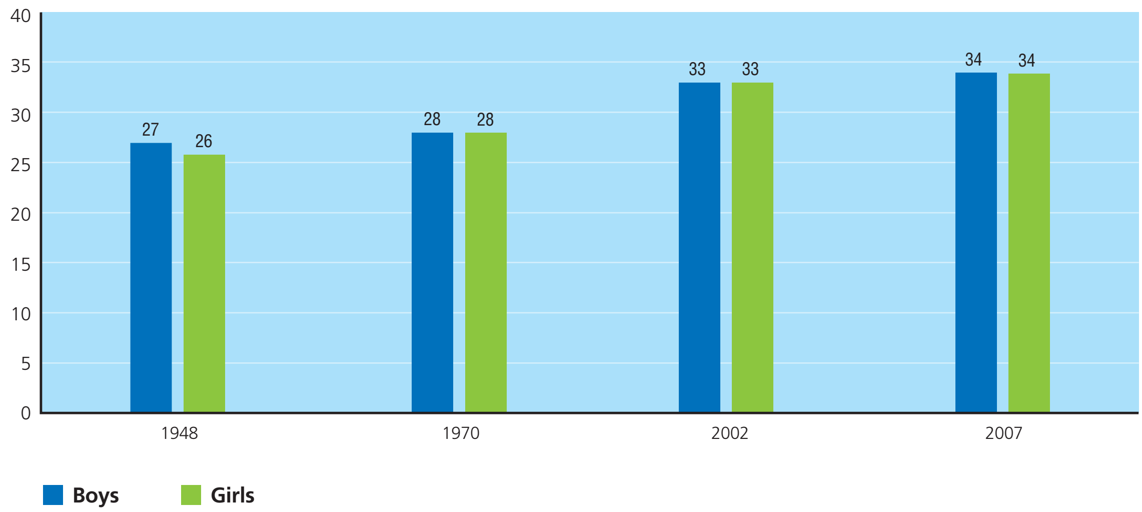


Figure 2.2 shows that the height of the average nine-year-old in Ireland increased by 9cm or 7% between 1948 and 2007. While it is possible that the average height increased by 2 to 3cm between 2002 and 2007, the difference in estimates may actually reflect greater sample error in the 2002 sample, which had 235 nine-year-old children compared to 8,568 in the sample from 2007. However, sample error does not obscure the substantial increase in height over the period.

Figure 2.3 gives the average weight of children in Ireland over the same period. This shows an increase in average weight from 26/7kg to 34kg, which is a proportionate increase of 26% among boys and 31% among girls. The disproportionate increase in weight over height means that average BMI rose from 16 in 1948 to over 18 by 2007, a 10% increase among boys and a 14% increase among girls (no published data on the proportion above BMI thresholds is available for these earlier studies).

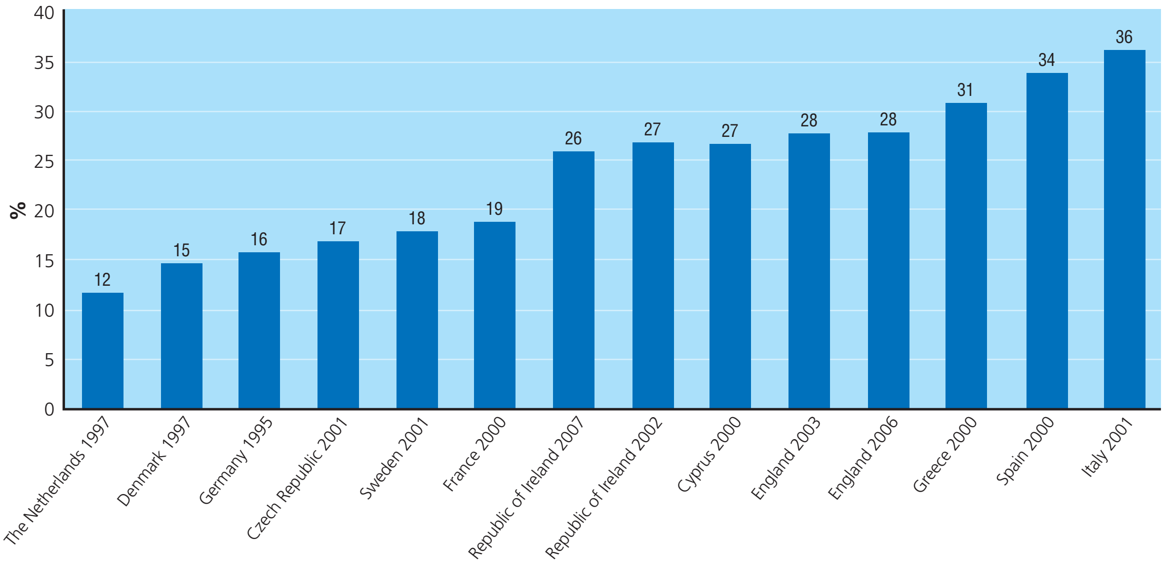
Figure 2.3: Mean Weight (kg) by Sex of Children Aged 9 – 1948-2007



2.4 ARE LEVELS OF OVERWEIGHT AND OBESITY HIGH IN IRELAND COMPARED TO OTHER EUROPEAN COUNTRIES?

Figure 2.4 provides comparative data on children aged between 7 and 11 years for a number of European countries (drawn from (Lobstein & Frelut 2003). Interpretation of this table is complicated by the fact that the data were collected at different times across countries. Levels of adiposity have been increasing across most European countries so more recent data-collection is likely to be associated with higher prevalence, although Stamatakis (Stamatakis, Wardle, & Cole 2010) has presented evidence that the epidemic has plateaued in England since the early 2000s.

Figure 2.4: Proportion of Overweight and Obese Children Aged 7-11 by Country, using IOTF Thresholds (from Lobstein & Frelut 2003)



Note: Republic of Ireland 2002 includes ages 8-11, 2007 age 9 alone

Figure 2.4 suggests that the prevalence of overweight and obesity in Ireland is higher than in northern European countries such as France, Sweden and Germany; similar to that found in England, but less than in the southern European countries such as Italy, Greece and Spain.

2.5 SOCIAL CLASS VARIATION IN THE RISK OF OVERWEIGHT AND OBESITY IN IRELAND

Chapter One discussed socio-economic inequalities in the levels of overweight and obesity found among children and young people in other countries, including the UK. Some evidence on this relationship in Ireland can be seen in *Figures 2.5* and *2.6* which give the proportions of overweight and obesity by the sex of the child and the social class (Central Statistics Office schema) of their parents.[3] These figures clearly show gradients in the prevalence of overweight and obesity by social class (i.e. the proportion increases as we move from left to right). Comparisons between *Figures 2.5* and *2.6* show that the steepness of the social-class gradient is larger among girls. Boys and girls from professional households have approximately the same probability of overweight or obesity (boys 19%, girls 18%). But, whereas the probability among boys increases to 23% for the non-manual group and peaks at 29% for the semi- and unskilled group, for girls, the probability increases to 32% among the non-manual group and peaks at 38% for the semi- and unskilled. The ratio between professional and semi- and unskilled is therefore 1.53 for boys compared to 2.24 for girls, suggesting a steeper gradient among girls in the inequality between social classes.

[3] Household class is that of the child's parents. For a household where the child lives with two parents, the household social class is taken as the higher of the two (known as a 'dominance' procedure). For information on the construction of the social-class schema, see http://www.cso.ie/census/census2006results/PSER/PSER_Appendix%203-9%20Details%20and%20Classifications.pdf

Figure 2.5: Proportion of Overweight and Obese Boys (IOTF Thresholds)
(Error bars represent 95% confidence intervals.)

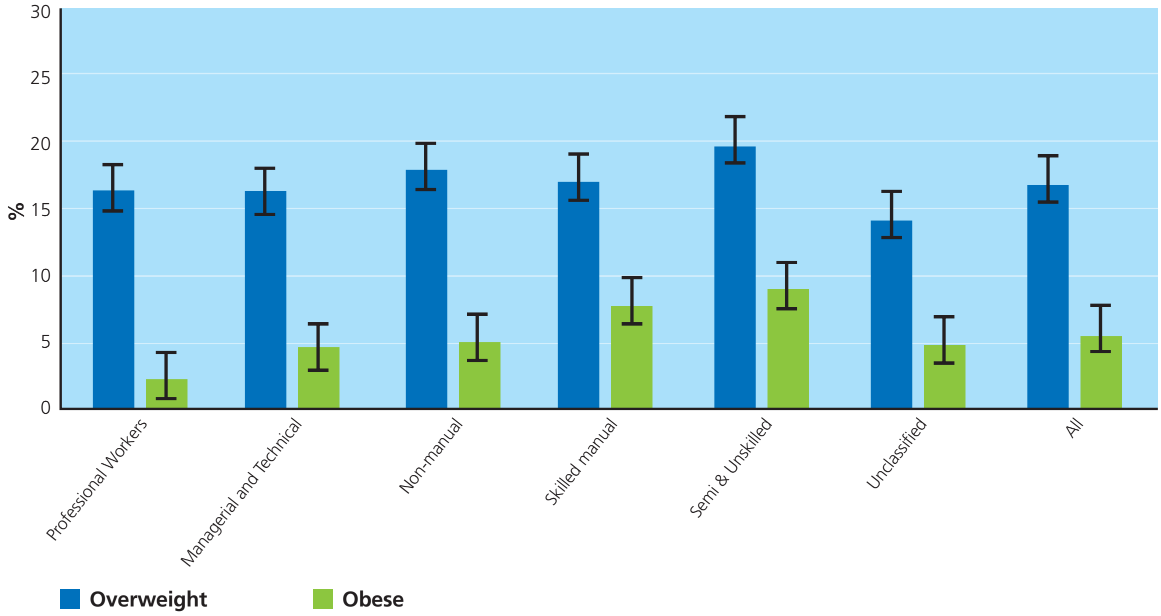
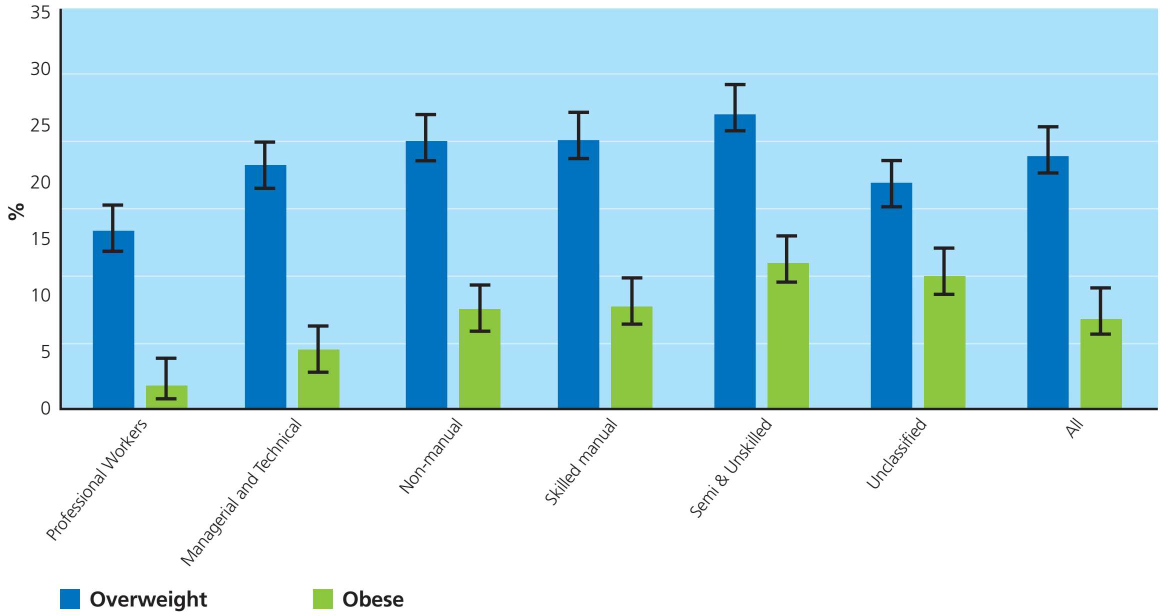


Figure 2.6: Proportion of Overweight and Obese Girls (IOTF Thresholds)
(Error bars represent 95% confidence intervals.)



2.6 SUMMARY AND CONCLUSIONS

The last half century has witnessed a substantial increase in the average height and weight of Irish children. In one respect this is a positive development. The Irish Nutrition Survey of 1948 was carried out because of the widespread concern at the time about the extent of malnutrition and stunted growth among Irish children, particularly in the large cities. Nonetheless, the disproportionate increase in the average weight of Irish children relative to their height has raised concerns about the impact of overweight and obesity on current and future health. Results from the ***GUI*** study confirm that a sizeable proportion of nine-year-old children in Ireland are overweight: 30% of girls and 22% of boys. Fully comparable figures are difficult to obtain, but data suggest that Ireland may have one of the higher levels of overweight among European countries, similar to the UK but below that of the Southern European countries. The final section of the chapter showed that children from less socio-economically advantaged households are more likely to be overweight, particularly girls. This is an important issue since inequalities in overweight among children will contribute to inequalities in adult health and mortality in the coming decades.

Chapter 3

ANALYSIS OF THE ASSOCIATION OF DIET AND PHYSICAL ACTIVITY WITH CHILD OVERWEIGHT AND OBESITY

3.1 INTRODUCTION

The last chapter presented evidence that there has been a substantial increase in child adiposity in Ireland over the last half century. One consequence of this is that a quarter of nine-year-old children in the ***GUI*** study are defined as being overweight or obese. This chapter analyses the association between different behavioural risk factors for overweight and obesity and the measured weight status of the child. Body weight in children and adults depends on the balance of energy intake and daily energy expenditure, so the simple reason as to why some children become overweight is that they consume too many calories for their level of physical exercise. Individuals can differ significantly in the manner in which energy is used in the body, in terms of resting metabolic rate and the energy cost of physical activity, so it is possible that the same energy intake and level of physical activity could lead to differential weight gain across individuals. However, research suggests that metabolic and physiological differences between individuals account for a small part of their overall risk of obesity (Filozof & Gonzalez 2000).

Though the balance of diet and physical activity are the proximate causes of overweight and obesity, other, more *distal* factors may also play a role in shaping the proximate or direct influences. For example, there is now evidence that maternal behaviours and circumstances during pregnancy as well as infant feeding practices may contribute to the risk of overweight in infancy, childhood and adulthood, although the mechanisms through which this occurs are still relatively poorly understood. The bio-ecological perspective of this study and previous research also suggest that the proximate causes of obesity are influenced by the characteristics of parents such as their income, education and social class.

The environment in which the child grows and develops may also be important in shaping the type of diet consumed and influencing the opportunities for and levels of physical activity. For example, a family living in an area with fewer, more expensive food outlets or poorer access to fresh food will find it more difficult to provide a balanced, healthy diet for their child. Similarly, a child living in an environment with fewer spaces for physical activity or who must travel longer distances to school each day will have more limited opportunities for exercise, if they travel by car or bus.

These distal factors will themselves be shaped by social, economic and cultural forces. For example, where a family lives will be influenced by the income and resources of the parents which is determined by their level of education, employment status and occupation. Food choice will be influenced not only by available resources but also by culturally formed preferences. Some indirect evidence of the influence of socio-economic processes was provided in the last chapter in the form of social-class differentials in the risk of overweight and obesity among the children in the ***GUI*** sample. This chapter takes a more direct approach by examining the patterning of child diet, physical exercise and sedentarism, and their relationship to the probability of overweight and obesity.

3.2 THE RELATIVE IMPORTANCE OF DIET AND PHYSICAL ACTIVITY FOR OBESITY IN CHILDREN

The rise in childhood obesity (Popkin, Conde, Hou, & Monteiro 2006;Wang & Lobstein 2006) across many developed and developing countries has generated a large literature trying to understand the relative contributions of energy intake and physical activity to the development of overweight and obesity, in the hope that this will lead to the development of more effective interventions. Unfortunately, understanding the interaction of diet and activity among children and adolescents living in the community has proved complex (Livingstone 2000). The debate about the role of diet and physical exercise in weight gain has not been helped by the fact that different methodologies have returned different results; epidemiological and prospective studies in particular have produced mixed results (Lissner & Heitmann 1995). Independently, insufficient exercise and higher consumption of calories are acknowledged as the primary mechanisms underlying excess body weight (Nicklas & Johnson 2004) but lean children and adolescents are often found to consume more calories than their overweight peers. The difference is that lean children compensate for that energy intake while the overweight do not (Ebbeling et al. 2004), and vice versa.

The type of food consumed is also important. The fat content of food appears to influence perceived satiety and so can lead to passive overconsumption (Blundell et al. 1993). Pure fat has almost twice the energy content of pure carbohydrate by weight, so the same calorific content can be consumed in a smaller volume, leading to weaker satiation which promotes passive over-consumption (Prentice 1998;Rolls 1995;Yao & Roberts 2001). This suggests that the energy density of foods being consumed may be important, particularly if this is combined with a higher frequency of eating snack foods (Maffeis et al. 2000).

Reviews of research on the relationship between physical activity and obesity have found inconsistent results, and associations are generally found to be weak. One review of evidence on the relationship for children and adolescents found that, of seven large-scale studies, four found an association between lower levels of physical activity and weight gain, but three did not (Molnar & Livingstone 2000). A more recent review (Wareham, van Sluijs, & Ekelund 2005) found similar results, with many studies finding no or weak effects of physical activity on weight gain. Again, the equivocal nature of the evidence may result from methodological differences across studies, although there is no consistent variation across epidemiological, prospective and controlled trial studies (Wareham, van Sluijs, & Ekelund 2005).

3.3 MEASURES OF RISK FACTORS FOR OVERWEIGHT AND OBESITY

3.3.1 DIETARY QUALITY

The ***GUI*** questionnaires contained a number of questions around food and nutrition. Unfortunately, the study could not include a full food-frequency questionnaire which would have allowed us to generate overall measures of energy consumption. Instead, a battery of questions on the number of times that the study child had consumed a list of 20 foods in the last 24 hours was used to measure dietary quality. This measure was an amended version of a dietary measure used in the Longitudinal Study of Australian Children, itself derived from the Sallis Amherst Questionnaire (Sallis et al. 2001). These questions were asked of the primary carer (usually the mother) while a reduced set was asked of the child in their self-completion questionnaire. The 20 foods listed were:

- Fresh fruit
- Fruit juice
- Meat / chicken / fish
- Eggs
- Cooked vegetables
- Raw vegetables or salad
- Meat pie, hamburger, hot dog, sausage or sausage roll
- Hot chips or French fries
- Crisps or savoury snacks
- Bread
- Potatoes / pasta / rice
- Cereals
- Biscuits, doughnuts, cake, pie or chocolate
- Cheese / yoghurt / fromage frais
- Low-fat cheese / low-fat yoghurt
- Water (tap water / still water / sparkling water)
- Soft drinks / minerals / cordial / squash (not diet)
- Soft drinks / minerals / cordial / squash (diet)
- Full-cream milk or full-cream milk products
- Skimmed milk or skimmed milk products

The respondent was asked if the study child had consumed each type of food, once, more than once or not at all in the last 24 hours. The questions were not designed to amount to a full food-frequency questionnaire but to provide an index of dietary quality that could be compared within the sample. We can summarise this overall difference in dietary quality by combining the different items of food consumption into a single index of dietary quality. This is done by assigning positive values (1=eaten once, 2=more than once) to foods seen as beneficial (such as raw vegetables, fresh fruit, etc) and a negative value to those generally seen as less beneficial (burger, sausage, chips, crisps, etc). Foods such as bread, potatoes and rice are deemed as neutral so are excluded from the scale. By summing the scores and taking the mean value we produce a single index of dietary quality. Analysis of the statistical reliability of the dietary index shows that it achieves an alpha coefficient of 0.47, which is comparatively low. Analysis of the index collected as part of the child questionnaire found that it was weakly correlated with the parental index and displayed little structured variability. Given this, only the index collected as part of the parent questionnaire is used in this report.

3.3.2 PHYSICAL ACTIVITY

The ***GUI*** questionnaires asked both parents and children about the physical exercise of the study child. Questions tried to assess the overall level of physical exercise, in relation to both national adult and international child health guidelines, and involvement in sport both inside and outside school. Two questions were asked of parents about their child's level of physical activity. These asked parents to estimate on how many days in the last 14 their child had done at least 20 minutes' physical activity. One question asked about 'light' exercise and the second about 'hard' exercise, and examples of each were provided. These questions were adapted from the Leisure Time Exercise Questionnaire (Godin & Shephard 1985). This self-report measure has been shown to demonstrate concurrent validity with measures of maximum oxygen intake (VO2 max) and muscular endurance (Godin, Jobin, & Bouillon 1986), as well as acceptable test-retest reliability (Sallis et al. 1993). The most widely cited recommendation for how active children should be states that they should accumulate at least 60 minutes of moderate to vigorous physical activity each day (Koplan, Liverman, & Kraak 2005). However, concerns over rising levels of obesity among children mean that more recent guidelines have stated that children should accumulate more than 60 minutes of physical activity, in bouts lasting at least 15 minutes, and avoid prolonged periods of inactivity (NASPE 2004). A question in the child's school-based questionnaire was based on this concept of activity and asked children to report the number of days in the last week when they did vigorous physical activity of 60 minutes or more. Two questions were also asked in the child's home-based questionnaire on the frequency of playing sport and number of times in the last week that they did 20 minutes or more of 'exercise', where the intensity was not specified.

Although it would be possible to use all these measures, initial tests showed relatively little overlap between the measures and that the parent reports were more predictive of weight status. Given this, only the parent measures are used in this report.

3.3.3 SEDENTARY ACTIVITY

The ***GUI*** study asked a number of questions of parents about the time that their child spent doing sedentary activities 'on an average weekday during term time'. Questions were asked about watching television/DVDs/videos, reading (all kinds), using a computer and, lastly, playing games on a games console. Parents were given a range of time periods, from none to seven or more hours.

The ***GUI*** questionnaires also asked parents about other behaviours which research has suggested may be important as risk factors for overweight and obesity. Rampersaud et al (2005) reviewed the results of 47 studies that examined the association between breakfast consumption and nutritional adequacy, body weight and academic performance in children and adolescents. Children who reported consistently eating breakfast had superior nutritional profiles to those of peers who consistently skipped breakfast. Although children who ate breakfast tended to consume more daily calories, they were less likely to be overweight. ***GUI*** included measures of whether breakfast was consumed and of what kind. We use the question on whether the child had any breakfast in analyses below.

Information was also collected on the child's method of travel to and from school. It is estimated that 73% of Irish primary-school children use motorised transport to get to and from school (Fahey et al 2005). Although ***GUI*** collected information on travel to and from school, only transport to school is used and differentiation is made between those walking or cycling (i.e. physically active methods) versus those using motorised transport.

3.4 THE DISTRIBUTION OF RISK FACTORS FOR OVERWEIGHT AND OBESITY

This section analyses the distribution of different behaviours across the sample of nine-year-old children. *Table 3.1* gives results on each by sex and across CSO social class groups. Because of space constraints, the measures have been dichotomised in the table. More differentiation is used in the later analyses in this chapter.

Table 3.1: Distribution of Risk Factors for Overweight and Obesity

	Professional Workers	Managerial & Technical	Non-manual	Skilled manual	Semi & Unskilled	Unclassified	All
% Dietary Quality in Lowest Tertile							
Boys ***	24.3	34.1	39.2	40.7	50.3	47.0	38.1
Girls ***	16.3	23.6	36.5	33.5	37.0	41.7	30.9
All ***	20.9	29.2	37.9	37.2	42.9	44.2	34.6
% Doing 20+ Minutes' Light Exercise 9+ Days Last 2 Weeks							
Boys ***	78.2	74.6	72.8	70.0	69.5	71.9	73.7
Girls n.s	70.6	67.5	65.2	67.7	66.2	69.2	67.4
All ***	74.6	71.0	68.9	68.7	67.7	70.4	69.3
% Doing 20+ Minutes' Hard Exercise 9+ Days Last 2 Weeks							
Boys *	66.0	63.5	60.4	64.2	59.4	56.8	62.7
Girls n.s	48.6	46.6	45.2	49.7	47.1	52.2	47.4
All n.s	57.7	55.0	52.6	56.4	52.5	54.3	54.4
% Reading for 1+ Hours on an Average Weekday (outside school)							
Boys n.s	24.2	24.8	22.8	22.8	24.9	34.0	24.9
Girls n.s	36.2	37.0	39.0	33.8	39.2	47.0	38.2
All n.s	29.4	30.5	30.6	28.2	33.0	40.8	31.4
% Watching 3+ Hours' TV on an Average Weekday							
Boys ***	5.9	8.7	10.5	11.4	15.8	19.7	11.0
Girls ***	5.6	8.1	12.9	10.4	11.6	16.5	10.6
All ***	5.7	8.4	11.7	11.0	13.4	18.1	10.8
% Using Computer for 1+ Hours on an Average Weekday (outside school)							
Boys n.s	15.5	11.5	13.8	12.9	18.1	14.2	13.5
Girls n.s	13.7	14.6	13.9	11.5	13.0	19.0	14.1
All n.s	14.7	12.9	13.8	12.3	15.2	16.7	13.8
% Not Eating Breakfast Before School							
Boys **	1.0	1.3	2.5	2.2	2.3	5.4	2.1
Girls ***	1.2	1.5	3.7	3.8	7.3	7.5	3.7
All ***	1.1	1.4	3.1	3.0	5.1	6.5	2.9
% Walking or Cycling to School							
Boys n.s	28.4	23.4	22.2	22.0	35.9	34.6	25.7
Girls *	22.6	24.8	24.7	21.6	31.6	35.7	26.2
All *	25.9	24.0	23.4	21.8	33.5	35.2	25.9
% Gaming 1+ Hours Daily on an Average Weekday							
Boys ***	20.7	23.6	27.2	31.1	33.2	43.8	26.5
Girls ***	7.0	9.9	13.3	10.4	12.8	16.5	10.9
All ***	16.1	18.4	22.1	22.5	23.7	30.5	21.3

*Asterisks represent significance of categorical correlation (Spearman) between class and variable. Key: n.s. =Not Significant; *=P<0.05; **=P<0.01; ***=P<0.001*

Table 3.1 shows that that a lower proportion of girls fall into the group with the lowest-quality diet than boys, suggesting that they consume a higher-quality diet on average. The difference between the sexes is true within each social class group. The fall in dietary quality between social class groups is very significant (P<0.001). Social class differences in dietary quality contribute to inequalities in health across social class groups both in childhood and adulthood (Irala-Estevez et al. 2000;Park et al. 2005;WHO 1990) but it is not clear that they necessarily contribute to inequalities in the risk of obesity as this is more closely associated with total energy intake.

Table 3.1 gives the proportion of children doing 20+ minutes of light exercise 9+ times in the last 14 days (from the parent report). Boys are significantly more likely (74% v 67%; P<0.001) to have reached this threshold than girls. There is a significant class gradient to this measure for boys only. The results for the same question referring to 'hard exercise' show that boys are again more likely than girls to have done 20+ minutes 9+ times in the last 14 days (63% v 47%; P<0.001) but that there are fewer differences across social class groups (although still significant; P<0.05).

A significantly higher proportion of parents of girls report their daughter reading for one or more hours per day compared to parents of boys (38% v 25%, P<0.001) but *Table 3.1* shows no significant differences across social class groups.

There is no significant difference between boys and girls in the proportions watching three or more hours of television on a weekday. There are class differences: whereas 6% of boys from professional households watch 3+ hours of TV on a normal weekday, the figure rises to 11% among boys from non-manual households and 16% among those from semi- and unskilled households. These differences are statistically significant (P<0.001). There is a similar pattern among girls.

Console and computer games have become increasingly important in children's time use. ***GUI*** data show that 8% of nine-year-old children have a computer or laptop in their room and 35% a games console (unlike computers and TVs, boys are more likely to have a console in their room, at 44%, compared to 26% among girls). If a child has a TV in their room, there is a much higher likelihood that they will also have a games console or computer. Whereas 15% of boys without a TV in their room have a console, this is true of 77% who have a TV in their room. Analysis shows no significant difference in the proportions of boys and girls using a computer for one or more hours a night on an average weekday, and no significant differences across social class groups. Around a quarter of boys (27%) and almost half of girls (46%) spend no time playing computer or console games on an average weekday. Just over 21% of parents report that their child plays games for one or more hours, but this proportion is significantly higher among boys than girls, and among children from lower social class groups (P<0.001).

The proportion of children not eating breakfast before school is relatively low at 3% although this is significantly higher among girls (3.7% v 2.1%, P<0.001). There are also social class differences in the proportion eating breakfast before school among both boys and girls; lower social class groups are significantly more likely to skip breakfast (P<0.001).

There is no significant difference in the proportions of boys and girls walking or cycling to school rather than using a motorised form of transport, but there are significant social class differences. Among boys, those in non-manual and skilled-manual households are more likely than those in either the professional or unskilled groups to walk or cycle (P<0.05). Among girls, walking or cycling is significantly more likely among girls from semi- or unskilled households compared to the professional and managerial group (P<0.05).

Table 3.1 shows that the social class position of parents is strongly associated with a number of risk factors for overweight and obesity. Children from lower social class positions, and children from semi- and unskilled manual class households in particular, tend to have higher levels of risk factors than children of non-manual and professional parents. There are significant inequalities in seven of the nine variables in *Table 3.1.*

3.5 A MULTIVARIATE MODEL OF OVERWEIGHT AND OBESITY

This section examines the association of the different risk factors with overweight and obesity. To do this, the section first analyses the extent to which the probability of overweight and obesity varies with different characteristics controlling only for the sex of the child. To examine the independent effect of each variable, the chapter then uses multivariate regression models to estimate the probability that the child is overweight and obese, relative to being of healthy body weight. Since the effect of different risk factors may vary depending on the BMI threshold concerned (i.e. being above the threshold for overweight but not obesity) we use different models for each threshold. The previous chapter showed that the risk of overweight and obesity varies between girls and boys. It is likely that the effect of different risk factors varies by sex, so separate models are estimated for boys and girls. Given the magnitude of social class differences in the risk of overweight and obesity (see the last chapter), it is important to examine the extent to which risk factors for overweight and obesity statistically account for the observed difference in prevalence of overweight and obesity across social class groups. In the multivariate analyses, social class position is entered along with other risk factors. The extent to which the effect of social class is reduced by the addition of other risk factors to the statistical model provides a measure of the role of those factors in social class differentials.

3.5.1 PROBABILITY OF OBESITY

Table 3.2 provides the proportion of children whose BMI measurements define them as obese by characteristic, plus the bivariate and multivariate odds ratios and significance for each of the risk factors by sex. When analysed bivariately, the levels of light and of hard exercise are both significant predictors of the probability of obesity; less exercise is associated with higher odds of obesity. Boys doing hard exercise for 20 minutes or more on three days out of the previous two weeks are over 350% more likely to be obese compared to peers doing hard exercise on nine or more days over the same period. Similarly, boys not doing a sport outside school are 222% more likely to be obese than those that do. The righthand columns of *Table 3.2* show similar effects for girls; those doing 20 minutes of hard exercise on three or fewer days in the last two weeks are 321% more likely to be obese than girls doing the highest levels of exercise. Girls who do not do a sport outside school are shown to have a raised risk in the bivariate model, but the effect is only weakly significant.

Among the sedentary activities, boys using a computer for one or more hours on an average weeknight are over twice as likely to be obese as those not using a computer. There is a strong association between the amount of television watched and the risk of obesity. Boys watching TV for between one and three hours are 269% more likely and those watching for three or more hours are 424% more likely to be obese than boys watching less than an hour on average. The sedentary activities appear to have limited association with obesity among girls. Only the bivariate association between 3+ hours of watching TV and obesity is significantly associated with a higher risk.

The indicators of dietary quality and behaviour prove to be weak predictors of obesity, except for the variable representing eating breakfast before school. The bivariate odds suggest that boys who skip breakfast are 288% more likely to be obese. This variable is not significant among girls. The odds ratio for boys who do not eat dinner at the table is weakly significant (<0.1) and greater than one (odds ratios greater than one suggest an increased risk).

Once we control for the other factors in *Table 3.2*, there is a significant fall in the effect of all of the predictors, and some become statistically insignificant. Level of hard exercise remains significant but the odds attached to the lowest level of exercise are reduced by 45% among boys. The fall is smaller among girls, at 33%, where the odds fall from 3.21 to 2.14. Among boys, none of the light-exercise coefficients remains significant, whereas that for the lowest light-exercise group remains significant among girls, although much reduced.

Table 3.2: Frequencies, Bivariate and Multivariate Odds and Significance for Obesity by Child Sex

	Boys (N=3911)					Girls (N=4138)				
	Bivariate Proportion, Odds & Sig.			Multivariate Odds Ratio		Bivariate Proportion, Odds & Sig.			Multivariate Odds Ratio	
	%	OR	Sig.	OR	Sig.	%	OR	Sig.	OR	Sig.
CSO Social Class										
Prof Workers	2.2	1.00	-	1.00	-	2.0	1.00	-	1.00	-
Managerial & Tech.	4.5	2.12	n.s	1.85	n.s	5.0	2.56	**	2.54	**
Non-manual	5.1	2.39	#	2.01	n.s	8.6	4.62	***	4.51	***
Skilled manual	7.7	3.69	**	3.15	*	9.0	4.84	***	4.77	***
Semi & Unskilled	8.8	4.31	**	3.09	*	12.7	7.13	***	7.12	***
Unclassified	4.8	2.26	n.s	1.59	n.s	11.5	6.39	***	6.29	***
Hard Exercise										
<3	12.2	3.55	***	1.96	#	15.8	3.21	***	2.14	**
3-5	8.9	2.51	***	1.97	**	10.1	1.92	***	1.62	*
6-8	5.8	1.57	#	1.50	n.s	7.0	1.30	n.s	1.41	n.s
9+	3.7	1.00	-	1.00		5.5	1.00	-	1.00	
Light Exercise										
<3	10.9	2.67	***	1.45	n.s	22.8	4.28	***	2.71	***
3-5	8.7	2.07	**	1.24	n.s	9.8	1.57	*	1.11	n.s
6-8	6.2	1.45	n.s	0.94	n.s	6.3	0.98	n.s	0.85	n.s
9+	4.4	1.00	-	1.00		6.5	1.00	-	1.00	
Sport Outside School?										
Yes	4.6	1.00	-	1.00		7.0	1.00	-	1.00	
No	9.7	2.22	***	1.61	*	9.4	1.37	#	1.02	n.s
Eats Dinner at the Table?										
Yes	5.2	1.00	-	1.00		7.6	1.00	-	1.00	
No	8.3	1.66	#	1.33	n.s	10.5	1.43	n.s	1.21	n.s
Hours Using Computer										
None	4.7	1.00	-	1.00		8.4	1.00	-	1.00	
<1	4.9	1.07	n.s	1.14	n.s	6.6	0.76	n.s	0.87	n.s
1+	9.2	2.09	**	1.70	*	10.6	1.29	n.s	1.26	n.s
Eats Before School?										
Yes	5.2	1.00	-	1.00		7.7	1.00	-	1.00	
No	13.7	2.88	**	2.43	*	11.4	1.55	n.s	1.31	n.s
Hours Reading										
None	4.2	1.00	-	1.00		11.3	1.00	-	1.00	
<1	5.6	1.37	n.s	1.42	n.s	6.9	0.58	n.s	0.73	n.s
1-3	5.1	1.24	n.s	1.31	n.s	7.7	0.66	n.s	0.71	n.s
3+	8.6	2.17	#	1.45	n.s	15.2	1.41	n.s	1.28	n.s
Hours Watching TV										
<1	2.3	1.00	-	1.00		6.1	1.00	-	1.00	
1-3	5.9	2.69	***	2.08	*	8.0	1.34	n.s	1.22	n.s
3+	9.0	4.24	***	2.42	*	10.2	1.75	*	1.12	n.s
Transport to School										
Walks/Bike	5.9	1.00	-	1.00		8.6	1.00	-	1.00	
Car/Bus	5.2	0.89	n.s	0.90	n.s	7.5	0.86	n.s	0.94	n.s
Quality of Diet										
Low	6.4	1.40	n.s	1.08	n.s	7.5	0.95	n.s	0.67	*
Moderate	5.0	1.08	n.s	1.04	n.s	8.2	1.04	n.s	0.92	n.s
High	4.6	1.00	-	1.00		7.9	1.00	-	1.00	

Significance Key: n.s. + Not Significant; #=P<0.1;=P<0.05; **=P<0.01; ***=P<0.001*

Among boys, the coefficients for computer use and time spent watching TV remain significant, although much reduced. For example, the odds associated with watching three or more hours of TV per night are reduced by 43%, from 4.24 to 2.42. Interestingly, not eating breakfast before school remains significant among boys even when controlling for all other factors in the model, with odds reduced from 2.9 to 2.43 but still significant.

Table 3.3: Frequencies, Bivariate and Multivariate Odds and Significance for Overweight (including Obesity) by Child Sex

	Boys (N=3911)					Girls (N=4138)				
	Bivariate Proportion, Odds & Sig.			Multivariate Odds Ratio		Bivariate Proportion, Odds & Sig.			Multivariate Odds Ratio	
	%	OR	Sig.	OR	Sig.	%	OR	Sig.	OR	Sig.
CSO Social Class										
Prof Workers	18.5	1.00	-	1.00	-	17.5	1.00	-	1.00	-
Managerial & Tech.	20.9	1.16	n.s	1.12	n.s	26.1	1.67	***	1.65	**
Non-manual	23.0	1.31	n.s	1.25	n.s	31.9	2.21	***	2.19	***
Skilled manual	24.7	1.44	*	1.36	n.s	32.3	2.25	***	2.26	***
Semi & Unskilled	28.5	1.76	**	1.55	*	38.4	2.94	***	2.92	***
Unclassified	18.9	1.02	n.s	0.88	n.s	31.1	2.13	***	2.05	**
Hard Exercise										
<3	27.8	1.49	*	1.18	n.s	37.7	1.79	***	1.34	#
3-5	25.8	1.35	*	1.19	n.s	38.6	1.86	***	1.57	***
6-8	22.0	1.09	n.s	1.06	n.s	28.6	1.18	n.s	1.18	n.s
9+	20.5	1.00	-	1.00		25.3	1.00	-	1.00	-
Light Exercise										
<3	26.1	1.32	n.s	1.14	n.s	48.6	2.58	***	1.87	***
3-5	26.0	1.32	#	1.12	n.s	38.4	1.70	***	1.37	*
6-8	22.7	1.10	n.s	0.97	n.s	30.1	1.17	n.s	1.03	n.s
9+	21.0	1.00	-	1.00		26.8	1.00	-	1.00	-
Sport Outside of School?										
Yes	21.2	1.00	-	1.00		28.9	1.00	-	1.00	-
No	26.5	1.34	*	1.15	n.s	32.2	1.17	n.s	0.98	n.s
Eats Dinner at the Table?										
Yes	21.9	1.00	-	1.00		29.6	1.00	-	1.00	-
No	24.6	1.16	n.s	1.04	n.s	35.5	1.31	n.s	1.05	n.s
Hours Using Computer										
None	20.0	1.00	-	1.00		31.8	1.00	-	1.00	-
<1	21.5	1.10	n.s	1.12	n.s	27.3	0.80	*	0.82	*
1+	29.8	1.70	***	1.52	**	35.5	1.18	n.s	1.07	n.s
Eats Before School?										
Yes	21.6	1.00	-	1.00		29.6	1.00	-	1.00	-
No	43.2	2.76	***	2.67	**	40.1	1.59	#	1.59	#
Hours Reading										
None	22.4	1.00	-	1.00		32.2	1.00	-	1.00	-
<1	21.9	0.97	n.s	0.90	n.s	29.5	0.88	n.s	1.03	n.s
1-3	21.0	0.92	n.s	0.85	n.s	29.3	0.87	n.s	0.95	n.s
3+	31.0	1.55	n.s	1.13	n.s	38.6	1.32	n.s	1.23	n.s
Hours Watching TV										
<1	16.6	1.00	-	1.00		27.4	1.00	-	1.00	-
1-3	22.8	1.48	**	1.42	**	29.7	1.12	n.s	1.06	n.s
3+	29.4	2.09	***	1.73	**	38.0	1.62	**	1.34	#
Transport to School										
Walks/Bike	23.7	1.00	-	1.00		31.7	1.00	-	1.00	-
Car/Bus	21.5	0.88	n.s	0.90	n.s	29.4	0.90	n.s	0.91	n.s
Quality of Diet										
Low	22.8	0.97	n.s	0.84	n.s	28.5	0.85	n.s	0.68	***
Moderate	20.1	0.83	n.s	0.78	*	30.2	0.92	n.s	0.85	n.s
High	23.3	1.00	-	1.00		31.9	1.00	-	1.00	-

Significance Key: n.s. + Not Significant; #=P<0.1;=P<0.05; **=P<0.01; ***=P<0.001*

One of the central concerns of this section is the extent to which the measures of risk factors for obesity statistically account for the inequalities in prevalence across social class groups. *Table 3.2* confirms the association between class of child's household and risk of obesity. Boys from semi- and unskilled manual households are 431% more likely to be obese than their peers from professional households, while boys from skilled manual households are 369% more likely, before we control for other factors. The inequalities between girls are even larger. Girls from skilled manual households are 484% more likely to be obese than girls from professional households and girls from semi- and unskilled manual households are 713% more likely.

Once we control for all the other factors in the table, the odds ratio for boys from skilled manual households falls to 3.15 (a 15% reduction) and that for unskilled manuals to 3.09 (a 28% reduction). These reductions show that the model for boys explains a sizeable minority of the variation in the risk of obesity for boys from the manual class. However, the success of the girl's model in accounting for variation in the level of obesity across social class groups is far more modest. Controlling for other factors in *Table 3.2*, the fall in the odds ratios is far smaller than found for boys. The largest fall is among the non-manual at 2.4% but the fall among the semi- and unskilled is less than 1%. This suggests that the factors in the girls model explain only a fraction of the social class variation in obesity.

3.5.2 PROBABILITY OF OVERWEIGHT/OBESITY

Table 3.3 provides results for the models of overweight/obesity for male and female children in the ***GUI*** study. For boys, low levels of hard exercise, not doing a sport outside school, using a computer for an hour or more a day, and watching TV for longer are all associated with a higher odds of being overweight or obese. The effect of not doing a sport outside school becomes insignificant when controlling for other factors in the multivariate model. Boys who do not have breakfast before school are also at a raised risk of overweight; this effect was only marginally reduced once we adjusted for other factors in the table. The pattern of effects for boys is relatively similar to that found in the model of obesity except that the odds ratios are generally smaller. For example, whereas the odds of obesity in the lowest category of hard exercise were 3.55 for boys, the odds of overweight or obesity for this category are 1.49. Interestingly, unlike the model predicting obesity, the model of overweight for boys finds only a mildly significant effect for light exercise. *Table 3.3* shows similar results for girls, with significant positive effects on the odds of overweight for low levels of exercise although, for girls, both hard and light exercise are important. The only other significant effect for girls is that associated with watching three or more hours of TV a day, although this effect becomes almost insignificant when controlling for other factors in the model. Interestingly, not eating breakfast before school is a mildly significant positive predictor of overweight for girls, with the effect remaining when controlling for other factors.

For boys, the children of skilled manual parents are 144% more likely than the children of professional parents to be overweight or obese. Male children of semi- and unskilled manual parents are 176% more likely to be overweight or obese. In the multivariate model controlling for all the factors in *Table 3.3*, the coefficient for male children of skilled manual workers becomes statistically insignificant, while that for semi- and unskilled children becomes less significant and is reduced by 12%.

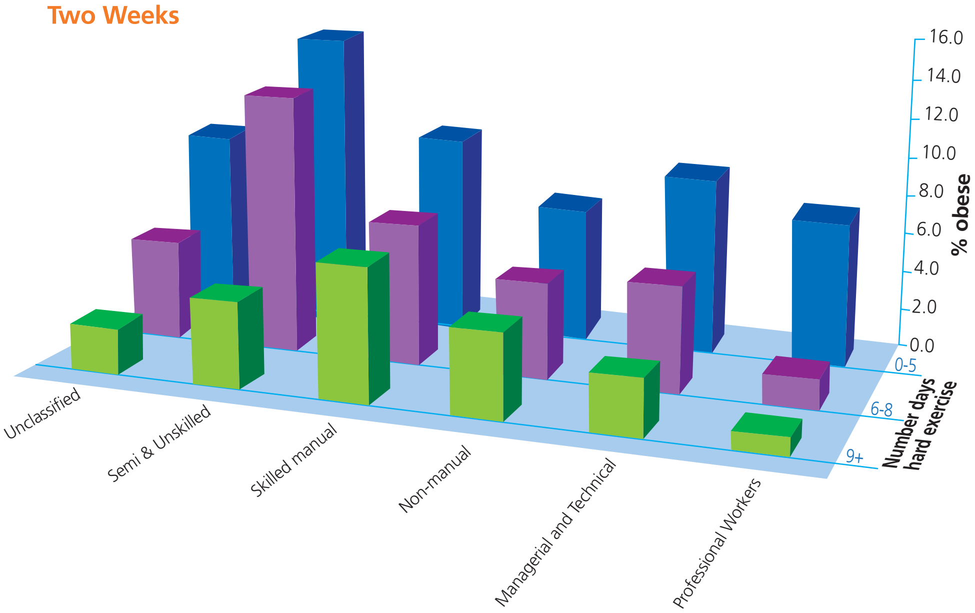
As in the model of the probability of obesity, the model of overweight for girls is far less effective in accounting for the inequality between social class groups. In the bivariate analyses, girls from skilled manual households are 225% more likely than those of professional parents to be overweight or obese, while those of semi- and unskilled parents are 294% more likely. In the multivariate model, controlling for all other factors, these figures are barely altered and levels of significance remain unaffected.

The bivariate and multivariate analyses in *Tables 3.2* and *3.3* provide evidence that low levels of physical exercise and higher levels of sedentary behaviours are significantly associated with overweight and obesity.

However, even controlling for the large range of risk factors in *Tables 3.2* and *3.3,* the models account for a minority of the inequality in risk between the children of manual class households and those of professional parents. For boys, the models account for between one-seventh and a third of the social class variation, whereas among girls the social class coefficients are reduced by less than 3%. This suggests that additional factors need to be identified to fully explain the social class differences in overweight and obesity.

It may be that, even when children from more advantaged households have behaviours that increase their risk of overweight and obesity, this risk is moderated to some extent by other advantages, thus blunting the effect. *Figure 3.1* shows the relationship between the proportion of boys who are measured as obese and level of hard exercise in the last 14 days, by the social class of the child.

Figure 3.1: Proportion of Obese Boys by Number of Days doing 20 Minutes' Hard Exercise in the Last Two Weeks



For each class, the proportion of boys who are obese decreases as the level of hard exercise increases but, within levels of exercise, those in skilled, semi- and unskilled manual classes have higher levels of obesity. To some extent this is likely to reflect the presence of other risk factors among lower social class children but, as already shown, this will not account for all or even the majority of the difference. Given this, other processes or advantages in higher social class households must explain the difference. Future waves of the ***GUI*** project may be able to shed more light on these complex patterns, using longitudinal data.

3.6 TO WHAT EXTENT DO RISK FACTORS AMONG GUI CHILDREN CLUSTER?

The previous sections of this chapter have shown the distribution of different risk factors for obesity and overweight across the population of nine-year-old children in Ireland and the effect of these risk factors on the probability of overweight and obesity. This analysis assumed that the different risk factors vary independently across the population of children. In reality, this is unlikely to be true. For example, children who take low levels of physical exercise may be more likely to also watch high levels of television. This has important implications for the kind of intervention policies deployed to alter the risk factors and thus the way that resources would be used. If each risk factor is isolated to a specific group of children, they can be targeted independently, with less complex interventions. On the other hand, if risk factors tend to be clustered, this increases the likelihood that interventions will need to be multi-faceted, because the likelihood of changing one risk factor is likely to depend on the success of other interventions.

One way to look at this problem is in terms of the way in which the value of one risk factor varies with another. For example, as the child's level of exercise increases, does their time spent watching television decrease? This is a measure of 'correlation', i.e. the proportionate increase or decrease in one factor for a unit increase in another. *Table 3.4* shows the categorical or Spearman correlation coefficients between the diet, physical exercise and sedentary activities already analysed in this chapter. The diagonal line across the table shows a correlation of 1 because this represents the correlation of each variable with itself. The cells below the diagonal refer to the correlations for boys, and those above to those for girls.

Table 3.4: Correlation between Risk Factors at the Level of the Child by Child Sex

(Spearman correlation coefficients – boys below diagonal, girls above)

	Hours of TV	Hours of Gaming	Dietary Quality	Frequency Hard Exercise	Frequency Light Exercise
Hours of TV	1	0.18	-0.21	-0.12	-0.10
Hours of Gaming	0.29	1	-0.13	-0.02	-0.05
Dietary Quality	-0.19	-0.19	1	0.06	0.08
Frequency Hard Exercise	-0.11	-0.07	0.06	1	0.53
Frequency Light Exercise	-0.11	-0.06	0.05	0.55	1

Note: All coefficients significant at <0.01 except time gaming and hard exercise for girls.

Table 3.4 shows that, as the number of hours spent watching television or computer-gaming increases, the quality of diet and level of both hard and light exercise fall (and vice versa) for both boys and girls. Similarly, as hours of TV viewing increases, so does the level of gaming, although the relationship between these two tends to be lower for girls compared to boys (0.18 v 0.29). As the level of hard exercise increases, so does the level of light exercise (this relationship is the strongest across all the factors for both boys and girls). There is less than a 1% probability that any of these relationships occur by chance, except that between gaming and hard exercise for girls where the relationship is much weaker.

These results suggest that the risk factors do indeed cluster across children; with those engaging in more sedentary activity more likely to have worse diets and to exercise less. However, correlation coefficients do not indicate how the risk factors cluster across the children in the ***GUI*** sample. Latent class analysis (LCA) (sometimes referred to as finite mixture modelling) is a statistical technique which relates observed variables to unobserved or 'latent' categorical variables. The technique allows the analyst to vary the number of 'latent classes' to find the best statistical 'fit' with the observed variables and then provides a probability that each unit in the analysis (or child in the context of the ***GUI*** study) will be a member of each latent class.

Although LCA can be carried out on a large number of variables, this can often lead to a prohibitively high number of latent groups if the clustering of some risk factors is low. Given this, the analysis was carried out using the five variables analysed in *Table 3.4*. Given the difference in risk profiles by the child's sex, separate LCA models were estimated for boys and girls. Preliminary analysis showed that the optimal number of clusters (i.e. classes) for both boys and girls was four and that this number provided the best statistical fit.

Table 3.5 shows the results of this characterisation for the four clusters of boys. This shows that 65% of boys are in two clusters (1 and 3), and around 1 in 6 boys in each of the two remaining clusters. Analysis of the risks of overweight and obesity across clusters shows relatively small differences in risk of overweight, with proportions varying from 15% to 17%. The probability of obesity is more differentiated, with 1.3% of cluster 2 measured as obese compared to 9.7% of cluster 4, an odds ratio of 8.13. It is important to note that the child's weight status is not used in the LCA estimation.

Table 3.5: Levels of Risk Factors by Cluster Grouping – Boys

	Cluster Grouping			
	1	2	3	4
Level of Hard Physical Exercise	High	Moderate	Low	Low
Level of Light Physical Exercise	High	High	Low	Moderate
Dietary Quality	Moderate	Moderate	Low	Low
Time Watching TV/DVD	Low	Low	Moderate	High
Time Gaming	Moderate	Low	Moderate	Moderate
% of Sample	34.9	17.8	30.5	16.9
% Overweight (not Obese)	15.3	15.5	17.3	16.4
% Obese	4.5	1.3	6.5	9.7

Table 3.5 also gives the level of each risk factor for each cluster. The clusters are strongly differentiated by their levels of exercise and time spent watching TV. Clusters 1 and 2 have high or moderate levels of exercise compared to low to moderate levels for clusters 3 and 4. Similarly, clusters 1 and 2 have low levels of TV watching compared to moderate and high levels in clusters 3 and 4. There are smaller differentiations by dietary quality; none of the groups has high-quality diets but clusters 3 and 4 have low-quality diets compared to the moderate diets of clusters 1 and 2. This analysis suggests that close to half of the sample of boys (47%) have low levels of exercise combined with moderate to high levels of sedentary behaviour. These differentiations appear to be associated with a small increase in the risk of overweight and a larger increase in risk of obesity.

Table 3.6: Levels of Risk Factors by Cluster Grouping – Girls

	Cluster Grouping			
	1	2	3	4
Level of Hard Physical Exercise	High	Low	Moderate	Moderate
Level of Light Physical Exercise	High	Low	Moderate	Moderate
Dietary Quality	Moderate	Low	Moderate	High
Time Watching TV/DVD	Moderate	Moderate	Moderate	Low
Time Gaming	Low	Moderate	Moderate	Low
% of Sample	38.5	7.5	40.6	13.5
% Overweight (not Obese)	19.7	17.7	24.2	24.7
% Obese	5.6	5.3	9.0	10.6

Table 3.6 shows that almost four-fifths of the sample of girls are grouped into two clusters (1 and 3). Analysis of the risks of overweight and obesity across clusters shows differentiation in the risk of overweight and obesity between the clusters. Between 18% and 20% of Clusters 1 and 2 respectively are measured as overweight and 5% to 6% as obese. In clusters 3 and 4 the proportion of overweight increases to 24% and 25% and the proportion of obese to 9% and 11% respectively.

Analysis of the proportions with different risk factors shows that the LCA model does not provide a simple differentiation of the sample of girls. Cluster 1 has high levels of exercise plus low to moderate levels of sedentary activities, but clusters 2 to 4 have a mix of risk factors. Cluster 2 has low levels of exercise and moderate levels of sedentary activities plus a low-quality diet. Cluster 3 on the other hand has moderate levels of all risk factors, while cluster 4 has moderate physical activity and low sedentary activity accompanied by a high-quality diet. Unlike with boys, there is no simple association between the measured levels of overweight and obesity and the cluster profiles.

3.7 SUMMARY AND CONCLUSIONS

This chapter has sought to describe the distribution of specific risk factors for overweight and obesity and to quantify the effect of these observed risk factors on the probability of obesity and overweight. Our analyses show that dietary quality varies significantly across child sex and between social class groups, as does the level of physical activity and sedentarism. Around two-thirds of parents of boys report that their son did hard exercise (for 20 minutes or more) on nine out of the previous 14 days, falling to around half the parents of girls. Levels of sedentary behaviour are also a concern; one in 10 children watch three or more hours of television on an average weekday and 66% watch for between one and three hours.

The multivariate models show that the risk of obesity is significantly related to the levels of physical exercise and sedentarism but there is no evidence that poor dietary quality increases the risk. Although the measured quality of diet varies systematically by child sex, social class and a number of other factors, it appears to be weakly associated with the probability of overweight and obesity. This may be because the measure is of dietary quality and is not a full food-frequency index. If overweight and/or obesity is more strongly related to overall energy consumption, our measure is unlikely to measure this effectively. Unfortunately, food-frequency questionnaires are time-consuming for respondents to complete and the decision was made not to include one in the ***GUI*** instruments. This may be rectified in future waves.

Among boys, the analyses showed that low levels of physical exercise and high levels of sedentary behaviour were both implicated in the risk of overweight and obesity, even controlling for a host of other factors. Among girls on the other hand, only hours of TV among the sedentary behaviours was a significant predictor, and this became insignificant when controlling for other factors. It is unclear why levels of sedentary behaviours would have different effects across the sexes but the addition of longitudinal data with the next wave of the study will be important in unravelling the relationships.

The lack of effect for sedentary behaviours may have been one reason why the girls models were less successful at accounting for social class variation in overweight and obesity. Whereas the addition of risk factors reduced the class inequality by between 15% and 28% among boys, the reduction was less than 3% among girls. The fact that the class inequalities among boys and girls remained after controlling for a large number of behavioural differences is an important finding. It suggests that the source of class inequalities should be sought elsewhere. Problems in our measures may be an issue and the lack of a measure of calorie intake a challenge, but the result does suggest that class inequalities are deep-rooted.

Our correlation and cluster analyses showed that the risk factors are not distributed evenly across the population of children but tend to coalesce within some clusters of children. Among boys, around 18% appeared to have a set of low risk factors and this did indeed translate into a lower risk of obesity. A further 35% had generally low risk factors but a higher level of computer gaming. However, almost half (47%) of the boys were clustered into two groups with low to moderate physical activity and moderate to high amounts of time doing sedentary activity, and this had a clear impact on their risk of obesity. Among girls, analyses were not as insightful but levels of exercise emerged, once again, as important.

Chapter 4

LOCAL AREA EFFECTS, OVERWEIGHT AND OBESITY

4.1 INTRODUCTION

The increasing influence of the ecological model of child development (Bronfenbrenner 1979) has sensitised researchers to the role which the local community and environment may play in shaping child outcomes. This interest meshes well with developments in epidemiology, where researchers have examined the role of the local physical and built environment in shaping exposure to risk factors for disease and poor health. Although there are a number of pathways through which local community and environment influence health, given space constraints, this chapter focuses on one particular process linking the child's local environment to overweight and obesity: the local food environment, food access and its impact on individual dietary quality.

4.2 DOES THE LOCAL FOOD ENVIRONMENT INFLUENCE DIETARY QUALITY?

This report has already shown evidence of socio-economic gradients in dietary quality among children in Ireland, which suggests that low income and resources may affect the affordability of food and thus the quantity and quality of food consumed. However, it is also possible that living in an area with fewer food outlets or fewer outlets selling affordable, high-quality food may also lead to poorer dietary quality. If so, this would mean that, net of the child's and the family's own characteristics, the area in which they live could have a significant bearing on the quality of the child's diet. Moreover, should lower income and social class families be more likely to live in areas with fewer or lower-quality food outlets, this may lead to a situation where the local food environment compounds the effect of low income on dietary quality.

The research literature in this area does suggest that poorer areas are likely to have fewer larger supermarkets and more convenience stores and takeaway restaurants (Cummins & Macintyre 2002). Research has also found that shops in poorer areas are more likely than larger stores to stock a higher proportion of processed foods, which tend to be higher in saturated fats, salt and sugars, and a smaller range of fruit and vegetables. The smaller convenience stores also tend to charge higher prices than larger supermarkets (Chung & Myers 1999; Kaufman et al. 1997;MacDonald & Nelson 1991). Proximity to a supermarket and number of local supermarkets is positively associated with higher fruit and vegetable intake and better dietary quality among low-income households (Rose & Richards 2004).

However, studies of this subject have found varying results depending on national context. Studies from the US and Canada have consistently shown that poorer communities have fewer larger supermarkets and more convenience stores and takeaway food outlets. Evidence from the UK, Australia and the Netherlands, on the other hand, has not shown an association between socio-economic status of the area, food availability and diet. Although some UK studies in the late 1980s did show an association between food availability and poorer areas (Mooney 1990), later studies did not find differences in the availability or price of food between better-off and worse-off communities (Cummins & Macintyre 1999;Cummins & Macintyre 2002). Moreover, studies outside the US have failed to find an independent association between neighbourhood/community food availability and individual diet and fruit and vegetable intake, once adequate control was taken of household income (Pearson et al. 2005; White et al. 2004). The only exception to this difference in results is the case of Ireland where Layte et al. (Layte et al. 2011) found a strong association between the number of larger supermarkets and socio-economic advantage, and a negative association between distance to a supermarket and dietary quality among the adult population, using a national health and lifestyle survey.

It is unclear why the findings from North America and Ireland are so different from those elsewhere, but it has been suggested that the different regulatory environment in the US compared to European countries and Australia, in combination with greater socio-economic segregation in North America, due to ethnic and racial divisions, may contribute (Cummins & Macintyre 2006). Low levels of inward migration until comparatively recently means that Ireland has nothing like the racial or ethnic segregation of the US, but there has been a tendency since the 1960s for lower-income and local-authority housing in Ireland to be built in large estates on the periphery of the larger cities, with little or no infrastructure, including retail opportunities (Poole & Parker 1990). This may mean that Ireland has higher levels of socio-economic segregation than Britain and other European countries, although there is no published evidence of this.

4.3 LOCAL AREA DEPRIVATION AND NUMBER OF FOOD OUTLETS

The next section examines whether the child's diet, as reported for the most part by their mother, is influenced by the distance from their home to the nearest food store. Previous research has shown that geographic areas where lower socio-economic groups are predominant have a lower density of large food shops. If so, there may be a community or local-area influence on dietary quality in addition to an individual or household effect associated with lower socio-economic status. This section examines whether local socio-economic status and supply of food shops are related.

Figure 4.1 shows the distance in metres to the nearest food shop by the type of shop and the level of deprivation in the local area. We use the Haase (Haase & Pratschke 2005) area measure of deprivation here, which is a weighted combination of a large number of different variables measured at the area level such as the proportion of unemployed, proportion of the population in higher socio-economic groups, etc.

Here, 'supermarket' is defined as one of the stores of the six large food retailers in the Irish context which are known as 'vertically integrated retailers': Tesco, Dunnes, Superquinn, SuperValu, Lidl and Aldi. Another large presence in Irish food retailing is the smaller 'convenience' stores known as 'group/symbol' retailers. These are franchised operations such as Spar, Mace and Centra.

Figure 4.1: Distance to Food Outlet by Type of Outlet and Area Deprivation Decile
(Error bars represent 95% confidence intervals.)

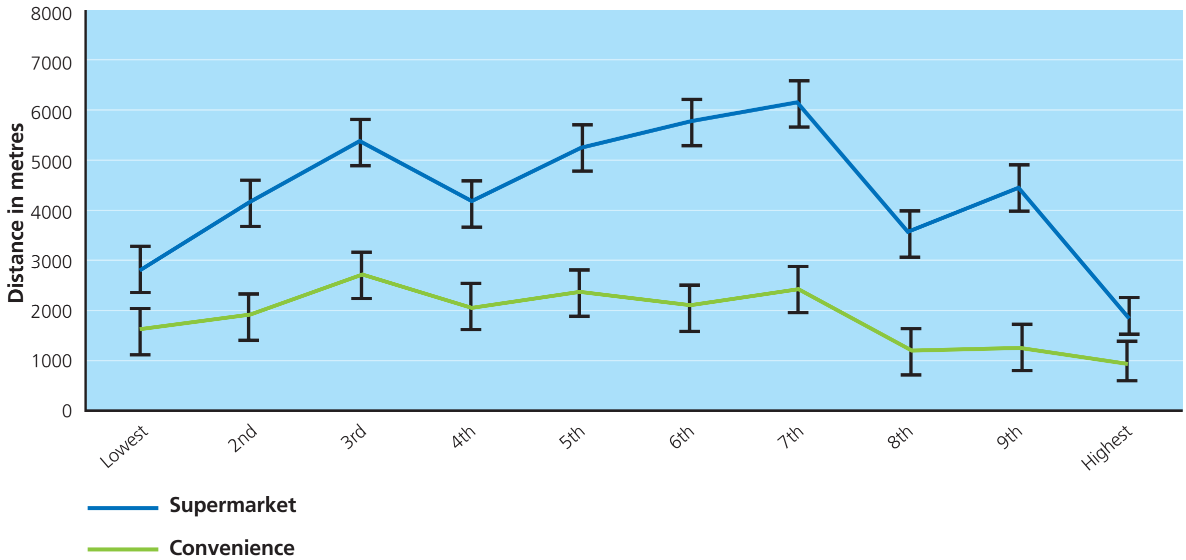


Figure 4.1 shows that the distance to a convenience store is lower, on average, than that to a supermarket, irrespective of area deprivation level. Convenience stores, as the name suggests, tend to be both more numerous and distributed more evenly across urban areas, as can be seen from the relatively flat relationship with level of area deprivation compared to the relationship between supermarket distance and deprivation. The significantly shorter distance at higher levels of deprivation reflects the fact that areas of greater deprivation tend to be in the centres of large cities where population densities also tend to be higher, leading to a greater density of food stores. This effect can be seen for supermarkets too. Distance to supermarket rises as area deprivation increases, but it subsequently falls at the highest levels of deprivation, leading to a slightly u-shaped relationship. The confounding effect of population density with area-level deprivation has important consequences for our analyses that we return to after the next section.

4.4 HOUSEHOLD SOCIO-ECONOMIC ADVANTAGE AND ACCESS TO FOOD OUTLETS

The last section showed that there is a relationship between area deprivation and distance to supermarkets. Is there a similar relationship between distance to the nearest food store and socio-economic disadvantage at the individual and household level? *Table 4.1* gives the mean distance to nearest supermarket and convenience store from the homes of the children in the ***GUI*** study by three different measures of socio-economic advantage: household social class (CSO measure), household income, and mother's highest educational level. This shows relatively clearly that more advantaged households have less far to travel for food shopping. For example, the average distance in metres to the nearest supermarket is significantly higher for all social class groups relative to the children from professional households ($P<0.001$) (apart from the unclassified). Similarly, distance to the nearest supermarket and convenience store is smallest for children from households in the highest income group ($P<0.001$). The relationship is far from perfect, as some groups have shorter distances than groups who would seem more advantaged, but overall the relationship is pronounced.

Does the distance to nearest food store influence the diet of the child? Since more disadvantaged children have poorer diets on average, it could be expected that distance and diet would be negatively related (i.e. as distance increases dietary quality would fall). To examine this requires a multivariate model.

Table 4.1: Descriptive Statistics for Distance (Metres) to Nearest Food Outlet by Outlet Type and Parental and Household Characteristics

Variable	Distance to Nearest Supermarket				Distance to Nearest Convenience Store		
	N	Mean Distance (m)	95%	CI	Mean Distance (m)	95%	CI
All							
Household CSO Social Class							
Professionals	1,172	3557.5	3107.5	4007.6	1602.0	1440.0	1763.9
Managerial & Technical	3,317	4147.4	3789.0	4505.7	1762.9	1629.4	1896.4
Non-Manual	1,686	4499.0	4061.7	4936.3	1929.3	1749.8	2108.7
Skilled Manual	1,196	5275.4	4741.6	5809.1	2121.1	1928.3	2314.0
Semi & Unskilled	739	4542.9	3953.4	5132.3	1988.1	1729.2	2247.0
Unclassified	409	3710.8	3013.7	4407.9	1419.9	1168.5	1671.3
Income Quintile							
Lowest	1,055	4664.2	4046.9	5281.5	1873.1	1637.4	2108.8
2nd	1,375	4938.5	4415.4	5461.6	2018.7	1829.0	2208.5
3rd	1,583	4504.1	4064.1	4944.2	1903.6	1719.7	2087.4
4th	1,815	4238.2	3847.3	4629.1	1859.5	1709.4	2009.5
Highest	2,114	3490.2	3123.6	3856.8	1575.4	1427.9	1723.0
Mother's Highest Educational Qualification							
Lower Secondary	1,510	4238.2	3739.6	4736.7	1750.4	1574.6	1926.2
Higher Secondary	2,698	4626.4	4241.3	5011.4	1934.2	1784.7	2083.7
Post Secondary	2,123	4309.0	3922.6	4695.3	1918.4	1757.5	2079.3
Degree or Higher	2,237	4006.5	3572.4	4440.5	1694.4	1539.7	1849.2

4.5 MODELLING THE EFFECT OF DISTANCE TO NEAREST FOOD STORE ON CHILDREN'S DIETARY QUALITY

As in previous chapters, here we use a measure of dietary quality derived from a battery of 20 questions completed by the primary caregiver, usually the mother (see Chapter 3). Although standard multiple regression analysis would produce estimates of the effect of distance on dietary quality, the relationship is complicated by the u-shaped relationship between area deprivation and distance to supermarkets found in the last section. Areas with greater social deprivation are more frequently in large cities but these areas also tend to have higher population densities and thus more shops. The analysis needs to remove the effect of population density to isolate the specific effect of distance; this can be accomplished by using models which examine the effect of distance within rather than across areas. This is done using a fixed-effects or 'within' estimator that examines the effect of distance for children within each area, rather than looking at the overall effect of distance on diet across the whole sample. In this approach, the average dietary quality among children in the same school is taken from the child's own dietary quality score (to give the deviation from the school mean). A similar process is applied to the predictor variables (e.g. distance) and a standard OLS estimation carried out controlling for the correlation between children in the same school. This means that the effects of all differences between children living in different areas are controlled for, allowing the effect of distance from the child's home to local food outlets to be measured. To make sure that any residual effect of rurality is absorbed, the model uses a variable describing the level of urbanisation of the area where the child lives (open country, village, small town, larger town, other city, Dublin). Local area deprivation (the Haase deprivation index) is also entered into the analysis to absorb socio-economic differences across areas, correlated with diet.

Lastly, it is important to control for the socio-economic status of the child's household since parental education, income and social class may also influence the quality of diet (as shown in Chapter Three). Variables are fitted for the income of the household (logged), CSO social class group, mother's highest level of education, and mother's age.

Table 4.2: Model of Child's Dietary Quality (Fixed Effects – Supermarket Store Model)

	Boys		Girls	
Variable	**Estimate**	**Signif.**	**Estimate**	**Signif.**
Distance to Supermarket (m)	0.00	0.585	-0.02	0.01
Mother Aged 30-39	-0.01	0.796	0.05	0.018
Mother Aged 40-49	0.01	0.817	0.06	0.006
Mother Aged 50+	0.06	0.151	0.07	0.052
Household (HH) Manag. & Tech.	-0.01	0.482	0.00	0.822
HH Non-Manual	-0.03	0.088	-0.01	0.455
HH Skilled Manual	-0.04	0.074	0.00	0.851
HH Semi and Unskilled	-0.05	0.03	-0.02	0.311
HH Unclassified	-0.06	0.063	0.00	0.967
Log of Household Income	0.01	0.33	0.04	<0.001
Mother Lower 2ndary Educ.	-0.12	<0.001	-0.13	<0.001
Mother Higher 2ndary Educ.	-0.07	<0.001	-0.07	<0.001
Mother Post-2ndary Educ.	-0.02	0.124	-0.05	<0.001
Village (Pop <1500)	0.01	0.791	0.00	0.995
Small Town (Pop <10,000)	-0.03	0.143	0.00	0.942
Large Town (Pop 10,000+)	-0.03	0.279	0.00	0.881
City Outside Dublin	-0.04	0.346	-0.07	0.046
Dublin City	-0.06	0.135	-0.06	0.135
Haase Deprivation Index	0.00	0.632	0.00	0.833
Constant	-0.47	0.001	-0.68	<0.001
N Individuals		3815		4031
N Areas		733		714
R2 Within		3%		5%
R2 Between		8%		9%
R2 Overall		5%		7%
% Variance Explained by Area Differences		34%		28%

Table 4.2 gives the results of the model of child's dietary quality (separately for boys and girls) including a variable for the effect of distance to the nearest supermarket. It is interesting to note that having an older mother is important in improving dietary quality, but only for girls. On the other hand, mother's level of education is very important for both boys and girls, even controlling for household social class and income; lower educational levels are associated with a significantly worse dietary quality.

The top line of *Table 4.2* gives the coefficient associated with distance to nearest supermarket. This is not significant for boys and essentially zero, while for girls it is significant and negative at -0.02; i.e. dietary quality falls as the distance to a supermarket increases. This is an elasticity (the proportionate change in diet for a unit change in distance) of around .2 or 20% (for a doubling of the distance between child's home and shops, dietary quality will fall by 20%) which is a great deal higher than the 1% elasticity found by Layte et al (2011) for the adult population.

Table 4.3 gives the results for the model estimating the effect for distance to convenience stores. As expected, this reports very similar findings to Table 4.2 (all variables but one are the same). As for distance to supermarkets, distance to convenience stores is only significant among girls, but the coefficient is around half the size of that for supermarket distance at -0.01, around a 10% elasticity. It appears that convenience-store access is less important as a determinant of dietary quality than supermarket access, but is still significant. The discussion earlier showed that convenience stores tend to stock a higher proportion of convenience foods with higher salt/fat/sugar content compared to supermarkets (as well as being more expensive). Research by the Irish Competition Authority (Competition Authority 2008) also shows that the supermarkets have a larger share of the grocery market, so most households will do most of their shopping in a supermarket and buy less food locally at a convenience store.

Table 4.3: Model of Child's Dietary Quality (Fixed Effects – Convenience Store Model)

	Boys		Girls	
Variable	**Estimate**	**Signif.**	**Estimate**	**Signif.**
Distance to Convenience Store (m)	0.00	0.53	-0.01	0.014
Mother Aged 30-39	-0.01	0.804	0.05	0.021
Mother Aged 40-49	0.01	0.8	0.06	0.008
Mother Aged 50+	0.06	0.149	0.07	0.054
HH Managerial and Technical	-0.01	0.479	0.00	0.847
HH Non-Manual	-0.03	0.09	-0.01	0.436
HH Skilled Manual	-0.04	0.072	0.00	0.822
HH Semi and Unskilled	-0.05	0.03	-0.02	0.303
HH Unclassified	-0.06	0.063	0.00	0.995
Log of Household Income	0.01	0.345	0.04	<0.001
Mother Lower 2ndary Educ.	-0.12	<0.001	-0.13	<0.001
Mother Higher 2ndary Educ.	-0.07	<0.001	-0.07	<0.001
Mother Post-2ndary Educ.	-0.02	0.132	-0.05	<0.001
Village (Pop <1500)	0.01	0.656	-0.01	0.615
Small Town (Pop <10,000)	-0.02	0.296	0.00	0.898
Large Town (Pop 10,000+)	-0.02	0.5	0.00	1
City Outside Dublin	-0.03	0.502	-0.07	0.056
Dublin City	-0.05	0.207	-0.05	0.162
Haase Deprivation Index	0.00	0.726	0.00	0.775
Constant	-0.54	<0.001	-0.72	<0.001
N Individuals		3815		4031
N Areas		733		714
R2 Within		3%		5%
R2 Between		8%		9%
R2 Overall		5%		7%
% Variance Explained by Area Differences		34%		29%

4.6 SUMMARY AND CONCLUSIONS

Economic resources at the household and individual level have a significant impact on the economic affordability of food, and thus shape the quality and quantity of food consumed by children. However, the local food environment may also shape the availability of different types of foodstuffs, their cost and quality net of individual and household characteristics. If so, even socio-economically advantaged households in poorly served communities may have a poorer diet than their peers in better-served areas. This would imply that poorer households in poorer areas are doubly disadvantaged in terms of diet and nutrition. Studies of the local food environment in the US have found variations in the number and kinds of shops across communities which differ by socioeconomic status, and that these variations independently contribute to differentials in diet and nutrition at the individual level. However, these results had not been replicated outside of North America until recently. This study is the first, to our knowledge, to show the effect of local food environment on children's dietary quality.

That the effect of distance appears to apply to girls only is both important and troubling. Boys' diets are on average worse than girls' (just as men's are worse than women's on average) irrespective of parental class and income (Harrington et al. 2008), although there are socio-economic gradients in dietary quality among boys. Given this, it would be reasonable to think that at least some of the effect could be explained by food access in the local area, but the results suggest not. The results do not appear to be related to the use of control variables in the model.

The negative association of distance to shops with diet in this study could suggest that Ireland is closer to the USA than it is to European countries in this regard. There is some research for Ireland which has suggested that Irish urban planning and development has had a negative influence on food availability by allowing large out-of-town shopping facilities to develop at the expense of smaller shops within urban areas (Poole & Parker 1990). It may be that the increased distances involved in buying food along with social segregation have had a negative impact on the diets of Irish citizens and poorer citizens in particular. This may have contributed to inequalities in health in Ireland.

Chapter 5

THE PERCEPTION OF CHILD OVERWEIGHT AND OBESITY AND ITS ASSOCIATION WITH CHILD SELF-CONCEPT AND PSYCHOLOGICAL ADJUSTMENT

5.1 INTRODUCTION

Research on the psychological consequences of obesity has a long history but the amount of research has increased substantially over the last two decades as the extent of the increase in average BMI among children has been fully realised. In the early 1970s Lerner (Lerner 1972; Lerner 1973) presented a theoretical framework within which to understand the relationship between physical appearance and psycho-social function; this was extended to children by Baum and Forehand in the early 1980s (Baum & Forehand 1984). They also showed that obese children received more negative peer reactions and had lower self-esteem than non-obese children.

Following Baum and Forehand (Baum & Forehand 1984), a number of studies have sought to understand the multi-dimensionality of child self-esteem and the way in which it might be affected by obesity. Different domains of self-esteem have been put forward and research suggests that negative experiences in these domains can have a substantial impact on the self-concept of the child. As the child's age increases, it appears that physical appearance and attractiveness become more important, but results are inconsistent. Although obesity in childhood does seem to have negative consequences for self-esteem, the prevalence and magnitude of the relationship varies. Early studies (Allon 1979;Sallade 1973;Strauss et al. 1985) showed decreased levels of self-esteem in obese children, but other studies found no simple relationship between weight status and self-esteem (Mendelson & White 1982;Wadden et al. 1984). More recently, a meta-analysis of studies of obesity using a global measure of self-esteem found a statistically significant relationship in a majority of studies (Miller & Downey 1999) but the relationship was modest. The review showed that the association increased with age and was strongest among adolescents, young adults and female children.

Studies suggest that the relationship between child obesity and self-esteem varies by family socio-economic status and ethnic group (Strauss 2000), but it also appears that the relatively modest relationship between self-esteem or self-concept and obesity stems in part from the complexity of measuring both self-esteem and overweight/obesity. First, the child's physical height and weight does not translate automatically into an overweight self-identity. A number of studies have shown that both the child's own and their parent's perceptions of their weight status often fail to overlap with the weight status found in biometric tests (Huang et al. 2007;Maynard et al. 2003;Meizi & Evans 2007) and this can affect the development of the child's self-concept, which is itself multi-dimensional. Given that overweight and obesity are likely to be only one factor influencing the child's self-esteem among a plethora of other variables, it is perhaps unsurprising that weight status does not translate directly into lowered self-esteem.

The child's own perception of their weight status and its impact on their self-concept and self-esteem may influence and be influenced by their peers. Research suggests that victimisation on the grounds of body size (both for fatness and thinness) may be relatively common and have a significant impact on the self-esteem of the child being teased. One US study (Hill & Murphy 2000) found that 12% of girls and 16% of boys identified with the description of themselves as a 'fat-teased child'. Interestingly, although these children were heavier than their non-teased peers, less than one-half were either overweight or obese. This research also showed that fat-teased children had lower global assessments of self-worth and lower perceived competence in all the domains in the study except behavioural conduct.

In the last decade, an increasing number of studies have sought to examine whether overweight and obesity is associated with a higher prevalence of psycho-pathology and emotional and behavioural problems among children. A number of studies have found relationships between conditions such as attention deficit/hyperactive disorder (Rojo et al. 2006), peer relationship problems (Boneberger et al. 2009), depression (Sjöberg, Nilsson, & Leppert 2005), emotional and behavioural problems (Griffiths, Dezateux, & Hill 2010;Pitrou et al. 2010) and childhood overweight and obesity. Unfortunately, this research has largely failed to shed light on the processes that underlie these relationships or, indeed, whether the psycho-pathology leads to the child's weight status.

In this chapter we begin with an analysis of the overlap between the parent's perception of their child's weight status, the child's own perception and the child's actual BMI. Results show substantial misalignment and so analyses examine whether the extent of overlap can be explained by other factors. The chapter then examines the relationship between actual and perceived weight status and the child's self-concept and self-esteem. This analysis is used to develop a hypothesis about the role of self-concept in mediating the relationship between weight status and the prevalence of emotional and behavioural problems. The last section of the chapter tests this hypothesis using a conceptual model and path-analytic techniques.

5.2 PARENT'S PERCEPTION OF THEIR CHILD'S WEIGHT STATUS

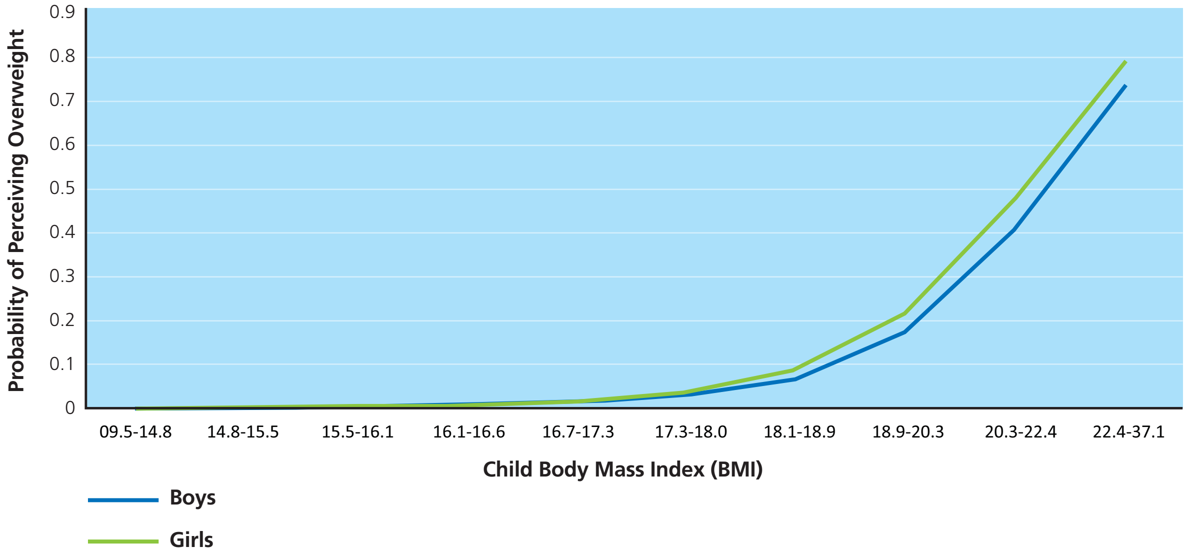
The chapter begins by studying the parent's perception of their child's weight status and the factors that influence this. It would be expected that, as the child's measured weight status increases, this would be recognised by the parent, but this need not necessarily be so, for the reasons discussed above. Since recognition of an issue is the first step in dealing with it, non-recognition of child adiposity may contribute to increasing overweight among children. *Table 5.1* gives the response of parents when asked directly whether they thought their child was 'underweight', 'overweight' or 'about the right weight'. Parents were given gradations of under- and overweight (very, moderately, slightly) but these responses are collapsed into three categories to avoid small numbers of cases in some groups. The results show that the assessments of some parents disagree significantly with an assessment based on BMI. Less than 2% of the parents of children classed as overweight or obese by BMI report that their child is underweight. However, 54% of parents of overweight children and 20% of parents of obese children report that they are 'about the right' weight for their height.

Table 5.1: Mother's Perception of Child Weight Status by Child's Measured BMI

	Underweight	About Right	Overweight	Total
Healthy	14.1	83.4	2.5	100
Overweight	1.7	54.1	44.2	100
Obese	2.0	19.5	78.5	100
All	11.0	73.7	15.4	100
N	874	6,078	1,183	8135

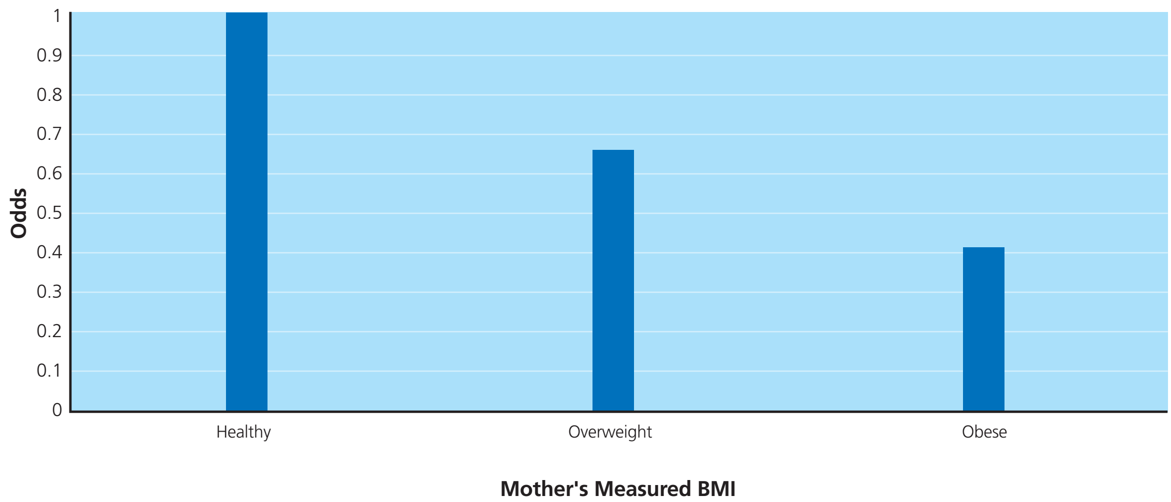
The fact that a fifth of parents whose child is measured to be obese believe them to be 'about right' suggests that the perception that the child is overweight can be influenced by other factors. If the child's actual body weight is held constant, it is possible to examine how the propensity to identify the child as under- or overweight varies with other factors. This can be done using a statistical model which predicts the probability that parents see their child as overweight, while controlling for the child's actual measured BMI as well as other factors that may be of interest. For example, does the sex of the child make a difference to the assessment of parents? Awareness of female body size and shape has tended to be more acute than perception of male body shape, so girls may be more likely to be perceived as overweight at any given BMI than their male peers. *Figure 5.1* shows that this is indeed so, with the probability that mothers will perceive their child as overweight higher for daughters than sons at each level of BMI after a score of around 19. This is just under the International Obesity Task Force (IOTF) cut-off for overweight used in this report. There is some steepening of the curve at a BMI of around 20 but none thereafter, which suggests that the IOTF cut-off for obesity at 23.5 is not perceived as significant by parents.

Figure 5.1: Probability of Mother Perceiving Child as Overweight by Measured BMI and Child Sex



Other factors are also important for parental assessment of whether the child is overweight.[4] Controlling for the child's measured BMI, mothers are less likely to perceive that their child is overweight if they are themselves overweight or obese. Interestingly, this effect only appears to occur for girls and not boys. As shown by *Figure 5.2*, among girls, an overweight mother is 35% less likely than a 'healthy' BMI mother to class her daughter as overweight. An obese mother is 59% less likely to class her daughter as overweight than her 'healthy' weight peer.

Figure 5.2: Odds of Mother Perceiving Daughter as Overweight by Own BMI (Controlling for Child BMI)



[4] These results are based on multinomial logistic models of the probability of the child's primary caregiver perceiving the child to be underweight or overweight rather than 'about the right weight'. Full models can be found in Appendix 1.

This result suggests that the perception of the child's weight status depends, to a certain extent, on who they are being compared to. A mother who is herself overweight is thus less likely to see her daughter as overweight even though she is, by clinical measurement. The same logic suggests that father's weight status may also influence the assessment. However, analysis (see Appendix One) shows that father's BMI appears to have no statistically significant impact. Children from working-class households (see Chapter Two) are more likely to be overweight and obese, which could suggest that mothers in such households would be less likely to perceive overweight. Once again though, analysis shows that, controlling for the child's actual weight and other factors, social class has no impact on the perception of overweight by the mother (see Appendix 1).

5.3 WHAT INFLUENCES THE CHILD'S PERCEPTION OF THEIR OWN WEIGHT STATUS?

The perception of the child of their own weight status is likely to have implications for their social and emotional well-being. *Table 5.2* shows the relationship between the child's observed BMI (healthy, overweight, obese) and their own perception of their weight status. Children were asked 'how would you describe yourself?' and were offered five options, from 'very skinny' to 'very overweight' via 'a bit skinny/overweight' and 'just the right size'. For analysis, the 'a bit' and 'very' responses have been collapsed to make three categories: 'underweight', 'about right' and 'overweight'.

Table 5.2: Child's Own Perception of Weight Status by Child's Measured BMI

	Underweight	About Right	Overweight	Total
Healthy	24.7	70.8	4.5	100
Overweight	7.4	78.0	14.6	100
Obese	5.2	60.1	34.7	100
All	20.2	71.5	8.3	100
N	1,542	5,916	623	8081

Table 5.2 suggests that the children themselves are worse judges of their weight status than their parents. Of those measured as overweight using IOTF cut-offs, only 15% perceive themselves to be overweight. For those measured as obese, the proportion perceiving themselves as overweight increases to 35%, but this means that 65% see themselves as 'about right' or underweight.

Figure 5.3: Probability of Child Perceiving Themselves as Overweight by Actual BMI and Child Sex

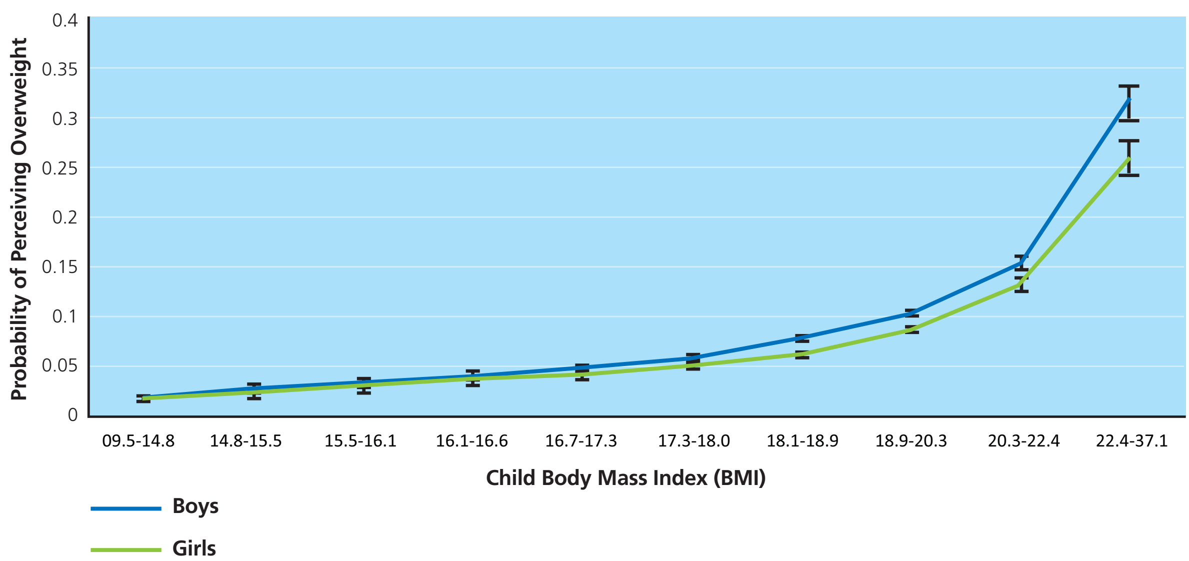


Figure 5.3 compares boys' and girls' perceptions of overweight and shows that boys are significantly more likely to perceive themselves as overweight at each level of BMI than are girls. This is a surprising finding as it is assumed that girls are more weight-conscious than boys, but it may reflect the fact that girls are more likely to be overweight and obese than boys, and thus that their relative assessment of overweight is set marginally higher. It is interesting, for instance, that the slope of the girls' curve in *Figure 5.3* is less steep after a BMI of 22.5 than is the boys', suggesting that sensitivity to perception of obesity is lower among girls.

As with parental judgements, we can assess the role of other factors in the child's perception of their own weight alongside the impact of measured BMI, using a statistical model (see Appendix 2). The mother's age was significant for her perception and may influence the child so this is included in the model, as is her level of education. To examine the effect of parental overweight, measures of the parents' BMI are added to the model, as are the mother's perception of the child's weight.

Mothers' characteristics and perceptions appear to be very important in determining the child's perception of weight status (see Appendix 2).[5] For example, among boys, having a mother who is overweight increases the likelihood that they will see themselves as underweight (controlling for the child's BMI), perhaps suggesting a process of relative comparison. It is unclear why this would not happen for girls, or why fathers' weight appears not to influence their son's, although results do suggest that having an obese father raises the likelihood the son will see himself as overweight.

Mother's age and education both have an influence on child assessments. Daughters of older mothers appear less likely to perceive themselves as overweight (controlling for their actual weight), while daughters of more educated mothers appear less likely to see themselves as underweight. There appears to be a graduated relationship, with more education leading to a shrinking perception of underweight among daughters. Mothers' assessments of their child's weight also clearly affect the child's self-assessment. Net of their actual weight, if the mother perceives her son to be underweight, he is five times more likely to see himself as such. Similarly, if the mother perceives her son to be overweight, he is 3.7 times more likely to believe this himself. In comparison, girl's assessments appear less influenced by their mother's, although the mother's opinion still plays a significant role. If the mother perceives her daughter to be underweight, the girl is four times more likely to see herself as such, and 2.5 times more likely to see herself as overweight if this is her mother's perception.

5.4 OVERWEIGHT, OBESITY AND THE CHILD'S SELF-CONCEPT

An extensive literature now suggests that the perception of under- or overweight can have an important influence on the development of child self-concept and self-esteem. The ***GUI*** study of nine-year-old children included the Piers-Harris Children's Self-Concept Scale (2nd edition). This is a 60-item self-report questionnaire for assessing 'self-concept' (which includes dimensions of self-esteem). Self-concept can be thought of as a set of attitudes and beliefs that children hold about themselves which are relatively stable over time. The Piers-Harris includes six sub-scales which can be summed together to form an overall or 'total score'. It is possible that the child's weight status could have an influence on all six sub-scales through different processes. Rather than trying to examine all the possible influences, here we concentrate on just two sub-scales: physical appearance and popularity, which the research literature suggests are more directly related to the experience of overweight and obesity among children:

- *Physical appearance and attributes* – a sub-scale of 11 items about perceptions of physical appearance and other attributes such as leadership and ability to express ideas
- *Popularity* – a sub-scale of 12 items exploring the study child's evaluation of his or her social functioning

[5] Results in this section are based on a multinomial logistic model of the probability that children will perceive themselves to be underweight and overweight relative to being 'about the right weight'.

Combined, these scales are constructed from 23 different question items, each of which is an imperfect measure of the underlying or latent scale, but which together provide a more reliable measure. The two sub-scales have very good levels of reliability, with Cronbach's alpha scores of .75 (physical) and .74 (popularity).

The hypothesis in this section is that child overweight and obesity will be associated with a lower self-concept on our three Piers-Harris scales of interest. However, the perception of overweight should have a more significant effect on self-concept than the simple fact of having a height and weight that translate into overweight and obese status, using the IOTF cut-offs. To examine this question requires a multivariate statistical methodology that controls for the child's actual weight while measuring the effect of the child perceiving themselves as overweight. Results showed that BMI does have a significant negative effect on each of the Piers-Harris scales, i.e. the child's self-concept worsens as BMI increases. However, once we control for the perception of overweight and underweight, the child's actual BMI ceases to be significantly related to each sub-scale, whereas the perception variable remains very significant and predictive.

Table 5.3: Effect of Perception of Underweight or Overweight

(Relative to 'About the Right Weight') on Piers-Harris Scores by Sex and Piers-Harris Sub-Scale

	Underweight		Overweight	
	Boys	Girls	Boys	Girls
Physical	-0.58 n.s	-0.54 n.s	-3.76**	-3.23***
Popularity	-0.95 n.s	-2.05 **	-3.52 ***	-3.88 ***

*Significance Key: n.s=Not Significant; *=P<0.05; **=P<0.01; ***=P<0.001*

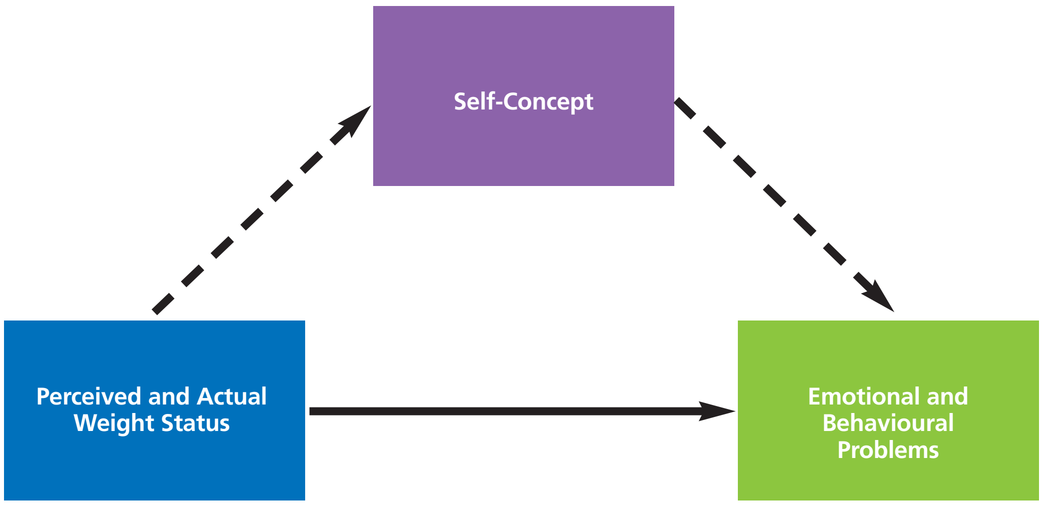
Table 5.3 shows the negative effect of the child believing that they are either underweight or overweight relative to believing that they are 'about the right weight', for each sub-scale. In each case, apart from the effect of being underweight on physical appearance (and popularity among boys), the belief that the child is under- or overweight is associated with a significantly negative effect relative to those children who perceive themselves to be 'about the right weight'. This effect is particularly pronounced for children who perceive themselves to be overweight. Although the effect of overweight on physical self-concept appears to vary between boys and girls, analysis comparing the interaction effect between sex and overweight in the models showed no significant difference.

5.5 OVERWEIGHT, OBESITY AND PSYCHOLOGICAL ADJUSTMENT

The discussion in the introduction to this chapter showed that there is already an established literature about the association between child obesity and higher levels of child emotional and behavioural problems, but the processes linking the two phenomena are not well understood and there is little discussion of causality in the literature. It is possible, for instance, that the emotional and behavioural problems identified among obese children in previous research could themselves contribute to the risk of obesity. Higher levels of emotionality or hyperactivity can contribute to problematic relationships to food and diet (Griffiths, Dezateux, & Hill 2010;Pitrou, Shojaei, Wazana, Gilbert, & Kovess-Masf 2010). The current ***GUI*** data are cross-sectional and this means it is not possible to be certain of the causal direction. This section examines whether overweight and obesity are associated with more externalising and internalising psychological states and, if so, whether this association can be accounted for by the lower self-esteem of overweight and obese children.

The following analyses examine these hypotheses by measuring the degree to which poor self-concept and bullying by other children mediates the relationship between the child's actual and perceived weight status and their level of emotional and behavioural difficulties. This is done using a multivariate analytical technique known as 'path-analysis', which measures both the direct and indirect effect of one factor on another. The technique does not compensate for the cross-sectional nature of the data but, if self-concept does mediate the process, this would suggest that it plays an important role in the relationship between behavioural problems and child weight status.

Figure 5.4: A Conceptual Model of the Direct and Indirect Relationship between Weight Status and Child Emotional and Behavioural Problems



Direct relationship – solid line; indirect – broken line

The hypothesis that weight status leads to higher levels of emotional and behavioural problems indirectly, via the child's self-concept, rather than directly, is shown schematically in *Figure 5.4*. Child emotional and behavioural problems are measured here using the Strengths and Difficulties Questionnaire (SDQ). The SDQ is a relatively brief (25-item) behavioural screening questionnaire designed to measure psychological adjustment in children aged 3-16 years (Goodman 1997). The instrument produces scores for each of five sub-scales scored on a scale from zero to 10: emotional symptoms, conduct problems, hyperactivity/inattention, peer problems and pro-social behaviour. A total difficulties score is obtained by summing scores across the four deficit-focused scales (i.e. all except the pro-social behaviour scale), giving a score between zero and 40. The SDQ is psychometrically well validated with good internal consistency and reliability. It has a robust factor structure and produces scores that are stable over time. In addition, it has been shown to correlate strongly with longer instruments such as the Child Behaviour Checklist (Goodman & Scott 1999;Klasen et al. 2000;Koskelainen, Sourander, & Kaljonen 2001;Becker et al. 2004), to differentiate well between clinical and community-based samples (Goodman 1997;Goodman & Scott 1999;Klasen, Woerner, Wolke, Meyer, Overmeyer, Kaschnitz, Rothenberger, & Goodman 2000) and to be sensitive to changes in behaviour following intervention (Mathai, Anderson, & Bourne 2002).

5.6 ASSESSING THE DIRECT AND INDIRECT EFFECTS OF ACTUAL AND PERCEIVED WEIGHT STATUS ON EMOTIONAL AND BEHAVIOURAL DIFFICULTIES

To test the hypothesis about the relationship between the child's actual and perceived weight status, three separate equations are estimated to assess the mediating influence of the two Piers-Harris scales (physical and popularity) on the effect of weight status on psychological adjustment. The analysis yields a total effect for each variable plus a breakdown of the direct and indirect effects of the weight status variables via the two Piers-Harris scales (see Appendix 3 for full results). Previous research has found that overweight children are both more likely to be bullied and to be bullies themselves. To control for the distribution of bullying, which can itself be related to emotional and behavioural problems, a variable representing whether the child is a bully, a victim or both is entered into the models.

Earlier analyses of self-concept in this chapter showed that measured overweight or obesity was unimportant once the child's perception of under- or overweight was controlled for. Appendix 3 shows that this is also the case in the path analyses where the self-perception of weight status has both direct and indirect effects on emotional and behavioural problems, whereas actual weight status only has a direct effect. This suggests that there may be reverse causality, with emotional and behavioural difficulties and weight status correlated because of their relationship with a third variable which is influencing the likelihood of both. To put this another way, the child may be overweight for the same reason that they have emotional and behavioural problems, because some other condition, environmental or personality factor is raising their likelihood of both outcomes.

As found earlier in this section, the perception of child weight status has a direct effect on the two Piers-Harris scales (only popularity is influenced significantly by actual weight status), with negative effects in all cases. Perhaps more importantly for the hypothesis, the self-perception of under- or overweight also significantly increases emotional and behavioural problems indirectly via the self-concept scales. Indeed, the perception of being overweight appears to influence emotional and behavioural difficulties indirectly only (the direct effect is insignificant). The total effect of perceived weight status on the SDQ scales is the sum of the direct and indirect effects. It is possible to calculate the proportion of the total effect accounted for by each. Doing this shows that, whereas the indirect effect of the child perceiving themselves to be underweight is low, only 29% of the total, a majority of the effect of perceiving themselves to be overweight comes via their self-concept, or 59% of the total.

5.7 SUMMARY AND CONCLUSIONS

Although the physical health consequences of overweight and obesity tend to be those that garner the headlines, this chapter has shown that the emotional and behavioural consequences can be problematic also. The analyses in this chapter showed that the relationship between the child's measured BMI and both their own and their parents' perception of their weight status is less than perfect. Although the proportion of parents reporting that their child is overweight increases with the child's measured BMI, a majority of mothers still perceive their child's weight to be 'about right' when they are measured to be overweight. A fifth perceive their child to be 'about right' weight when they are measured as obese. Among children, the overlap between their perceived weight status and the measured values are even looser. This means that, even among those measured to be obese, only around a third report that they think themselves to be overweight. It is possible that the lack of overlap on both measures is a measurement problem, i.e. measured BMI does not easily translate into an overweight 'shape', or parents or children know they are overweight but think this acceptable and appropriate. However, it may also be that perception of weight status is influenced by other factors which bias weight perception. Perception of female children's weight seems to be more acute than that of male children's, perhaps because of differences in Irish society about appropriate body size between the genders, but judgements about weight are also influenced by what children are compared to. Analyses here clearly show that overweight mothers are less likely to perceive their daughter as overweight, perhaps because their perception of what is 'normal' or average has been biased upwards. This is a concern, as the proportion of the adult population who are overweight and obese has been increasing for some time. Since action to reduce overweight will begin by recognising the problem, growing adult obesity could present a difficulty.

Analysis of child perception of overweight shows that the increase in the likelihood of perceiving overweight as actual BMI increases is less steep among girls than boys. Given that rates of overweight are higher among girls, this could suggest that their perception of overweight has been biased by a general increase in the prevalence among girls. Maternal views also clearly influence the child's own perception of their weight. If the mother perceives their child to be underweight or overweight, this significantly increases the likelihood that the child will agree, underlining the importance of making sure that mothers are aware of child weight from a public health perspective.

Does the perception of overweight influence child self-concept? Our results suggest that it does, with overweight and obesity leading to worse self-concept across two important domains. Our results show that children's beliefs about themselves are quite robust. Even where children perceive themselves to be overweight or underweight only a minority endorse negative statements about themselves. Measured using appropriate scales however, our results show that being overweight and knowing that this is the case, is damaging to self-concept. Does this effect have implications for broader psychological adjustment? Analyses here show that it does. The perception of overweight is associated with an increase in the level of emotional and behavioural problems, with the majority of this effect for overweight children being mediated by the effect of perceived overweight on self-concept.

APPENDIX ONE

Multinomial Logistic Regression of Mother Perceiving Child to be Underweight or Overweight Compared to Being 'about the right weight', by Child Sex

	Boys Model				Girls Model			
	Underweight		Overweight		Underweight		Overweight	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Mother Aged <30 (Ref.)	1.00		1.00		1.00		1.00	
Mother Aged 30-39	0.39	0.08	1.27	0.713	1.19	0.75	0.84	0.703
Mother Aged 40-49	0.30	0.023	1.05	0.939	1.07	0.897	0.86	0.749
Mother Aged 50+	0.33	0.086	2.39	0.296	1.04	0.962	1.00	0.995
HH Professional (Ref.)	1.00		1.00		1.00		1.00	
HH Managerial and Technical	1.00	0.986	0.80	0.462	1.02	0.924	0.93	0.75
HH Non-Manual	0.90	0.702	0.64	0.178	1.32	0.309	0.65	0.095
HH Skilled Manual	1.14	0.601	0.75	0.409	1.27	0.364	0.98	0.938
HH Semi and Unskilled	1.45	0.223	0.50	0.091	1.84	0.061	0.58	0.133
HH Unclassified	4.35	0.039	1.39	0.694	1.03	0.965	1.16	0.826
Mother BMI – Healthy (Ref.)	1.00		1.00		1.00		1.00	
Mother BMI – Overweight	0.69	0.033	0.79	0.343	0.68	0.083	0.65	0.048
Mother BMI – Obese	0.44	0.002	0.66	0.216	0.44	0.018	0.41	0.002
Father BMI – Healthy (Ref.)	1.00		1.00		1.00		1.00	
Father BMI – Overweight	1.13	0.521	0.94	0.832	0.83	0.395	1.06	0.811
Father BMI – Obese	0.86	0.558	0.60	0.13	0.66	0.204	0.67	0.177
Child's BMI – Healthy (Ref.)	1.00		1.00		1.00		1.00	
Child's BMI – Overweight	0.22	0.001	45.50	<0.001	0.20	<0.001	26.10	<0.001
Child's BMI – Obese	0.46	0.318	229.38	<0.001	0.84	0.765	123.80	<0.001
Mother Per. Self Underweight	1.72	0.105	1.19	0.719	1.65	0.154	0.76	0.561
Mother Per. Self Healthy Weight (Ref.)	1.00		1.00		1.00		1.00	
Mother Per. Self Slightly Overweight	2.04	<0.001	1.92	0.01	1.32	0.205	2.18	<0.001
Mother Per. Self Moderately Overweight	2.85	<0.001	2.21	0.025	1.99	0.034	4.11	<0.001
Mother Per. Self Very Overweight	3.93	0.004	3.93	0.009	3.89	0.002	3.39	0.003
Father Per. Self Underweight	1.36	0.309	1.35	0.506	2.23	0.003	1.37	0.365
Father Per. Self Healthy Weight (Ref.)	1.00		1.00		1.00		1.00	
Father Per. Self Slightly Overweight	1.02	0.904	1.98	0.007	1.37	0.112	1.08	0.679
Father Per. Self Moderately Overweight	1.17	0.532	1.98	0.037	1.67	0.166	1.63	0.066
Father Per. Self Very Overweight	1.13	0.798	2.21	0.141	2.32	0.093	2.18	0.095
N	**2997**				**2992**			

APPENDIX TWO

Multinomial Logistic Regression of Child Perceiving Themselves to be Underweight or Overweight Compared to Being 'about the right weight', by Child Sex

	Boys Model				Girls Model			
	Underweight		Overweight		Underweight		Overweight	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Mother Aged <30 (Ref.)								
Mother Aged 30-39	0.66	0.459	0.88	0.841	0.41	0.045	0.23	0.032
Mother Aged 40-49	0.67	0.473	0.59	0.423	0.42	0.05	0.26	0.044
Mother Aged 50+	0.97	0.964	0.36	0.207	0.61	0.545	0.09	0.001
Mother Lower 2nd Educ. (Ref.)	1.00		1.00		1.00		1.00	
Mother Upper 2nd Educ.	0.65	0.01	0.82	0.4	0.71	0.047	0.73	0.216
Mother Post 2nd Educ.	0.80	0.215	0.90	0.7	0.78	0.18	0.76	0.344
Mother 3rd Level Educ.	0.80	0.218	0.85	0.525	0.55	0.001	0.76	0.308
Mother BMI – Healthy (Ref.)	1.00		1.00		1.00		1.00	
Mother BMI – Overweight	1.26	0.07	1.14	0.512	1.00	0.987	0.99	0.967
Mother BMI – Obese	1.41	0.034	0.87	0.552	1.20	0.308	1.09	0.716
Father BMI – Healthy (ref.)	1.00		1.00		1.00		1.00	
Father BMI – Overweight	0.93	0.649	1.28	0.301	0.91	0.581	0.70	0.209
Father BMI – Obese	1.16	0.36	1.57	0.092	0.97	0.851	1.08	0.799
Child's BMI – Overweight	0.44	<0.001	1.70	0.034	0.28	<0.001	1.45	0.2
Child's BMI – Obese	0.37	0.063	4.40	<0.001	0.29	0.003	3.65	0.001
Mother Perceives Child Norm. (Ref.)	1.00		1.00		1.00		1.00	
Mother Perceives Child Underweight	5.01	<0.001	1.35	0.455	3.96	<0.001	0.36	0.095
Mother Perceives Child Overweight	0.84	0.522	3.67	<0.001	0.85	0.54	2.47	0.003
N	**3000**				**2991**			

APPENDIX THREE

Maximum Likelihood Path Analytic Model of Strengths and Difficulties Total Score by Mediating Factors

	PH - Physical		PH - Popularity		SDQ - Total	
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
DIRECT EFFECTS						
Child BMI Healthy (Ref.)	Ref.		Ref.		Ref.	
Child BMI Overweight	-0.08	0.86	-0.14	1.46	0.53	2.85
Child BMI Obese	-0.14	1.02	-0.31	1.99	1.38	4.37
Self-Perception: About Right (Ref.)	Ref.		Ref.		Ref.	
Self-Perception: Underweight	-0.13	1.40	-0.36	3.89	0.88	4.77
Self-Perception: Overweight	-0.83	5.30	-0.92	6.24	0.33	1.14
Neither Bully nor Victim (Ref.)					Ref.	
Child Bully Victim					0.93	5.71
Child Bully					0.42	0.97
Child Both Victim and Bully					1.48	5.60
No Chronic Illness (Ref.)					Ref.	
Chronic Illness					2.67	9.63
Male Child (Ref.)					Ref.	
Female Child					-0.52	3.80
Mother <30 (Ref.)					Ref.	
Mother 30-39					-1.20	3.18
Mother Aged 40-49					-2.08	5.49
Mother Aged 50+					-2.17	3.96
HH Professional (Ref.)					Ref.	
HH Managerial and Technical					0.27	1.36
HH Non-Manual					0.45	1.80
HH Skilled Manual					0.32	1.17
HH Semi and Unskilled					0.59	1.92
HH Unclassified					1.24	3.21
Mother Lower 2ndary Educ.					1.99	8.41
Mother Higher 2ndary Educ.					1.03	5.44
Mother Post-2ndary Educ.					0.78	4.05
Mother Third Level Educ. (Ref.)					Ref.	
Piers-Harris: Physical					-0.04	0.96
Piers-Harris: Popularity					-0.35	8.11
Constant	7.74	179.542	8.89	212.247	10.30	19.72
INDIRECT EFFECTS						
	PH - Physical		PH - Popularity			
	Coeff.	t-stat	Coeff.	t-stat		
Child BMI Overweight	0.00	0.62	0.05	1.46		
Child BMI Obese	0.01	0.69	0.11	1.93		
Self-Perception: Underweight	-0.01	0.77	0.12	3.42		
Self-Perception: Overweight	0.03	0.95	0.32	4.82		
Log Likelihood				**-93156.189**		
N				**7516**		
RMSEA				**0.092**		

Chapter 6

POLICY IMPLICATIONS

6.1 INTRODUCTION

The findings of this report have important implications for policy development. In discussing these it should be remembered that the conclusions are based on patterns within cross-sectional data. This means that analyses are of the association between different factors at roughly the same time period, rather than observing change over time. This makes definitive statements about the causal ordering between different factors extremely problematic and means that all findings should be seen as tentative at best. Only when data over different time periods are available in future waves of the ***GUI*** project will it be possible to discuss cause at the individual level.

Nonetheless, it is possible to combine logical inferences from the available data with research from other countries to derive some implications. The implications of our findings for the stabilisation and reduction of rates of overweight and obesity should be discussed in terms of the proximate and distal causes of overweight. In doing this it is useful to bear in mind the conceptual model of Bronfenbrenner (Bronfenbrenner 1979) (outlined in the introduction to the report). It should also be remembered that our discussions centre, for the most part, on the prevention of obesity, not the treatment of children who are already overweight or obese. The latter often requires clinical and medical assistance as well as adjustment of lifestyle and behavioural factors.

The results also support the finding from research in other countries that body shape has an important influence on the peer relations and self-esteem of the child. Once again it should be remembered that the analyses used cross-sectional data and it is entirely possible that the direction of causation actually ran in the opposite direction, with poor peer relations and low self-esteem influencing the adoption of behaviours that led to overweight and obesity. Nonetheless, if the Irish results do support the international findings, low self-esteem may affect the prevalence of emotional and behavioural problems. This has several implications for policy that are discussed below.

6.2 IDENTIFYING OVERWEIGHT AND OBESITY

One very telling and important result was the rather limited overlap between the objective measures of overweight and the child and parent perception of the child's weight status. Over half (54%) of parents whose child was overweight thought that their child's weight status was 'about right'; almost 20% of parents whose child was obese thought their child's weight was 'about right'. Health promotion literature suggests that behaviour change and weight reduction can only come about once the individual recognises the need for change, yet it is clear that many parents have a poor understanding of appropriate body weight.

One reason for this may be the upward trend in the prevalence of adult overweight and obesity. This report shows that mothers who were themselves overweight or obese were less likely to perceive their child as overweight, although, interestingly, this only occurred for girls and not boys. An overweight mother is 35% less likely to perceive her daughter as overweight than a 'healthy' bodyweight mother (controlling for the child's BMI). An obese mother is almost 60% less likely.

It appears that parents need to be better informed about the healthy weight for their child, while stigmatisation of being overweight should be avoided, given the problems this can produce (see below). Accurate parental perception of child weight would be helped if the heights and weights of children were routinely measured when they visit their GP and the parents informed of the child's BMI and its implications for their current and future health. The average nine-year-old visits their GP at least once a year, so the GP or practice nurse would be able to compare the child's height and weight relative to previous visits (assuming an accurate record-keeping system). This would also facilitate the delivery of lifestyle advice to children and parents. If parents were to receive their own BMI at the same time, this would also be positive. Preventative medicine is not an explicit part of the current GMS contract and the fee for service arrangement for private patients offers little incentive to GPs to spend time taking measures and offering advice at present.

The child's school offers another opportunity to measure weight status. Child vaccination and dental and optical checks are already a part of the public health nurse (PHN) routine in Irish schools. Consideration should be given to the inclusion of height and weight measures in this routine. Unlike visits to GPs, checks in schools would not automatically include parents, but nurses could subsequently make contact with parents if appropriate resources were provided.

6.3 PROMOTING BEHAVIOURAL CHANGE

The results in Chapter Three point to the need to decrease levels of sedentary activities, such as watching TV and computer gaming, and to increase physical activity, particularly among girls. Parental reports indicate that around a quarter of boys and a third of girls did light exercise on fewer than 9+ days in the last two weeks. Two-thirds of children aged nine watch between one and three hours of TV on an average weekday night, and one in 10 watches three or more hours a night.

Research on children's sports and exercise in Ireland (Fahey, Delaney, & Gannon 2005) shows that the average primary-school pupil had physical education (PE) lessons once a week. The average second-level child did 69 minutes of PE rather than the 120 minutes recommended. Moreover, girls receive slightly less PE than boys and take part in less extra-curricular sport than boys. These results suggest that lower levels of physical activity is not solely a function of preference and that teachers and schools timetable less exercise than necessary and involve girls less than boys. Not all sport takes place in school, however, and there is differential take-up of sport and exercise by sex and socio-economic group. Retrospective research (Lunn & Layte 2008) has shown that lower-income adults did less sport in school and elsewhere than their higher-income peers from as young as five years of age.

Education and health policy needs to recognise the importance of sport and exercise and make room for this in the school day. Schools also need to think about how to make sport and exercise more attractive to girls. Given the role of non-governmental organisations in providing education in Ireland, this would also require a strategic approach which ensured a consistent level across schools, and particularly those in lower socio-economic and deprived areas. Nonetheless, not all sport occurs within schools. A key challenge for policymakers is the development of an integrated approach to sport and exercise which draws together those involved in sport from inside and outside schools.

Evidence from England suggests that the upward trend in obesity has plateaued among more socially advantaged groups. Studies are ongoing, but this may have occurred because parents heeded public health warnings and intervened to change their own and their children's behaviour. This would suggest that the upward trend in Ireland is not immutable and that education campaigns among parents on issues around diet, physical activity and sedentary activities may be effective as long as parents are given concrete guidelines about children's activities.

The measure of dietary quality in the ***GUI*** study proved to be a weak predictor of the probability of overweight. This may be because diet is not an important contributor in Ireland. However, international evidence suggests that the consumption of energy-dense foods such as high-fat foods, sugary foods and sweetened drinks are a contributor to patterns of obesity. Future research should include full food-frequency questionnaires so that the role of diet in overweight and obesity can be established.

6.4 DEALING WITH THE UNDERLYING DISADVANTAGES

The pronounced socio-economic distribution of the risk factors for obesity suggests that resources for interventions should be heavily targeted at lower socio-economic schools and communities. The Delivering Equality of Opportunity in Schools (DEIS) designation provides an existing mechanism through which this can occur. However, while individual behaviour change is possible, effective prevention should also deal with the wider social and economic factors that promote the development of risk factors for obesity. This will require a far larger effort across a number of agencies that would be facilitated by leadership from a core government department such as the Department of the Taoiseach, in a similar manner to that adopted for 'poverty proofing' under the National Anti-Poverty Strategy.

6.5 CURRENT GOVERNMENT INITIATIVES

A multi-agency approach led by the Department of the Taoiseach, as mentioned above, was one of the recommendations of the National Taskforce on Obesity (NTO) report, 'Obesity: The Policy Challenges' published in 2005. The taskforce examined the issue of obesity in depth across the age spectrum in Ireland. The NTO report highlighted the need for a multi-sectoral approach to obesity prevention and made 93 recommendations across six broad sectors:

- high-level government
- education
- social and community
- health sector
- food, commodities, production and supply
- physical environment

The report of the Inter-Sectoral Group on Implementation 2009 (DoHC 2009) states that the vast majority of these 93 recommendations are being implemented with only 8 identified as not implemented or feasible. However, closer inspection shows that this does not necessarily imply fidelity to the original recommendations. For example, the recommendation of leadership in initiatives by the Department of the Taoiseach was classed as implemented in the review. In fact, leadership was actually given to the Department of Health and an 'inter-sectoral working group' established.

The NTO report also put forward a number of recommendations to increase physical activity in schools, including (as stated above) guidelines for time spent on physical education, and teacher training to support healthy eating and active living. However, the report of the Inter-Sectoral Group on Implementation (2009) notes that this recommendation is "not possible at this time" because of constraints on the time available in the curriculum. One important recommendation was that Home-School-Community Coordinators should incorporate 'healthy life skills' within the wider framework of home visitation and should promote courses and classes for parents. These coordinators work in areas designated as deprived and so would be well placed to facilitate policy interventions targeted at home and school. The report of the Implementation Group states that there has been "significant progress" on this recommendation but it is unclear whether any actual change in practice has occurred.

The original report of the Obesity Taskforce recognised clearly the role of social disadvantage; it recommended that access to a healthy diet be included as an indicator of food poverty in the National Anti-Poverty Strategy. The Implementation report states that this has been accomplished as two items in the Government's measure of consistent poverty relate to food deprivation. Although technically true, these items are general indicators of lifestyle deprivation and are not designed to measure food poverty. The Obesity Taskforce also recommended that the Government review the influence of fiscal policies on

[1] These are based on national level figures from the HIPE system, not GUI survey data.

consumer purchasing and their impact on overweight and obesity. Once again the Implementation report states that this has been "partially" attained whilst failing to identify any research carried out and stating that "the Minister (for Finance) wishes to point out that previous experience in the area of taxing/subsidising foodstuffs indicated this was not a useful approach".

More recently (July 2011) the Minister of Health has announced the establishment of a 'Special Action Group on Obesity' which will investigate issues such as nutritional labelling and calorie posting on restaurant menus as well as the treatment of obesity.

6.6 HEALTH-PROMOTING ENVIRONMENTS

The third chapter of this report showed that the local food environment in the form of distance to food outlets from the child's home had a significant impact on the quality of the child's diet. The greater the distance to food outlets, the worse the quality of the child's diet. Research among adults in Ireland (Layte, Harrington, Sexton, Cullinan, Perry, & Lyons 2011) has shown that Ireland is closer to North America in this respect than to the UK and the rest of Europe. There is little research at present on the local food environment in Ireland, but it may be that past policies and patterns of urban planning have contributed to health-damaging environments, and not just in terms of food environments. For example, relatively low investment in public transport and poor spatial planning have increased the use of cars, which is one reason why only a quarter of children walk or cycle to school.

6.7 PROMOTING HEALTHY WEIGHT STATUS WITHOUT STIGMATISATION

Research shows that children who are overweight or obese are significantly more likely to be bullied than their healthy weight peers. Similarly, children who perceive themselves as either under- or overweight perceive themselves to be physically less attractive and less physically capable, and see themselves as less popular than other children. These effects are associated with an increase in the level of emotional and behavioural problems among overweight children. These problems in turn are associated with worse educational performance and poorer examination results. Although causality cannot be determined from the current results, they suggest that overweight and obesity can have a detrimental effect on child well-being and development far beyond their health.

The data contained in the first wave of the ***GUI*** study of nine-year-old children provide a rich database with which to examine the pattern of overweight and obesity among children in Ireland. Nonetheless, it must be emphasised that the results in this report are based on a single, cross-sectional wave of data and this makes causal inferences problematic at best. The collection of the second wave of data in 2011 will provide longitudinal data which will greatly facilitate policy analysis and development.

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