Breastfeeding and risk of overweight and obesity at nine years of age

Mc Crory Cathal, Dr Richard Layte

PII: S0277-9536(12)00235-3

DOI: 10.1016/j.socscimed.2012.02.048

Reference: SSM 8359

To appear in: *Social Science & Medicine*

Received Date: 5 July 2011

Revised Date: 21 November 2011

Accepted Date: 27 February 2012

Please cite this article as: Cathal, M.C., Layte, D.R., Breastfeeding and risk of overweight and obesity at nine years of age, *Social Science & Medicine* (2012), doi: 10.1016/j.socscimed.2012.02.048

Manuscript Number: 11-01592r1

Breastfeeding and risk of overweight and obesity at nine years of age.

Authors: Dr. Cathal Mc Crory, PhD*; Dr Richard Layte, PhD

Affiliation: The Economic and Social Research Institute
Whitaker Square,
Sir John Rogerson's Quay
Dublin 2
Ireland
Tel: 00353 1 8632027
Fax: 00353 1 8632100

* Corresponding author: cathal.mccrory@esri.ie

Acknowledgements**:** The *Growing Up in Ireland* data have been funded by the Government of Ireland through the Department of Children and Youth Affairs; have been collected under the Statistics Act, 1993, of the Central Statistics Office. The project has been designed and implemented by the joint ESRI-TCD *Growing Up in Ireland* Study Team.

In addition to the funders, the authors would like to thank the entire Growing Up in Ireland Project and Study teams, and the children and families who participated in the study.

Keywords: Ireland; breastfeeding; children; overweight; obesity; body mass index (BMI); cohort study

Breastfeeding and risk of overweight and obesity at nine years of age.

ABSTRACT

Whether breastfeeding is protective against the development of childhood overweight and obesity remains the subject of considerable debate. Although a number of meta-analyses and syntheses of the literature have concluded that the greater preponderance of evidence indicates that breastfeeding reduces the risk of obesity, these findings are by no means conclusive. The present study used data from the Growing Up in Ireland study to examine the relationship between retrospectively recalled breastfeeding data and contemporaneously measured weight status for 7,798 children at nine years of age controlling for a wide range of variables including, socio-demographic factors, the child's own lifestyle-related behaviours, and parental BMI. The results of the multivariable analysis indicated that being breastfed for between 13-25 weeks was associated with a 38 percent ($p<.05$) reduction in the risk of obesity at nine years of age, while being breastfed for 26 weeks or more was associated with a 51 percent ($p<.01$) reduction in the risk of obesity at nine years of age. Moreover, results pointed towards a dose-response patterning in the data for those breastfed in excess of 4 weeks. Possible mechanisms conveying this health benefit include slower patterns of growth among breastfed children, which it is believed, are largely attributable to differences in the composition of human breast milk compared with synthesised formula. The suggestion that the choice of infant feeding method has important implications for health and development is tantalising as it identifies a modifiable health behaviour that is amenable to intervention in primary health care settings and has the potential to improve the health of the population.

INTRODUCTION

The belief that breastfeeding during infancy affords protection against a number of diseases features prominently in the epidemiological literature; there is considerable evidence to support this assertion. Breastfeeding is associated with reduced risk for a number of neonatal infections including gastro-intestinal infections, diarrhoeal infections, and types of extra-intestinal infections (Jackson & Nazar, 2006).

The claim that breastfeeding may protect against obesity in childhood and later life is less well established. Although two separate reviews of the literature (Arenz et al., 2004; Owen et al., 2005) have concluded that having been breastfed as an infant is associated with significantly reduced odds of childhood obesity, these meta-analyses disguise considerable heterogeneity in findings across studies. While Arenz and colleagues calculated an OR of 0.78 (95% CI:

0.71 – 0.85) across the nine studies which met their criteria for inclusion, careful scrutiny of the pattern of results reveals that of the seven studies that included a measure of parental weight status, three reported a statistically significant protective effect of breastfeeding (Bergmann et al., 2003; Gillman et al., 2001; Toschke et al., 2002) and four found that there was no statistically significant effect (Hediger et al., 2001; Li et al 2003a; Poulton & Williams, 2001; O'Callaghan et al., 1997), although the point estimates for all but the study by Li et al suggested a protective effect.

A subsequent review by Owen and collaborators (2005) showed that the pooled OR across 6 studies was markedly reduced when adjusted for socio-economic status, parental BMI and maternal smoking - decreasing from 0.86 (95% CI: 0.81-0.91) to 0.93 (95% CI: 0.88 – 0.99) - but remaining significant. The most heavily weighted of these was the study by Grummer-Strawn & Mei (2004), which involved 177,304 children up to 5 years of age. However, this study only had important covariate information (mother's age, educational attainment, mother's self-reported pre-pregnancy weight, measured height, weight gain during pregnancy, and post-partum smoking) for a subset of the sample (n = 12,587), and crucially, residual confounding cannot not be ruled out.

A further review by Harder and collaborators (2005), which included only those studies where the odds ratio, 95% confidence interval and duration of breastfeeding were reported and which used exclusively formula fed infants as the reference group, also concluded that breastfeeding was protective against obesity with the results of their meta-regression indicating a clear dose-response effect in the data. Each month of breastfeeding was associated with a 4% reduction in risk of overweight averaged across the 17 studies which met their criteria for inclusion. Again though, these studies varied widely in the list of confounders adjusted for, with only 5 of the studies including a control for parental BMI. If we consider only those studies which included adjustment for parental BMI, we find that four of these (i.e. Hediger et al., 2001; Poulton & Williams, 2001; Parsons et al 2003; Wadsworth et al., 1999) did not find any statistically significant effect of breastfeeding when adjusted for confounding factors.

Failure to adjust for parental weight status may be an important shortcoming since parental BMI has been shown to be amongst the strongest determinants of childhood overweight (Danielzik et al., 2002; Li et al., 2009), reflecting the contribution of shared genes and shared environment. What is more, studies have shown that women who are overweight or obese are less likely to breastfeed (Amir & Donath, 2007; Li et al., 2003b). Parental weight status is correlated with a range of familial (e.g. shared diet) and environmental variables (e.g. lifestyle factors) that may mediate the association with childhood overweight. Parents directly influence the types and varieties of foodstuffs to which children are exposed. Research shows that children and parents' dietary intakes are correlated for most nutrients (Oliveria et al., 1992: cited in Taylor et al., 2005); mothers with higher BMI are more likely to give their children low nutrient snacks and to consume more fat as a proportion of food intake (Davison & Birch, 2001). A U.S. study of 2149 children aged 9-19 years participating in the National Health and Growth Study found that the percentage of kilocalories from fat was inversely related to parental education and family income (Crawford et al., 1995). Studies of household food purchases also generally report a positive association between household SES and the quality and variety of purchased foods (Darmon & Drewnowski, 2008). Similarly, studies have documented an inverse association between parental BMI and rates of physical activity in adolescents (Kahn et al., 2008; Williams & Mummery, 2011), which suggests that parental BMI may serve as a proxy for other lifestyle related behaviours that are associated with rates of obesity.

The present study used data from the first wave of the Growing Up in Ireland study, a large nationally representative study of Irish school-children to explore the relationship between breastfeeding exposure and levels of overweight and obesity at nine-years of age controlling for a wide range of potentially confounding variables.

METHOD

Sample

The sample comprised 8,568 nine-year-old school-children participating in the Growing Up in Ireland (GUI) study, a nationally representative cohort study of children living in the Republic of Ireland. The sample was selected through a two-stage sampling method within the national school system. Eligible children were those who were born between 1st November 1997 and 31st October 1998. In the first stage, 1105 primary schools from the national total of 3,177 were selected using a probability proportionate to size (PPS) sampling method. In the second stage, a random sample of eligible children was selected within each school. At the school level, a response rate of 82.3% was achieved, while at the level of the household (i.e. eligible child selected within the school) a total of 57% of children and their families participated in the study. Interviews were carried out with the teacher and parents of the study child. Fieldwork for the school-based component was carried out between March-November 2007, while fieldwork for the home-based phase of data collection ran from July 2007-July 2008. The data were weighted prior to analysis to account for the complex sampling design, which involves the structural adjustment of the sample to the population using Census of Population statistics while maintaining the case base of 8568 children. More detailed information about the sample selection process and derivation of weights is contained in the sampling document that accompanies the anonymised microdata file (ISSDA, 2010). All stages of the Growing Up in Ireland project were approved by the Health Research Board's standing Research Ethics Committee based in Dublin.

Measures

Breastfeeding Measure

Information relating to breastfeeding initiation and duration were obtained retrospectively when the child was nine years of age via parental recall. Parents were asked about whether the child was ever breastfed, even if only for a short time, as well as the total number of weeks for which the child was breastfed. Duration of breastfeeding in weeks was grouped into a 6 level ordered categorical variable: never breastfed, breastfed for 4 weeks or less, breastfed for 5-8 weeks, breastfed for 9-12 weeks, breastfed for 13-25 weeks, and breastfed for 26 weeks or more. Although individual validation of breastfeeding information to an outside source was not possible, analysis of hospital records on the proportion of mothers breastfeeding at discharge following birth for the period during which the study children were born shows strong concurrence by maternal characteristics. Li et al. (2005) examined the validity and reliability of maternal recall of breastfeeding practice across 11 studies with variable recall periods. They found that retrospective report could yield accurate estimates of breastfeeding initiation and duration, particularly when the recall period was within the first three years. Very few studies have examined the validity of maternal recall over more extended periods, though one study found strong concurrence for initiation (85% correctly identified) when infant clinic records were compared with retrospective report 15 years after the event, but that recall of breastfeeding duration was lower with 37% accurately recalling to within one month and 59% accurately recalling to within two months (Tienboon et al., 1994). Nevertheless, Li and colleagues (2005) estimated that the mean difference in breastfeeding duration between recall and the validation standard with a recall period of 6 months was less than a week and increased to 5 weeks with a recall period of 14-15 years.

Measurement of BMI

Height and weight measurements were obtained from the primary and secondary caregiver as well as the study child as part of the household interview by trained interviewers using scientifically calibrated measuring instruments. Weight measurements were recorded to the nearest 0.5 kilogram using a SECA 761 medically approved (Class IIII) flat mechanical scale that graduated in one kilogram increments and had an upper capacity of 150 kilograms. Height was recorded to the nearest millimetre using a Leicester portable height stick. Respondents were asked to remove footwear, headwear and any heavy clothing prior to being measured. The data were screened by the GUI data management team for biologically implausible data prior to deposit in the archive and extreme outliers were set to missing. Valid height and weight measurements were obtained in respect of 94.5 percent of the sample of children.

Definition of overweight and obesity in early childhood

Body mass index (BMI) is the most widely used method for assessing the degree of adiposity in the general population. It is calculated by dividing weight in kilograms by height in metres squared and has been shown to correlate strongly with measures of body fat obtained using direct physiological assessment (Lindsay et al., 2001). There are no universally agreed thresholds for defining overweight and obesity in child and adolescent populations as BMI cut-offs have to be standardised for age, ethnicity and gender. Cole and colleagues (2000) pooled data from six international studies and employed a smoothing procedure to develop age and gender specific cut-offs that dissected the 25 and 30kg/m^2 at 18 years of age. As children could be interviewed at any stage between their ninth and tenth year of age, the IOTF cut-offs for children aged 9.5 years were used in the present analysis. This definition of overweight and obesity has the obvious and desirable benefit of providing internationally comparable estimates of prevalence.

Covariates

Child Variables

A wide range of child, family, cultural and social variables have been found to influence both the propensity to breastfeed and children's BMI status. We chose control variables on the basis of their association with obesity or breastfeeding in the literature, as informed by the most recent reviews of the subject (e.g. Kleiser et al., 2009; Reilly et al., 2005). In addition to the gender of the study child, parent-reported child variables included birth weight in kilograms, which is represented as a dichotomous variable (<2500 grams / >= 2500 grams), gestational period, which is represented as a four level variable (late (42 weeks or more), on-time (37-41 weeks), early (33-36 weeks), very early (32 weeks or less)), the study child's screen time, represented as a four level variable (none/less than an hour/1 hour to less than 3 hours/more than 3 hours). Childhood physical activity level was indexed using a question which asked on how many occasions in the past 14 days the child had done exercise hard enough to make him/her breathe heavily and make his/her heart beat faster, which is represented as a 5 level variable: none/1-2 days/3-5 days/6-8 days/9 or more days. Finally, dietary intake was indexed using a semi-quantitative food frequency questionnaire that asked the parent to recall whether the study child consumed each type of food, once, more than once or not at all in the 24 hour period preceding the interview. We summarised the overall difference in dietary quality by combining the different types of food consumption into a single index of dietary quality with lower scores indicating worse dietary quality. We did this by assigning positive values (1=eaten once, 2=more than once) to foods seen as beneficial (such as fresh fruit, cooked vegetables, raw vegetables/salad) and a negative value to those generally seen as less beneficial (burger, sausage, chips, crisps etc). The range of scores varied from –0.55 to +0.70 with a mean of 0.11 and a standard deviation of 0.17. We then developed a categorical variable by partitioning our measure of dietary quality into tertiles with lower scores indicating worse dietary quality.

Parental Variables

Adult weight status is indexed using the standard Garrow-Webster cut-offs with BMI >= 25.0 and less than 30.0 defining overweight and BMI in excess of 30.0 defining obesity. Some 4.4 percent of primary carers' and 5.4 percent of secondary carers' (in instances in which there was a resident secondary carer) did not have their weight measured during the course of the household interview. Tests showed that these were not missing at random and thus a missing code was used in analysis for this group. Maternal prenatal smoking status was captured via parental recall at nine-years of age and is represented as a three level variable (never smoked, smoked occasionally during pregnancy, smoked daily during pregnancy). Given the small numbers involved in some of the ethnic categories, we use Irish/non-Irish background as a proxy for this.

Socio-Economic Characteristics of the Household

Three different measures of socio-economic status of the child's household are used in the analysis: primary and secondary carer's social class, primary carer's education and household income. Household Social Class was measured using the Irish Central Statistics Office's social class schema and coded using the International Standard Classification of Occupations 1988 (ISCO88). Household social class is established using a dominance procedure. This meant that in two-parent families where both members of the household were economically active, the family's social class group was assigned as the higher of the two. Primary Carer's Level of Education was represented as a four category variable: lower secondary education or less, higher secondary education, post-secondary education, and third level education. Self-reported household net income was adjusted for household size and composition using the modified Organisation for Economic Co-Operation and Development (OECD) equivalence scale and is represented as income quintiles. The primary caregiver's employment status was indexed using a dichotomous variable (not in FT work/in FT work).

Missing Cases Analysis

Non-biological parents and fathers completing the questionnaire were not asked the questions relating to whether the child was breastfed during infancy (n =211). Overall, the degree of missing data was small for most covariates. The exception was household income, which was missing for 626 cases. Consequently, missing values on household income were imputed using the Multiple Imputation UVIS programs implemented in STATA by Royston (2004). Thus, the effective case base for the analyses that follow was 7,798. Inferential statistics reported in the tables have been weighted to take account of the complex survey design.

RESULTS

Mean BMI for the sample of 7,798 nine-year-old children was 17.97 (S.D. = 3.13). The estimated proportion of children in the non-overweight, overweight, and obese categories according to the IOTF cut-offs was 74.3%, 19.0% and 6.6% respectively. Table 1 shows the odds of being classified as overweight or obese for children who were breastfed for variable durations during infancy relative to those who were never breastfed. In unadjusted analysis, with breastfeeding treated as an ordered categorical variable representing varying durations of breastfeeding exposure, breastfeeding for 5 weeks or more was associated with significantly reduced odds of being obese at nine-years of age and a clear dose-response relationship was evident in the data. Those who were breastfed for 5-8 weeks were 47 percent less likely to be obese compared with those who were never breastfed (OR = 0.53 CI_{95} = 0.32-0.89), increasing through 58 percent for those breastfed for between 9-12 weeks (OR = 0.42 CI_{95} = 0.24-0.73), and 13-25 weeks (OR = 0.42 CI_{95} = 0.27-0.64), and 62 percent for those breastfeed in excess of 26 weeks (OR = 0.38 CI_{95} = 0.24-0.62). There was no statistically significant protective effect of breastfeeding against risk of overweight in the crude model.

INSERT TABLE 1 ABOUT HERE

Table 2 shows the probability of being overweight/obese at nine-years of age treated as a binary variable (non-overweight vs overweight/obese) and the probability of having been breastfed as an infant classified as a binary variable (ever vs never) according to important characteristics of the sample. It is evident that rates of overweight/obesity and the probability that a child will have been breastfed as an infant are strongly associated with socio-economic characteristics of the household, and with parental weight status. Other significant predictors included gestational age, prenatal smoking, and child level variables such as the frequency of hard exercise and children's screen time.

INSERT TABLE 2 ABOUT HERE

To determine whether breastfeeding remained protective against childhood overweight and obesity in a multivariate model when considered alongside other putative confounding variables, we performed a multinomial logistic regression analysis using forced entry and robust standard errors to estimate the effect of variable durations of breastfeeding on the probability of being overweight or obese controlling for all other variables in the analysis. The choice of variables to be used in the multivariate model was dependent on their association with breastfeeding in Table 2. The derived estimates are expressed as Adjusted Odds Ratios (AOR) relative to the baseline category (i.e. non-overweight). Table 3 shows the relationship between breastfeeding exposure and risk of overweight and obesity in the full multivariable model, controlling for gestational age, nationality, prenatal smoking, maternal education, household social class, household income, frequency of hard exercise, screen time, the study child's dietary quality, and parental weight status. The final model revealed that breastfeeding for 13 weeks or more was associated with significantly reduced odds of being obese controlling for other factors. Although there was a trend towards a dose-response effect in the data, with breastfeeding in excess of one month associated with decreasing odds of being obese, the relationship was statistically significant only for those who breastfed for 13 weeks or more. Breastfeeding for between 13-25 weeks was associated with a 38 percent reduction in the risk of obesity (AOR = 0.62 CI_{95} = 0.39-0.99; $p<0.05$) in the full multivariable adjusted model while breastfeeding for 26 weeks or more was associated with a 51 percent reduction in the risk of obesity (AOR = 0.49 CI_{95} = 0.29-0.80; $p<0.01$) at nine-years of age.

INSERT TABLE 3 ABOUT HERE

Discussion

This study sought to examine whether being breastfed during infancy was protective against overweight and obesity at nine-years of age using data from a large, nationally representative cohort study in the Republic of Ireland. In agreement with the results of other epidemiologic studies, our analyses indicate that being breastfed for a period in excess of 13 weeks during infancy was associated with a significantly reduced risk of being obese at nine-years of age after controlling for a wide range of potential confounding variables including parental overweight status. Breastfeeding for between 13-25 weeks was associated with a 38 percent reduction in the risk of obesity at nine-years of age in the full multivariable adjusted model, while being breastfed in excess of 26 weeks was associated with a 51 percent reduction in risk of obesity. While being breastfed for less than this amount of time was not associated with any statistically significant protective effect, the results pointed towards a dose-response relationship for children who were breastfed for more than four weeks. It could be argued that the finding of a dose-response gradient in the data adds to our confidence in a causal relationship as it becomes increasingly difficult to envisage how some unobserved variable could explain away the protective effect of breastfeeding at different levels of exposure. Being breastfed was not associated with any statistically significant reduction in the risk of being classified as 'overweight' for any duration of exposure. Why breastfeeding should be protective only at the higher end of the BMI distribution is clearly a topic that requires further examination in subsequent studies (see Beyerlein & Von Kries, 2011).

While the mechanism conferring this protective effect is not well understood, a number of tentative theories have been advanced to account for this phenomenon, which can be broadly characterised as (1) nutritional and (2) behavioural explanations. The first of these suggests that differences in the composition of human breast milk are protective against the development of obesity. The growth acceleration hypothesis (see Singhal & Lanigan, 2007) holds that the protective effect of breastfeeding is a result of a slower pattern of growth among breastfed children relative to those who were bottle fed. Consistent with this proposition, anthropometric studies of early infant growth patterns have established that children who are breastfed gain height and weight more slowly than those who were bottle fed (Ong et al., 2002; Ziegler, 2006), and that the extent of the divergence is such that it can amount to a difference of 600-650 grams by one year of age (Dewey, 1998). It has been suggested that rapid weight gain in early life defined by early centile crossing may predispose to later metabolic risk by bringing forward the timing of the adiposity rebound (Taylor et al., 2005) and a number of longitudinal studies have found that the velocity with which infants cross weight-for-age reference centiles is related to later cardiovascular and metabolic risk (Ong et al., 2000; Stettler et al., 2002).

Given that the energy density of infant formula can be anything from 10-18 percent higher compared with breast milk (Heinig et al., 1993), this represents a plausible etiologic pathway. An alternative hypothesis is that it is the protein density, as opposed to the energy density of infant formula that is causal to increased rates of adiposity in children. Again, research has shown that the concentration of protein is much higher in infant formula compared with breast milk

(Darragh & Moughan, 1996; Feng et al., 2009). Some studies have indicated that it is high intakes of protein, rather than high intakes of energy, fat or carbohydrates that predict early adipose rebound and higher BMI in childhood (Scaglioni et al., 2000). Most of this research is summarised in the excellent paper by Koletzko and colleagues (2009). Other investigators have suggested that it is not breastfeeding per se, but rather, the delayed introduction of complementary foods that may be protective against the development of obesity in later life (Ong et al., 2006; Schack-Nielson et al., 2010; Wilson et al., 1998). Alternatively, it could be that bioactive compounds such as leptin or ghrelin which have a role in satiety and regulation of hunger, occur naturally in human breast milk and are absent in infant formula that underlies the association (see Lawrence, 2010).

Behavioural explanations, by contrast, postulate that the method of infant feeding may lead to different behavioural patterns among breastfed and bottle fed infants, resulting in a predisposition towards obesity risk in later life. Much of this evidence is summarised in Bartok & Ventura (2009). For example, one study showed how dietary intake patterns varied across groups: breastfed children consumed a large feed in the morning followed by smaller feeds over the course of the day, while bottle fed infants consumed the same quantity at regular intervals, suggesting that parental control rather than hunger cues might be driving infant feeding behaviour (Wright et al., 1980). Breastfeeding mothers, by contrast, may be more responsive to children's cues indicating satiety. Consistent with such a hypothesis, several studies have shown that children are able to moderate their consumption of formula feed or breast milk when energy density is increased (Fomon et al., 1975). Furthermore, it has been hypothesised that breastfed children may also regulate the milk production of their mother (e.g. Bergmann et al., 2003). A recent retrospective study, comparing children fed human breast milk directly via the breast (as opposed to indirectly with the bottle), found that the method of feeding could have lasting effects on appetite regulation (Di Santis et al., 2011).

Nevertheless, the possibility cannot be ruled out that some other unmeasured factor accounts for the association and that breastfeeding simply serves as a marker, albeit a powerful marker, of other nutritional or lifestyle related exposures. In trying to locate this study within the broader framework of research examining the benefits of breastfeeding on childhood BMI, it should be acknowledged that this study has a number of limitations. Although we have demonstrated support for the idea that breastfeeding during infancy for a period in excess of 13 weeks is protective against obesity in middle childhood, an obvious limitation is that the study is cross-sectional in nature, examining BMI at only one time point. This is an important qualification because some investigators have speculated that the protective effect of breastfeeding against obesity is weak in early childhood and may not manifest until later in childhood (e.g. Dewey, 2003; Dietz, 2001). Other studies provide tentative support for this proposition (Gillman et al., 2001; Poulton & Williams, 2001), although a recent study by O'Tierney and colleagues (2009), which followed a birth cohort until 60 years of age has complicated the issue further. O'Tierney's group analysed BMI and obesity within sibling pairs discordant for breastfeeding duration and found that a longer period of breastfeeding was associated with lower BMI at one year of age, but this effect had disappeared by 7 years of age. At 60 years of age, being breastfeed for 8 months or longer or for less than 2 months was associated with increased BMI. The reason for these age related variations in obesity risk is an interesting avenue for empirical investigation, ideally in a longitudinal context employing an exclusively breastfed reference group.

Although we used breastfeeding duration as a proxy for dose, this obscures considerable heterogeneity in breastfeeding exposure across individuals. It would be anticipated for example that a child breastfed exclusively for 6 months would receive a higher dose of breast milk on average compared with those who used complementary feeding methods or transitioned to other milks or solid foods earlier. We also lacked a measure of child's age at time of transition to solid foods and were thus unable to examine the claim that it is the delayed introduction of solid foods rather than the nutritional or bioactive properties of breast milk that is protective against obesity.

A real strength of the current study is the large and representative nature of the sample, which accounts for approximately 1/7 of all children born in Ireland between 1997 and 1998. In addition, the reasonably proportionate split between those who were breastfed and those who were not allows for the estimation of robust main effects. We were able to control for multiple possible confounding factors including the child's low dietary quality, screen time and frequency of hard exercise. Perhaps most importantly, we could control for parental BMI, which reflects the confounding influence of genetic inheritance and environment.

The suggestion that the choice of infant feeding method has important implications for child health and development is tantalising as it identifies a modifiable health behaviour that is amenable to intervention and has the potential to improve the health of the population (Lawrence, 2010). However, further experimental research is required to elucidate the causal mechanism and to establish why the effect is apparent at certain ages and not others.

References

Amir L.H. & Donath S. (2007) A systematic review of maternal obesity and breastfeeding intention, initiation and duration. *BMC Pregnancy and Childbirth* **7**, 9.

Arenz, S., Ruckerl, R., Koletzko, B., & von Kries, R. (2004). Breastfeeding and childhood obesity: a systematic review. *International Journal of Obesity and Related Metabolic Disorders*, 28, 1247–1256.

Bartok, C. & Ventura, A.K (2009). Mechanisms underlying the association between breastfeeding and obesity. *International Journal of Pediatric Obesity*, 4, 196-204.

Bergmann, K.E., Bergmann, R.L., von Kries, R., Bohm, O., Richter, R., Dudenhausen, J.W. & Wahn, U. (2003). Early determinants of childhood overweight and adiposity in a birth cohort study: role of breastfeeding. *International Journal of Obesity and Related Metabolic Disorders*, 27: 162–172.

Beyerlein, A. & von Kries, R. (2011). Breastfeeding and body composition in children: will there ever be conclusive empirical evidence for a protective effect against overweight? *American Journal of Clinical Nutrition* (*in press*).

Cole, T.J., Bellizzi, M.C., Flegal, K.M., & Dietz, W.H. (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. *British Medical Journal*, 320, 1240-1243.

Crawford, P. B., Obarzanek, E., Schreiber, G. B., et al. (1995). The effects of race, household income, and parental education on nutrient intakes of 9- and 10-year-old girls: NHLBI Growth and Health Study. *Annals of Epidemiology*, 5, 360–368.

Danielzik, S., Langnase, K., Mast, M., Spethmann, C., & Muller, M.J. (2002). Impact of parental BMI on the manifestation of overweight 5-7 year old children. *European Journal of Nutrition*, 41, 132–8.

Darmon, N. & Drewnowski, A. (2008). Does social class predict diet quality? *American Journal of Clinical Nutrition*, 87(5), 1107-1117.

Darragh, A.J. & Moughan, P.J. (1998). The amino acid composition of human milk corrected for amino acid digestibility. *British Journal of Nutrition*, 80, 25–34.

Davison, K.K. & Birch, L.L. (2001). Childhood overweight: a contextual model and recommendations for future research. *Obesity Reviews*, 2(3), 159-171.

Dewey, K.G. (1998). Growth characteristics of breastfed compared to formula fed infants. *Biology of the Neonate*, 74, 94–105.

Dewey, K.G. (2003). Is breastfeeding protective against child obesity? *Journal of Human Lactation*, 19, 9-18.

Dietz, W.H. (2001). Breastfeeding may help prevent childhood overweight. *Journal of the American Medical Association*, 285, 2506-2507.

DiSantis, K., Collins, B.N., Fisher, J.O., & Davey, A. (2011). Do infants fed directly from the breast have improved appetite regulation and slower growth during early childhood compared with infants fed from a bottle? *International Journal of Behavioural Nutrition and Physical Activity*, 8, 89.

Feng, P., Gao, M., Holley, T., Zhou, T., Burgher, A., Trabulsi, J. et al. (2009). Amino acid composition and protein content of mature human milk from nine countries. *The Journal of the Federation of American Societies of Experimental Biology*, J 23, LB448.

Fomon, S.J., Filer, Jr L.J., Thomas, L.N., Anderson, T.A., & Nelson, S.E. (1975). Influence of formula concentration on caloric intake and growth of normal infants. *Acta Pediatrica Scandinavia*, 64, 172–181.

Gillman, M.W., Rifas-Shiman, S.L., Camargo, C.A., Berkey, C.S., Frazier, A,L., Rockett, H.R.H., Field, A.E. & Colditz, G.A. (2001). Risk of overweight among adolescents who were breastfed as infants. *Journal of the American Medical Association*, 285, 2461-2467.

Grummer-Strawn, L. & Mei, Z. (2004). Does Breastfeeding Protect Against Pediatric Overweight? Analysis of Longitudinal Data From the Centers for Disease Control and Prevention Pediatric Nutrition Surveillance System. *Pediatrics*, 113, e81-e86.

Harder, T., Bergmann, R., Kallischnigg, G., & Plagemann, A. (2005). Duration of Breastfeeding and Risk of Overweight: A Meta-Analysis. *American Journal of Epidemiology*, 162, 397-403.

Hediger, M.L., Overpeck, M.D., Kuczmarski, R.J., & Ruan, W.J. (2001) Association between infant breastfeeding and overweight in young children. *Journal of the American Medical Association*, 285, 2453-2460.

Heinig, M.J., Nommsen, L.A., Peersen, J.M., Lonnerdal, B., & Dewey, K.G. (1993). Energy and protein intakes of breastfed and formula-fed infants during the first year of life and their association with growth velocity: the DARLING study. *American Journal of Clinical Nutrition*, 58, 152-161.

Jackson, K. M. & Nazar, A. M. (2006). Breastfeeding, the Immune Response, and Long-term Health. *The Journal of the American Osteopathic Association*, 106, 203-207.

Kahn, J. A., Huang, B., Gillman, M. W., Field, A. E., Austin, S. B., Colditz, G. A. & Frazier, A. L. (2008). Patterns and determinants of physical activity in U.S. adolescents. *Journal of Adolescent Health, 42*, 369-377.

Kleiser, C., Rosario, A.S., Mensink, G.B.M., Prinz-Langenohl, R. & Kurth, B.M. (2009). Potential determinants of obesity among children and adolescents in Germany: results from the cross-sectional KiGGS study. *BMC Public Health*, 9:46

Koletzko, B., von Kries, R., Monasterola, R.C., Subias, J.S., Scaglioni, S., Giovannini, M., Beyer, J., Demmelmair, H., Anton, B., Gruszfeld, D., Dobrzanska, A., Sengier, A., Langhendries, J.P., Cachera, M.F.R. & Grote, V. for the

European Childhood Obesity Trial Study Group. (2009). Can infant feeding choices modulate later obesity risk? *American Journal of Clinical Nutrition*, 89, (supp1) 1502S-1508S.

Lawrence, R.A. (2010). Does Breastfeeding Protect Against Overweight and Obesity in Children? A Review. *Childhood Obesity*, 6(4), 193-197.

Li, R., Jewell, S. & Grummer-Strawn, L. (2003b). Maternal obesity and breast-feeding practices. *American Journal of Clinical Nutrition*, 77(4), 931-936.

Li, L., Law, C., Lo Conte, R., & Power, C. (2009). Intergenerational influences on childhood body mass index: the effect of parental body mass index trajectories. *The American Journal of Clinical Nutrition*, 89:551–7.

Li, L., Parsons T.J., & Power, C. (2003a). Breastfeeding and obesity in childhood: cross-sectional study. *British Medical Journal*, 327, 904-905.

Li, R., Scanlon, K. S., & Serdula, M. (2005). The validity and reliability of maternal recall breastfeeding practice. *Nutrition Reviews*, 63, 103e110.

Lindsay, R.S., Hanson, R.L., Roumain, J., Ravussin, E., Knowler, W.C. & Tataranni, P.A. (2001). Body mass index as a measure of adiposity in children and adolescents: relationship to adiposity by dual energy x-ray absorptiometry and to cardiovascular risk factors. *Journal of Clinical Endocrinology and Metabolism*, 86, 4061-4067.

O'Callaghan M.J., Williams, G.M., Andersen, M.J., Bor, W. & Najmans, J.M. (1997). Prediction of obesity in children at 5 years: a cohort study. *Journal of Paediatrics and Child Health*, 33, 311-316.

Ong, K.K.L., Ahmed, M.L., Emmett, P.M., Preece, M.A., Dunger, D.B. and the Avon Longitudinal Study of Pregnancy and Childhood Study Team (2000). Association between post-natal catch-up growth and obesity in childhood: prospective cohort study. *British Medical Journal*, 320, 967-971.

Ong, K.K.L., Preece, M.A., Emmett, P.M., Ahmed, M.L., & Dunger, D.B. for the ALSPAC study team (2002). Size at birth and early childhood growth in relation to maternal smoking, parity and infant breast-feeding: longitudinal birth cohort study and analysis. *Pediatric Research*, 52, 6, 863-867.

Ong, K. K.L, Emmett, P.M., Noble, S., Ness, A., & Dunger, D. B. (2006). Dietary Energy Intake at the Age of 4 Months Predicts Postnatal Weight Gain and Childhood Body Mass Index. *Pediatrics,* 117, 503-508.

O'Tierney, P.F., Barker, D.J.P., Osmond, C., Kajantie, E., & Eriksson, J.G. (2009). Duration of Breast-feeding and Adiposity in Adult Life. *The Journal of Nutrition*, 139(2), 422S-425S.

Owen, C.G., Martin, R.M., Whincup, P.H., Davey Smith, G. & Cook, D.G. (2005). Effect of Infant Feeding on the Risk of Obesity Across the Life Course: A Quantitative Review of Published Evidence. *Pediatrics*, 115, 1367-1377.

Parsons, T.J., Power, C., & Manor, O. (2003). Infant feeding and obesity through the lifecourse. *Archives of Disease in Childhood*, 88, 793–4.

Poulton, R., & Williams, S. (2001). Breastfeeding and risk of overweight. *Journal of the American Medical Association*. 286, 1449-1450.

Royston, P. (2004). Multiple imputation of missing values. *Stata Journal*, 4, 227e241

Reilly, J.J., Armstrong, J., Dorosty, A.R., Emmett, P.M., Ness, A., Rogers, I., Steer, C., Sheriff, A. for the Avon Longitudinal Study of Parents and Children Study Team. (2005). Early life risk factors for obesity in childhood: cohort study. *British Medical Journal*, 330, 1357.

Scaglioni, S., Agostini, C., De Notaris, R., Radaelli, G., Radice, N., Valenti, M., Giovannini, M., & Riva, E. (2000). Early macronutrient intake and overweight at five years of age. *International Journal of Obesity*, 24, 777-781.

Schack-Nielson, Sorensen, T.I.A., Mortensen, E.K. & Michaelsen, K.F. (2010). Late introduction of complementary feeding, rather than duration of breastfeeding, may protect against adult overweight. *American Journal of Clinical Nutrition*, 91(3), 619-627.

Singhal, A. & Lanigan, J. (2007). Breastfeeding, early growth and later obesity. *Obesity Reviews*, 8(Supp1), 51-54.

Stettler, N., Zemel, B.S., Kumanyika, S., & Stallings, V.A. (2002). Infant weight gain and childhood overweight status in a multicenter cohort study. *Pediatrics*, 109, 194-199.

Taylor, J.P., Evers, S. & McKenna, M. (2005). Determinants of healthy eating in children and youth. *Canadian Journal of Public Health*, 96, Supplement 3, S20-S26.

Taylor, R.W., Grant, A.M., Goulding, A., & Williams, S.M. (2005). Early adiposity rebound: review of papers linking this to subsequent obesity in children and adults. *Current Opinion in Clinical Nutrition and Metabolic Care*, 8, 607–612.

Tienboon, P., Rutishauser, I. H. E., & Wahlqvist, M. L. (1994). Maternal recall of infant feeding practices after an interval of 14 to 15 years. *Australian Journal of Nutrition & Dietetics*, 51(1), e25-e27

Toschke, A.M., Vignerova, J., Lhotska, L., Osancova, K., Koletzko, B., & von Kries, R. (2002). Overweight and obesity in 6- to 14-year-old Czech children in 1991: protective effect of breastfeeding. *Journal of Pediatrics*, 141, 764–769.

Wadsworth, M., Marshall, S., Hardy, R., & Paul, A. (1999). Breast feeding and obesity. Relation may be accounted for by social factors. *British Medical Journal*, 319, 1576.

Williams, S.L. & Mummery, W.K. (2011). Links Between Adolescent Physical Activity, Body Mass Index, and Adolescent and Parent Characteristics. Health Education and Behaviour, 38(5), 510-20

Wilson, A.C., Forsyth, J.S., Greene, S.A., Irvine, L., Hau, C. & Howie, P.W. (1998). Relation of infant diet to childhood health: seven year follow up of cohort of children in Dundee infant feeding study. *British Medical Journal*, 316(7124), 21-25.

Wright, P., Fawcett, J., & Crow, R. (1980). The development of differences in the feeding behaviour of bottle and breast fed human infants from birth to two months. *Behavioural Processes*, 5, 1-20.

Ziegler, E.E. (2006). Growth of breast-fed and formula-fed infants. In Rigo J., & E. E. Ziegler (Eds.), *Protein and Energy Requirements in Infancy and Childhood* (pp. 51-59). Karger, AG, Basel.

Table 1: Mean BMI and the Probability of being Overweight or Obese at Nine-Years of Age by Breastfeeding Status in the crude multinomial model

Duration	Unweighted n	BMI (s.d.)	Overweight		Obese	
			Weighted %	*OR (95% CI)*	*Weighted %*	*OR (95% CI)*
Never breastfed	3788	18.18 (3.33)	20.1	1.00	8.1	1.00
Breastfed 4 weeks or less	964	18.05 (3.06)	17.3	0.83 (0.66-1.03)	7.9	0.94 (0.64-1.37)
Breastfed 5-8 weeks	568	17.62 (2.86)	18.1	0.84 (0.63-1.12)	4.6	0.53 (0.32-0.89)*
Breastfed 9-12 weeks	623	17.75 (2.65)	17.8	0.81 (0.62-1.07)	3.7	0.42 (0.24-0.73)**
Breastfed 13-25 weeks	926	17.65 (2.73)	18.4	0.85 (0.67-1.07)	3.7	0.42 (0.27-0.64)***
Breastfed 26 wks +	929	17.41 (2.77)	17.3	0.78 (0.60-1.01)	3.4	0.38 (0.24-0.62)***

Reference category on the dependent variable: non-overweight

*** significant at the 0.05 level ** significant at the 0.01 level *** significant at the 0.001 level**

Table 2: Independent association of each of the potential confounding variables with the probability of being overweight/obese at nine-years of age and having been breastfed as an infant using logistic regression analysis

	Overweight/Obese		Breastfed		
Variable	**Prevalence (%)**	**O.R. (95% CI)**	**Prevalence (%)**	**O.R. (95% CI)**	**Unweighted n**
Breastfeeding status					
Never Breastfed	28.1	1.00	-	-	3788
Breastfed 4 wks or less	25.2	0.86 (0.70-1.06)	-	-	964
Breastfed 5-8 wks	22.7	0.75 (0.58-0.97)*	-	-	568
Breastfed 9-12 wks	21.5	0.70 (0.54-0.90)**	-	-	623
Breastfed 13-25 wks	22.1	0.73 (0.59-0.90)**	-	-	926
Breastfed 26 wks +	20.8	0.67 (0.53-0.85)***	-	-	929
Child Gender					
Male	22.0	1.00	45.5	1.00	3761
Female	29.5	1.48 (1.30-1.68)***	44.0	0.94 (0.84-1.06)	4037
Birth-weight					
BW >=2500 grams	23.7	1.00	45.0	1.22 (0.93-1.60)	367
BW <2500 grams	25.8	1.12 (0.81-1.55)	40.2	1.00	7431
Gestation					
Late (>=42 wks)	29.2	1.26 (1.09-1.47)**	43.4	0.88 (0.77-1.01)	1895
On-time† (37-41 wks)	24.6	1.00	46.6	1.00	4912
Early (33-36 wks)	23.2	0.93 (0.76-1.13)	38.0	0.70 (0.58-0.85)***	873
V. early (<=32 wks)	27.0	1.13 (0.65-1.96)	47.4	1.03 (0.67-1.61)	118
Nationality					
Irish	25.9	1.00	40.9	1.00	6555
Non-Irish	24.8	0.94 (0.79-1.13)	66.1	2.82 (2.35-3.38)***	1243
Prenatal Smoking					
Never smoked	24.1	1.00	51.5	1.00	6064
Occasionally smoked	29.1	1.30 (1.06-1.59)*	36.0	0.53 (0.44-0.65)***	736
Daily smoked	30.3	1.37 (1.15-1.64)***	22.2	0.27 (0.22-0.33)***	998
PCG Education					
Lower secondary	30.3	1.82 (1.49-2.21)***	24.1	0.11 (0.09-0.13)***	1344
Higher secondary	25.3	1.41 (1.18-1.69)***	42.3	0.25 (0.21-0.29)***	2479
Post-secondary	24.7	1.36 (1.13-1.65)***	57.1	0.45 (0.38-0.53)***	1960
Third level	19.3	1.00	74.8	1.00	2015
Household Social Class					
Unclassified	24.8	1.62 (1.14-2.29)**	37.1	0.28 (0.21-0.37)***	366
Unskilled	30.9	2.19 (1.37-3.49)***	25.9	0.17 (0.10-0.27)***	124
Semi-skilled	34.2	2.55 (1.90-3.43)***	30.0	0.20 (0.16-0.26)***	551
Skilled manual	28.5	1.96 (1.50-2.55)***	34.9	0.25 (0.20-0.31)***	1092

Non-manual	27.4	1.85 (1.44-2.37)***	38.8	0.30 (0.25-0.36)***	1545
Managerial & Technical	23.1	1.47 (1.16-1.88)**	54.6	0.57 (0.47-0.68)***	3052
Professional Managers	16.9	1.00	68.0	1.00	1068
Income Quintile					
Lowest	27.6	1.39 (1.14-1.70)***	35.6	0.39 (0.32-0.47)***	1550
2nd	24.9	1.22 (0.99-1.49)	41.1	0.49 (0.41-0.59)***	1573
3rd	26.7	1.34 (1.10-1.63)**	45.7	0.59 (0.50-0.71)***	1575
4th	26.1	1.30 (1.06-1.59)*	51.5	0.75 (0.62-0.90)***	1565
Highest	21.4	1.00	58.7	1.00	1535
Employment Status					
Not working FT	24.8	1.00	42.1	1.00	3317
Working FT	26.5	1.09 (0.96-1.24)	47.1	1.23 (1.09-1.38)***	4481
Frequency of Hard Exercise					
none	39.1	2.26 (1.53-3.33)***	35.7	0.67 (0.45-0.97)*	167
1-2 days	32.4	1.68 (1.26-2.26)***	41.1	0.84 (0.64-1.08)	397
3-5 days	32.3	1.67 (1.42-1.97)***	43.8	0.93 (0.80-1.08)	1336
6-8 days	26.4	1.26 (1.07-1.48)***	45.9	1.01 (0.88-1.17)	1594
9 or more days	22.1	1.00	45.5	1.00	4304
TV Viewing Hrs					
None†	7.5	1.00	71.8	1.00	193
<1 hr	22.8	3.65 (1.90-7.01)***	51.1	0.41 (0.27-0.63)***	1849
1 to <3 hrs	26.1	4.36 (2.31-8.25)***	43.9	0.31 (0.20-0.47)***	5047
3 hrs or more	32.3	5.91 (3.06-11.43)***	32.7	0.19 (0.12-0.30)***	709
Dietary Quality					
Low	24.7	0.89 (0.76-1.04)	33.4	0.36 (0.31-0.42)***	2360
Medium	25.4	0.91 (0.79-1.06)	44.0	0.56 (0.49-0.64)***	2783
High	27.1	1.00	58.4	1.00	2655
Parental Weight Status					
Neither parent overweight/obese	10.4	1.00	55.1	1.00	798
One parent overweight/obese	19.1	2.03 (1.48-2.79)***	47.3	0.73 (0.60-0.90)**	2877
Both parents overweight/obese	34.1	4.45 (3.26-6.07)***	43.2	0.62 (0.51-0.77)***	2508
Mum not measured	30.4	3.76 (2.48-5.70)***	45.8	0.69 (0.51-0.93)*	345
Dad not measured	30.3	3.73 (2.52-5.54)***	40.8	0.56 (0.41-0.76)***	424
No resident partner	28.9	3.50 (2.47-4.97)***	38.0	0.50 (0.39-0.65)***	846

*** significant at the 0.05 level ** significant at the 0.01 level *** significant at the 0.001 level**

Table 3: Results of the multinomial logistic regression analysis expressing the odds of being overweight or obese by various risk factors in the full multivariable model.

		Overweight		Obese	
	Variable	**Adjusted Odds Ratio**	**Sig.**	**Adjusted Odds Ratio**	**Sig.**
Breastfeeding status	Never Breastfed	1.00	-	1.00	-
	Breastfed 4 wks or less	0.87 (0.69-1.09)	ns	1.05 (0.71-1.55)	ns
	Breastfed 5-8 wks	0.90 (0.67-1.21)	ns	0.68 (0.40-1.15)	ns
	Breastfed 9-12 wks	0.95 (0.71-1.26)	ns	0.61 (0.34-1.09)	ns
	Breastfed 13-25 wks	1.01 (0.78-1.30)	ns	0.62 (0.39-0.99)	p<0.05
	Breastfed 26 wks +	0.88 (0.67-1.15)	ns	0.49 (0.29-0.82)	p<.0.01
Gestation	Late (>=42 wks)	1.14 (0.96-1.35)	ns	1.32 (1.00-1.74)	ns
	On-time† (37-41 wks)	1.00	-	1.00	-
	Early (33-36 wks)	0.86 (0.69-1.07)	ns	0.85 (0.55-1.29)	ns
	V. early (<=32 wks)	0.64 (0.30-1.36)	ns	1.91 (0.84-4.35)	ns
Nationality	Non-Irish†	1.01 (0.82-1.25)	ns	1.25 (0.88-1.78)	ns
Prenatal Smoking	Never smoked	1.00	-	1.00	-
	Occasionally smoked	1.34 (1.05-1.72)	p<0.05	1.18 (0.80-1.74)	ns
	Daily smoked	1.26 (1.01-1.57)	p<0.05	1.33 (0.96-1.84)	ns
Maternal Education	Lower secondary	1.20 (0.90-1.59)	ns	1.92 (1.13-3.28)	p<0.01
	Higher secondary	1.10 (0.87-1.38)	ns	1.51 (0.92-2.48)	ns
	Post-secondary	1.12 (0.89-1.41)	ns	1.62 (0.99-2.65)	ns
	Third level	1.00	-	1.00	-
Household Social Class	Unclassified	1.01 (0.61-1.66)	ns	2.67 (1.20-5.93)	p<0.05
	Unskilled	1.73 (0.99-3.02)	ns	2.64 (0.97-7.17)	ns
	Semi-skilled	1.69 (1.17-2.43)	p<0.01	5.13 (2.68-9.79)	p<0.001
	Skilled manual	1.47 (1.05-2.05)	p<0.05	4.01 (2.19-7.36)	p<0.001
	Non-manual	1.24 (0.91-1.68)	ns	3.06 (1.70-5.52)	p<0.001
	Managerial & Technical	1.19 (0.91-1.56)	ns	2.76 (1.60-4.75)	p<0.001
	Professional Managers	1.00	-	1.00	-
Income Quintile	Lowest	0.86 (0.66-1.11)	ns	1.17 (0.74-1.85)	ns
	2nd	0.87 (0.68-1.11)	ns	0.81 (0.51-1.29)	ns
	3rd	0.99 (0.78-1.26)	ns	1.02 (0.65-1.60)	ns
	4th	0.98 (0.79-1.23)	ns	1.34 (0.84-2.14)	ns
	Highest	1.00	-	1.00	-
Employment Status	Working FT†	1.20 (1.00-1.43)	p<0.05	1.21 (0.91-1.61)	ns
Frequency of Hard Exercise	None	1.57 (0.97-2.55)	ns	4.53 (2.60-7.90)	p<0.001
	1-2 days	1.25 (0.89-1.76)	ns	2.71 (1.71-4.28)	p<0.001
	3-5 days	1.45 (1.20-1.75)	p<0.001	2.52 (1.85-3.41)	p<0.001
	6-8 days	1.18 (0.98-1.43)	ns	1.63 (1.20-2.21)	p<0.01

	9 or more days	1.00	-	1.00	-
TV Viewing Hrs	None	1.00	-	1.00	-
	<1 hr	3.21 (1.51-6.81)	p<0.01	3.55 (0.79-15.92)	ns
	1 to <3hrs	3.25 (1.55-6.82)	p<0.01	5.10 (1.17-22.20)	p<0.05
	3 hrs or more	4.18 (1.93-9.04)	p<0.001	5.48 (1.18-25.49)	p<0.05
Dietary Quality	Low	0.66 (0.55-0.80)	p<0.001	0.68 (0.50-0.92)	p<0.05
	Medium	0.80 (0.68-0.96)	p<0.05	0.82 (0.62-1.08)	ns
	High	1.00	-	1.00	-
Parental Weight Status	Neither parent overweight/obese	1.00	-	1.00	-
	One parent overweight/obese	1.90 (1.35-2.68)	p<0.001	3.20 (1.43-7.15)	p<0.01
	Both parents overweight/obese	3.60 (2.57-5.05)	p<0.001	9.50 (4.40-20.51)	p<0.001
	Mum not measured	3.05 (1.93-4.81)	p<0.001	10.12 (4.08-25.14)	p<0.001
	Dad not measured	2.78 (1.80-4.30)	p<0.001	7.79 (3.30-18.38)	p<0.001
	No resident partner	3.09 (2.07-4.61)	p<0.001	6.84 (2.97-15.75)	p<0.001
	Pseudo R^2	**0.061**			

Reference category on the Dependent Variable: Non-overweight
† **Reference categories on the dichotomous Independent Variables: Irish background, not in FT employment**

- Whether breastfeeding is protective against childhood obesity remains controversial.
- This study uses cross-sectional data from an Irish cohort to examine this question.
- The authors controlled for a range of confounding factors including parental BMI.
- Breastfeeding for >13 weeks was associated with a significant reduction in obesity.
- Increased periods of breastfeeding had a stronger protective effect against obesity.