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Still Unequal at Birth
Birth Weight, Socioeconomic Status and Outcomes at Age 9

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Abstract

Birth weight is an important aspect of public health which has been linked to increased risk of infant death, increased cost of care, and a range of later life outcomes. Using data from a new Irish cohort study, I document the relationship between birth weight and socioeconomic status. A strong association with maternal education does not appear to be due to the timing of birth or complications during pregnancy, even controlling for a wide range of background characteristics. However, results do suggest intergenerational persistence in the transmission of poor early life conditions. A comparison with the UK Millennium Cohort Study reveals similar social gradients in both countries. Birth weight predicts a number of outcomes at age 9, including test scores, hospital stays and health. An advantage of the data is that I am able to control for a number of typically unmeasured variables. I determine whether parental investments as measured by the quality of interaction with the child, parenting style, or school quality mediate the association between birth weight and later indicators. For test scores, there is evidence of non-linearity. Boys are more adversely affected than girls, and I find that the effects of low birth weight (<2,500g) are particularly strong. I also consider whether there are heterogeneous effects by ability using quantile regression. These results are consistent with a literature which finds that there is a causal relationship between early life conditions and later outcomes.

JEL Classification: I14, I18, J13
Keywords: Early Life Conditions, Birth Weight, Health Inequalities, Test Scores

1 Introduction

The focus of public health authorities on birth weight has been justified for a number of reasons, indeed it is often the target of public policy, for instance the Medicaid and WIC programmes in the US (Black et al., 2007).[1] Firstly, at the individual level reduced birth weight is an important risk factor in infant

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[1] In 2006 the Institute for Public Health in Ireland published a report on the prevalence of low birth weight (babies born less than 2,500g) "Unequal at Birth: Inequalities in the occurrence of low birth weight babies in Ireland" (McAvoy, Sturley, Burke and Balanda, 2006). The title of this paper is a reference to that report which was based on administrative data on all singleton births in the Republic of Ireland in the year 1999. See www.publichealth.ie/files/file/Unequal_at_Birth.pdf. The title is also shared with Costa (1998). Consistent with the literature from other countries, the report found substantial inequality in the prevalence of low birth weight in Ireland, as measured by parental occupation. Location and family structure were also found to be risk factors. Commissioned by the Department of Health and the National Children's Office, one of the aims of the aforementioned Irish report was to assess the National Anti-Poverty Strategy target of reducing the gap in low birth weight rates between children from the lowest and the highest socioeconomic groups by 10% from the 2001 level by 2007. A conclusion of the report is "if all socioeconomic groups had the same proportion of low birth weight births as the highest socioeconomic group, there would have been an estimated 695 fewer low birth weight babies born in 1999. This comprises approximately one third of the total number of low birth weight babies born in the Republic of Ireland in 1999."

mortality, those born with a weight of less than 2,500 grams are at a greater risk of dying within their first year of life. Almond et al. (2005) estimate that the cost of care for a child born at 1,000 grams can be in excess of $100,000. Even for babies weighing 2,000-2,100 grams, an additional pound (454 grams) is still associated with a $10,000 difference in hospital charges. Secondly, a substantial literature across the social sciences including epidemiology, economics and psychology has linked birth weight to a number of outcomes in later life. These include measures of health (in particular cardiovascular disease), but also education and labour market status. I review the evidence from the economics literature in the next section. Although the data used in this paper do not lend themselves to fully addressing the potential for omitted variables to affect the results with an experimental or quasi-experimental identification strategy, I am able to control for a wide range of variables on family background and typically unobserved aspects of a child's upbringing which arguably measure aspects of parental investments in their children. In particular, I examine whether the assocation between birth weight and later outcomes is mediated by indicators for parenting quality, parenting style, and school quality. As these factors are generally shared by twins or siblings, within family studies cannot establish the role of these variables as mediating factors in the wider population. Combined with the findings from sibling comparison approaches there is reason to believe that the results presented here have a causal component. Finally, birth weight is also relavent at the population level as a general marker of public health as it encapsulates many different aspects which contribute to make up the wellbeing of society. These include factors such as education and behaviour, the efficacy of the health care system, and the level of inequality. Although health at birth itself is characterised by inequality, it is also malleable (Currie, 2011).

The launch of Ireland's first cohort study (Growing Up in Ireland , henceforth GUI)[2] in 2009 provides the opportunity to examine the nature of inequalities in birth weight in more detail, as well any potential link to outcomes in later childhood. There are a number of advantages to using these data, notably the fact that this is a representative sample of Irish children which contains a rich set of information on family background and behaviour, including aspects of early development which are generally not measured (such as the nature of parent/child relationships). Although administrative data can provide complete population level information, the availability of these types of variables is generally limited unless the data have been specifically designed to examine a particular issue of interest. GUI is a cohort study of two groups, 8,500 nine year olds and 11,000 nine month olds first surveyed in 2009. Each group will be followed up at regular intervals; so far only one wave is available for each cohort. In each case interviews were conducted with all primary (and where available secondary) care givers, and in the case of the 9 year cohort data was also collected from schools (including teachers and principals), as well as interviews with the children themselves. The study was designed to be nationally representative, and weights are provided to ensure that this is the case. The data are publicly available,[3] and GUI is the first national survey in Ireland to include information on birth weight.

The aims of this paper are as follows. I first provide an overview of the literature in section 2. In section 3 I summarise the relationship between socioeconomic status and birth weight in Ireland using the 9 month cohort. I discuss the factors across the domains of family background, maternal characteristics and behaviour which predict weight at birth. A strong social gradient exists, and there is also evidence of intergenerational transmission of early life conditions. I make a simple comparison with the Millennium Cohort Study in the UK and find that a similar gradient in maternal education exists in both countries. In section 5 I determine whether birth weight predicts outcomes at age 9 using data from the second cohort, and in particular whether this relationship is mediated by parenting or school quality. I find that the effects of birth weight are independent of these factors. I also examine whether there is any heterogeneity in the effects of initial health by gender, and by ability using quantile regression. Section 6 concludes.

[2]www.growingup.ie. Growing Up in Ireland data have been funded by the Government of Ireland through the Office of the Minister for 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. ©The Department of Health and Children.

[3]See the Irish Social Sciences Data Archive (www.ucd.ie/issda) where the data are available in annonymised form, as are further details about the sampling procedure and survey design.

2 Literature

There is a growing literature which examines the link between early life conditions and later life outcomes. These findings have been argued as providing a credible basis for targeting initial health (low birth weight being one measure of this) for intervention. At the aggregate level the cohorts who experience reductions in early life mortality are the cohorts who experience improvements in longevity at advanced ages (Finch and Crimmins, 2004). At the individual level there is a well established correlation between birth weight and hypertension as an adult (Barker, 1997). Other papers have focused on the impact of health in childhood on health in adulthood (Case et al., 2005, and Case et al., 2002), and childhood health and adult labour market status and education (Currie, 2009). One contribution of the economics literature has been a focus on establishing whether a causal link exists. This issue is a difficult problem to address due to the potential for some omitted variable to bias estimates of the effects of early life conditions. Finding that birth weight matters for later outcomes could simply reflect the fact that it is correlated with some other component of family background which is the true causal factor in determining later outcomes. For example, "bad" parents may have children of lower birth weight, and this may be the factor which actually influences the future status of children with poor early life health. Similarly, children of low birth weight may be more likely to attend lower quality schools or live in poorer neighbourhoods. Genetics is another alternative explanation, however measuring all or even some of these components can be difficult. Also, the bias from using OLS is not clear a priori. While it is possible that birth weight is positively correlated with some other unobserved factor (resulting in an upward bias), if parents invest differentially in a twin or sibling of higher birth weight then OLS could be biased downwards. Ideally a source of exogenous variation in infant health could be used to establish true causal effects. Finding a natural experiment which affects only early life conditions can be difficult, however one example of this is Almond (2006) which compares individuals exposed in utero to the 1918 flu pandemic with cohorts born just before and after. Affected cohorts are found to be worse off on a number of outcomes. Delaney et al. (2011) use a dramatic shift in public health which occurred in Ireland in the 1940s to show that those children who benefited from improvements in early life conditions went on to be healthier and stronger adults. Currie (2011) argues that differences that have previously seemed to be innate could in fact reflect external factors related to environment. Disadvantaged children are more likely to be exposed to pollution during pregnancy, therefore poor initial health may in part be due to the fact that their mothers are less able to provide a healthy environment in utero. Almond and Currie (2011) provide a recent summary.

An alternative strategy to address concerns about omitted variable bias is to use data on siblings or twins. This allows the researcher to control for features which are common to each sibling group (such as family background, and genetics in the case of monozygotic twins) without the need to explicitly collect information on that factor. In fact there have been a number of papers which examine the determinants and effects of birth weight using this technique. Royer (2009) uses a database of Californian twins and finds significant (although relatively small) lasting consequences of initial health. Oreopoulus et al. (2006) also use a twin study and conclude that birth weight predicts mortality up to 17 years, as well as educational and labour force outcomes. Black et al. (2007) find similar results for education and wages, and in their case the results from fixed effects models for long run outcomes do not differ greatly from OLS. Behrman and Rosenzweig (2004) find comparable relationships with fixed effects models, but argue that the effects of birth weight on schooling could be underestimated by as much as 50% in cross sectional studies. There are some limitations to using twin studies which I discuss below. Overall, despite the fact that the results from these studies tend to differ in terms of magnitude, the direction of the findings is similar. Importantly for the models presented in this paper, OLS and twin fixed effects models often give similar results (see Lin and Liu, 2009 for another example of where this is the case).

In fact there is also evidence in favour of even more persistent effects. Currie and Moretti (2007) use information from Californian birth records to examine the intergenerational transmission of birth weight. In addition to finding that birth weight predicts future economic status, they also find that there is a strong persistence in low birth weight, especially for those born in high poverty areas. Allowing for within sibling comparisons, they are able to identify an important interaction effect in their data, the lasting impact of poor initial health is worse for those from disadvantaged backgrounds. The magnitude of their results is striking, the probability of being born of low birth weight is 50% higher for those with mothers of low birth weight.[4]

Several papers have also considered the role of omitted variables in infant health production functions. Although I am not able to isolate exogenous variation in the covariates in this data, one advantage of GUI is the comprehensive nature of the survey, which does include information on paternal characteristics which are not always available in other datasets. Reichman et al. (2009) argue that excluding typically unobserved variables (such as the father's characteristics) from infant health production functions does not substantially alter conclusions about the effects of inputs, and that single equation models of infant health production (as I adopt in this paper) can be used with confidence. In terms of the other factors which influence birth weight, Dearden et al. (2011) find that length of gestation is one of the most important predictors. Tanaka (2005) finds a relationship between paid leave and low birth weight, while Rossin (2011) also finds a positive effect of maternity leave. I am able to examine these associations in the data. Two papers consider the effects of plausibly exogenous variation in maternal education, which could either increase a mother's propensity to engage with health investments, or else improve the productivity of existing investments. Consistent with this theory (and using county level variation in college accessibility in the US), Currie and Moretti (2003) find that an additional year of maternal education reduces the incidence of low birth weight by ten percent. This is largely due to improvements in behaviour. Chevalier and O'Sullivan (2007) find a similar effect using the raising of the school leaving age in the UK in 1947 as an instrument. As is common in the wider returns to education literature, they find IV estimates which are higher than OLS. Grossman and Joyce (1990) consider how the role of pregnancy selection impacts on the determinants of birth outcomes. Returning to the problems associated with not controlling for unobserved heterogeneity, Conley and Bennett (2000) illustrate this issue using the PSID and the within siblings approach. In contrast to more basic specifications, they find that maternal income does not have an important impact on birth weight once parental birth weight is controlled for, although they do find that low birth weight is related to educational attainment. In fact several papers have found that this is a robust result, either using twins studies or cross sectional estimates (Boardman et al. (2002) find effects of birth weight independent of socioeconomic variables, with largest effects for those with very low birth weight, although the magnitudes are modest when compared with the effects of maternal education. Differences by birth weight are also smaller for older children).

The methodology of using within family comparisons is not open to me as I only have information on one child per family. Instead I use the rich data available in the GUI in an effort to control for the factors which have been identified in the literature as important determinants of birth weight and later outcomes. A further potential drawback of the data relates to the use of self reports (for a discussion see Reichman et al. 2009). However, using data from Northern Ireland, Walton et al. (2000) compare maternal reports of birth weight with linked objective data. 85% of parents were able to recall correctly (to within a specified margin). They conclude that self reports may be a suitable proxy, although they also find that low birth weight and high birth weight was associated with poorer recall, as was parental occupational status. If anything using birth weight as reported by mothers may therefore have the effect of understating socioeconomic differences. There have also been criticisms of the use of birth weight itself as a measure of infant health. Almond et al. (2005) examine the associated short run costs using a database of twins. They caution that the effects of birth weight on infant mortality may be overestimated. Although the associated costs themselves are large, within twin pairs birth weight is not a predictor of infant death. However, there is little consensus about which alternatives would be more appropriate, and other measures such as APGAR scores are rarely available, particularly historically. In fact the use of birth weight itself has not been consistent in the literature, with some papers using birth weight as a continuous measures, and others focusing only on the effects of low birth weight (less than 2,500g).[5]

Twin comparison approaches are not without their drawbacks, for example parental investments in their children may be a function of birth weight itself, which is a potential explanation for the downward bias of OLS results in Behrman and Rosenzweig (2004) and Lin and Liu (2009). In addition, twins typically tend to be of lower birth weight than singletons, and because twin studies implicitly compare differences in birth weight within a pair, it is problematic to draw strong conclusions about the effect of levels in the population as a whole. Differences in birth weight between twins may be small, at least relative to

[4] GUI does not contain information about the mother's own birth weight, however I proxy for her early life conditions using height.

[5] An exception is Royer (2009) who allows for more flexible effects with linear splines in birth weight.

the overall variation in birth weight. Finally, since siblings or twins tend to attend the same schools, and have the same parents, it is not possible to determine the extent to which shared influences such as parenting or school quality mediate the relationship between birth weight and later outcomes in the general population. Due to the data requirements, these types of studies generally use official linked data, which rarely has the kind of detailed information on family background available in cohort studies. Nevertheless, within family studies are a crucial tool for understanding establishing the limitations of cross sectional estimates, in particular in the context of omitted factors such as genetics which are difficult if not impossible to measure.

In summary, despite conflicting results in terms of the magnitude of the lasting effects of initial health, across methodologies the direction of the results is generally consistent with the idea that birth weight has important lasting consequences.

3 Determinants of Birth Weight

I begin by considering the determinants of birth weight in the 9 month cohort. In order to ensure a more homogeneous sample, I restrict the data analysis to those babies born in Ireland where their mother was identified as the primary caregiver. I also exclude non-singleton births. For the 9 month cohort this reduces the sample from 11,134 to 10,582. There are three important factors to note about the primary variable of interest in this paper. Firstly, mothers are asked to provide information on the weight of their babies as part of the GUI main carer questionnaire. As outlined in the previous section, there is reason to believe that self reports are reliable in this context. Secondly, although in theory birth weight is a continuous variable, as part of the annonymisation procedure the data have been recoded at the top and bottom of the distribution. Those born under 1,499 grammes are coded as "1,499 or less", those between 1,500 and 2,499 grammes as "1,500-2,499", and those born above 4,600 grammes are coded as "4,600 or above". Finally, birth weight is rounded to the nearest 100g. This type of measurement error will bias estimates of the effect of initial health downwards. Each of these issues also apply to the 9 year cohort. When the dependent variable is censored it is appropriate to adopt an estimation technique which takes account of this, as biased estimates could result from ignoring the fact that part of the distribution is missing from the data. I present results from a tobit where I amalgamate the bottom two categories, however using OLS does not greatly affect the results. Weights are also provided to account for differences between the data and population which arose during the sampling procedure. For all regressions I use these weights, not doing so generally increases the magnitude of the coefficients on the socioeconomic variables in this section, and increases the magnitude of the effects of birth weight in section 5. Here I begin by presenting some descriptive statistics, then move on to examine the factors which are correlated with birth weight in a multivariate regression. The focus will be on the socioeconomic gradient in birth weight, and on the effects of parental education in particular.

Figure 1 presents the distribution of the birth weight variable in the 9 month data. About 4% of the sample are of low birth weight (under 2,500g), with the mean being 3,513g. As the variable has been censored in the data it is not necessarily expected to match up exactly with the mean in the population. Despite this, these figures correspond to those obtained from official records.[6] There is a strong bivariate relationship between this variable and measures of socioeconomic status, for example figure 2 illustrates that the mean birth weight of those born in the lowest income quintile was 3,444g, compared to 3,551g in the highest, although the relationship appears to be non-monotonic. In fact this social gradient in birth weight is evident no matter which measure of socioeconomic status is chosen; consistent with previous studies it is clear from the data that initial infant health is strongly influenced by family social background. A very similar pattern is observed when looking at the prevalence of low birth weight as opposed to this continuous measure. The coefficient on a linear fit suggests that an extra year of maternal education results in an additional 13g in terms of weight at birth for her child. Other factors such as family structure are also important, birth weight is highest in families with two parents and two or more children. An important question is whether birth weight is related to any of the other measures of intial

[6] According to the Perinatal Statistics Report for 2009, the mean birth weight in the Irish population was 3,446g and the low birth weight rate was 5%. See www.esri.ie/health_information/nprs/nprs_reports/Perinatal_2009.pdf.

health available in the data. Figure 3 illustrates the relationship between the mothers' reports of their babies' health at birth. Figure 11 in the appendix confirms a correlation with sleeplessness. Birth weight is also related to ASQ scores (figure 12 in the appendix) in communication, gross motor control, fine motor control, problem solving ability and social ability at 8 months. On this basis it seems apparent that birth weight is a good reflection of initial conditions.

Figure 1: Birth Weight Histogram (9 Month Cohort)

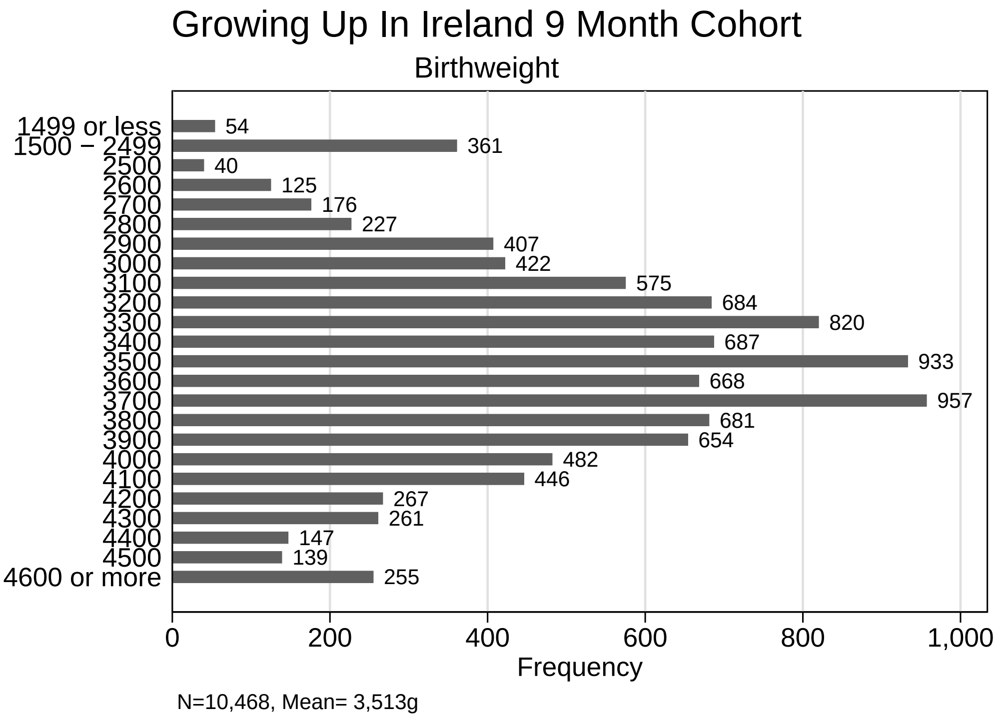


Table 1 presents regression results of birth weight on family characteristics with particular emphasis on household income and parental education. A tobit model is used to account for top and bottom censoring of the dependent variable, although OLS gives similar results. In fact other variables in the data have also been censored as part of the annonymisation procedure. These include mother's age and education. In the case of age I include an additional dummy variable for mothers over the age of 40. For each column I present the coefficients from the first specification only (for reasons of presentation), however the full table with all control variables is included in the appendix (table 8). The first column presents the results including only the variables present in the table as controls, namely household income and parental education, along with a quadratic in mother's age, a dummy variable taking the value 1 if the mother is over 40, and the gender of the baby. The outcome birth weight in grams as reported by the mother.

The relationship in the descriptive statistics is also present here, namely moving from the lowest income quintile to the second highest is associated with an increase in birth weight of about 58 grams, or about 2% of the mean. Interestingly, the coefficient on the highest income quintile is not significant, so the effect appears to be non-linear. An extra year of maternal education is associated with an increase of 9g, while an extra year of paternal education is associated with an extra 6g. Father's education therefore appears to have an effect independent of the mother's education. Particularly for the characteristics of the secondary caregiver, there are a relatively high proportion of individuals who were not interviewed and therefore have missing data. For father's education roughly 25% are missing. To address this I include a dummy variable for those who have missing data. These variables are often significant indicating that this attrition is non-random.

Figure 2: Birth Weight and Family Income (9 Month Cohort)

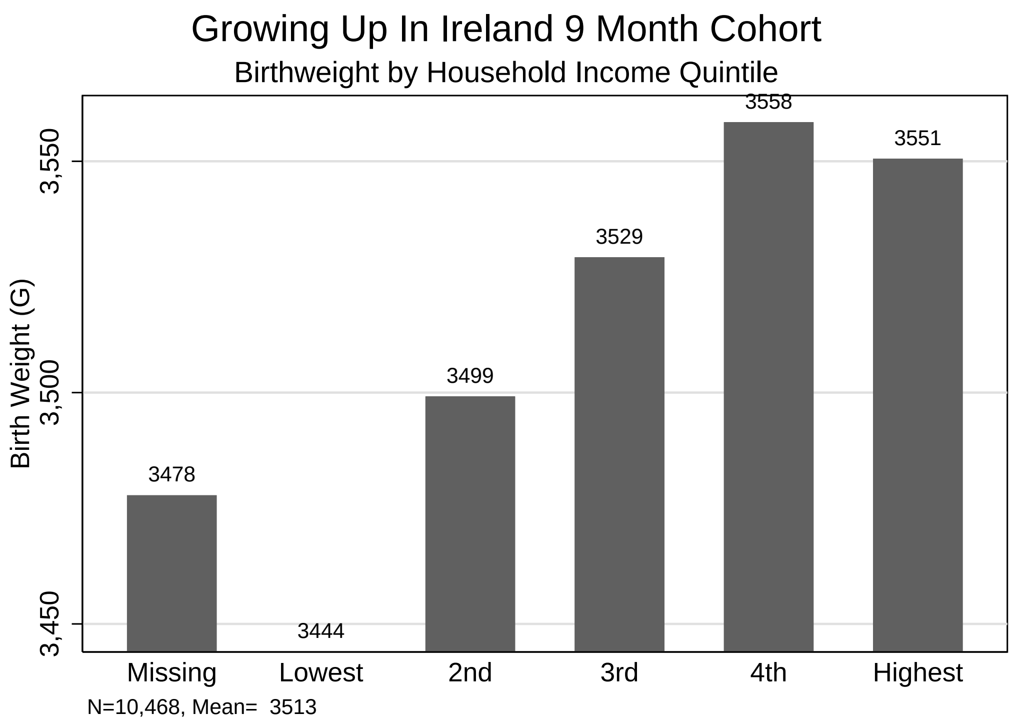
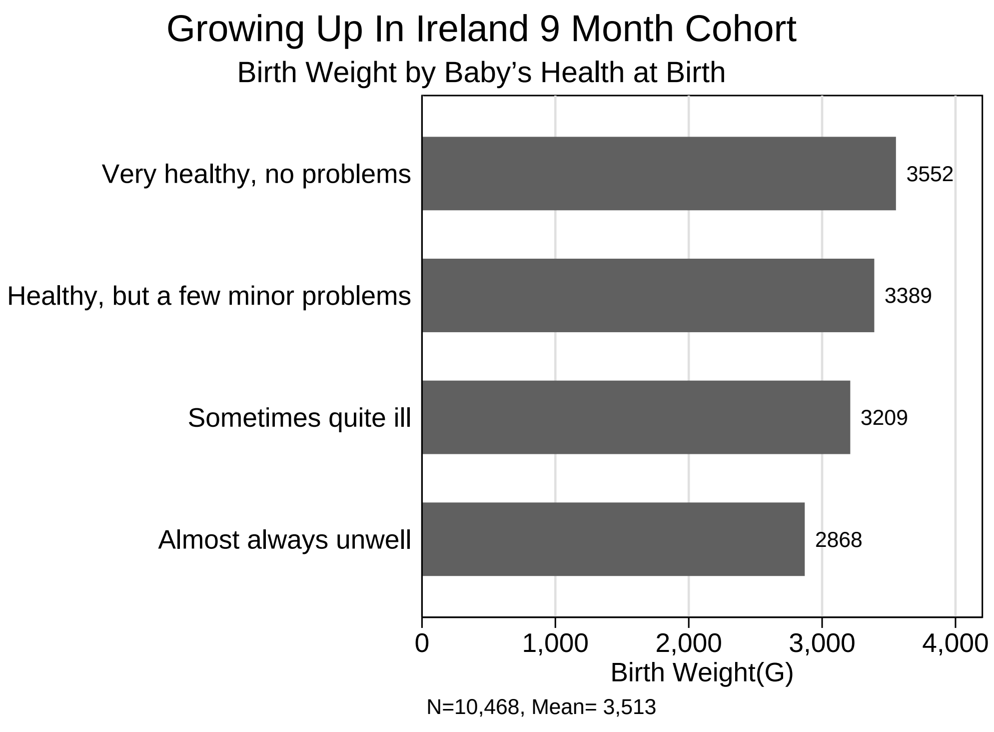


Figure 3: Birth Weight and Baby's Health at Birth (9 Month Cohort)



Due to this relatively large number, the treatment of missing values has the potential to greatly affect estimation results, and in particular the approach of recoding missing values can lead to biased estimates (Little and Rubin, 2002). I also consider the use of multiple imputation (where missing values are inferred from the other available information in the data, for implementation see Royston, 2009) as an alternative strategy for dealing with this problem. However, I find that this has little effect on the results. Table 7 in the appendix highlights the variables with the most missing values, while table 8 compares estimation results.

Table 1: Determinants of Birth Weight (Summary)

Variables	Birth Weight Tobit 1	Birth Weight Tobit 2	Birth Weight Tobit 3	Birth Weight Tobit 4	Birth Weight Tobit 5
Mother's Age	26.1*	18.2	18.6	1.1	6.5
	(14.115)	(14.663)	(14.288)	(12.622)	(12.390)
Mother's Age Squared	-0.3	-0.3	-0.4	-0.0	-0.1
	(0.233)	(0.240)	(0.234)	(0.207)	(0.203)
Mother Over 40	-38.4	-16.5	-19.0	-10.2	-5.0
	(33.652)	(33.451)	(33.022)	(29.725)	(30.283)
Female	-123.5***	-130.8***	-131.5***	-134.2***	-124.2***
	(12.371)	(12.295)	(12.074)	(10.930)	(10.849)
HH Income: Missing	0.6	-13.4	-7.9	-1.2	-3.2
	(29.649)	(30.408)	(29.998)	(27.009)	(26.897)
HH Income: 2nd Quintile	23.7	8.4	16.9	9.1	7.7
	(28.640)	(29.095)	(28.727)	(26.258)	(26.035)
HH Income: 3rd Quintile	39.8	33.0	33.5	22.2	16.5
	(28.150)	(28.244)	(27.908)	(25.313)	(25.025)
HH Income: 4th Quintile	57.5**	79.3***	70.5**	68.9***	62.3**
	(27.841)	(27.979)	(27.707)	(25.100)	(24.884)
HH Income: Highest Quintile	10.1	50.7*	36.7	21.7	5.8
	(28.157)	(28.619)	(28.466)	(25.558)	(25.414)
Mother Age Left Education	9.2***	11.8***	7.8***	5.6**	0.6
	(2.606)	(2.683)	(2.667)	(2.412)	(2.429)
Father Age Left Education	6.0**	8.9***	7.4***	7.4***	7.5***
	(2.521)	(2.598)	(2.578)	(2.353)	(2.347)
Father's Education Missing	73.8	161.0***	133.3**	129.4***	153.6**
	(51.560)	(54.722)	(54.226)	(49.551)	(63.660)
Observations	10,272	10,135	10,133	10,129	9,773
Extended SES Controls	No	Yes	Yes	Yes	Yes
Maternal Behaviour	No	No	Yes	Yes	Yes
Pregnancy Variables	No	No	No	Yes	Yes
Parental Height	No	No	No	No	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variable (birth weight) is censored under 2,500g and over 4,600g. All regressions are weighted. The omitted category for household income is the 1st quintile. The full table is presented in the appendix (table 8). Model 1 includes only the variables present in the table. Model 2 adds controls for household social class, number of siblings, family structure, rural area, mother not born in Ireland, and neighbourhood safety problems. Model 3 adds smoking in household during pregnancy, mother received help, mother's health, mother smokes, mother drinks. Model 4 adds weeks before birth stopped working, weeks became aware of pregnancy, weeks at first ante-natal appointment, gained weight during pregnancy, timing of birth, and pregnancy complications. The final model adds parental height.

As outlined in the previous section, a key question relates to whether the observed relationship between parental education and birth weight is causal, as there may be some other omitted variable which is correlated with this measure and the true cause of low birth weight. The second column adds additional controls for socioeconomic status, specifically household social class, number of siblings present in the household, rural area, mother not born in Ireland, and an index of neighbourhood problems. This has relatively little effect on the magnitude or significance of the coefficients on household income or education, if anything these variables now have a larger effect. Having more siblings is associated with higher birth weight (by about 30g per sibling), and this is independent of household type.[7] Neighbourhood also matters in this specification. This index was constructed from a series of questions based on statements concerning the safety of the respondents' areas, such as "is it safe to walk alone in this area after dark?".

[7] This variable refers to siblings present in the household. As it is essentially family size at birth it can also be interpreted as the effect of birth order.

Individuals responded on a four point scale ranging from strongly agree to strongly disagree, and the responses were summed from five such questions to form the index. The minimum score of 5 represents no problems, while the maximum of 20 represents the most problems. Alternative measures of area quality were examined as a robustness check, however these did not appear to have an impact on birth weight.

The third column adds additional controls for maternal behaviour, including whether someone in the household smoked during pregnancy, the quality of help received by the mother, mother's current health, and mother's smoking and drinking behaviour. Unfortunately some of these variables refer to the period when the question was administered (after birth) and may not accurately reflect circumstances during pregnancy, however information on prior behaviour is not available in the survey. Father's behavioural characteristics did not appear to have an important effect in a robustness check, and as outlined above there are many missing variables for these questions, therefore they were omitted for this specification. Again the addition of these variables had little effect on the coefficients on education or household income. Having someone smoking in the household during pregnancy was associated with a reduction in birth weight of 37g. Being in a different country to the mother's family was a negative, as was worse maternal health, and smoking regularly (the omitted category).

Table 2: Other Significant Determinants of Birth Weight

Variable	Coefficient
Number of Siblings in Household	19.1**
	(9.690)
HH Type: Parent 1 Child	-106.1***
	(38.148)
HH Type: 2 Parents 1 Child	-133.4***
	(18.114)
Rural Area	24.1**
	(11.288)
Someone in HH Smoked During Pregnancy	-28.9**
	(13.517)
Family not living in the country	-112.4***
	(25.961)
Mother's health: Poor	-132.0*
	(69.831)
Mother Smokes: Occasionally	126.7***
	(23.723)
Mother Smokes: Not at all	180.8***
	(17.437)
Weeks before birth mother stopped working	9.5***
	(2.295)
Weeks before birth mother stopped working NA	46.3**
	(18.998)
Gained weight during pregnancy (kilos)	12.2***
	(1.041)
Birth Timing: Very early (32 weeks or less)	-1,272.7***
	(82.856)
Birth Timing: Somewhat early (33-36 weeks)	-719.9***
	(32.691)
Birth Timing: Late birth (42 weeks or more)	228.5***
	(16.776)
No Pregnancy Complications	55.9***
	(10.913)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

This table shows the coefficient on significant variables in the final specification of table 1. The full table is presented in the appendix as table 8. The omitted category for household type is "2 parents and 2 or more children", for the mother's family not living in the country the omitted category is "mother gets enough help", for maternal health "excellent health", and birth timing "on time".

An important question relates to whether families of lower socioeconomic status are more likely to have pregnancies with medical complications and earlier births, as this could be a potential pathway mediating the social gradient in birth weight. In column four I add controls for the number of weeks at which the mother became aware of the pregnancy, stopped working before the birth, and had her first ante-natal appointment. I also control for weight gain, the timing of the birth and the presence of any complications during pregnancy. The coefficients on parental education and income are reduced to a certain extent, but they remain significant. I conclude that the social gradient in birth weight is not simply a consequence of the fact that families of lower socioeconomic status are more likely to have pre-term babies or medical complications during pregnancy. However, on their own the effect of these variables is large and significant, for example being born at 32 weeks or before is associated with a reduction of 1,315g compared to being on time. Being born at 33-36 weeks is associated with being 747g less in weight. A pregnancy without complications is associated with an extra 68g. Leaving work sooner is associated with higher birth weight, as is gaining weight during the pregnancy. Finally, in column 5 I control for both maternal and parental height. This is to take account of the possible intergenerational transmission of birth weight as discussed in Currie and Moretti (2007). As I do not observe the birth weight of the mother, I use height[8] as a marker of early life conditions. Consistent with the results in Conley and Bennett (2000), I find that the effect of maternal education is now not significant (although the coefficients on income and paternal education are unaffected), and interpret this as evidence for persistence in initial health. Irish mothers with less education are of lower height (a proxy for worse early life conditions), which explains at least part of the relationship between their educational attainment and the birth weight of their own children. This does not rule out the potential for maternal education to have an effect. As discussed in the previous section, Chevalier and O'Sullivan (2007) find that OLS results are biased downwards.

The other variables which retain a statistically significant effect on birth weight include the number of siblings in the household, household type, smoking in the household during pregnancy, the mother being in poor health, mother's smoking behaviour, maternal employment, weight gain during pregnancy, the timing of the birth and the absence of pregnancy complications. These are summarised in table 2. It is important to reiterate that this model does not address the endogeneity of inputs into infant health and therefore no causal interpretation of these results is intended, although again they are consistent with the previous findings discussed in section 2.

4 A Comparison With The Millennium Cohort Study

Growing Up in Ireland is the first Irish cohort study to be conducted, however other countries have a long tradition of this type of investigation, particularly the UK. I use the similarities between GUI and the Millennium Cohort Study (which is currently following the lives of around 19,000 children born in the UK in 2000 and 2001)[9] to conduct a simple comparison in terms of one measure of the social gradient (maternal education). I use data collected at the same age (9 months), although the children in the GUI 9 month cohort were born several years later, so this may distort the results somewhat. I try to make the samples as comparable as possible, for example I recode the birth weight and maternal education variables in the MCS so that they are censored in the same manner as GUI. I also restrict the MCS sample to the same criteria as I use for the GUI data, namely singletons born in the country where the main caregiver is the child's mother. The first thing to note is that there is some evidence that birth weight may be higher in Ireland, with figure 6 demonstrating that the percentage of babies born less than 2,500g is higher in the MCS. However, the MCS oversampled those in ethnic minorities which could distort the raw figures. I therefore use the weights provided in a simple regression analysis where I take use a tobit for birth weight with age the child's mother left education as the single explanatory variable. I use maternal education as the measure of socioeconomic status as this is more likely to be comparable across countries than educational qualification or household income. Figure 7 displays the coefficient from this simple analysis. As is evident the coefficients on maternal education are very similar in the two datasets with an extra year of education associated with an extra 17 grams in birth weight.[10] I concluded that there is a similar social gradient in both countries.

[8]This is measured height, and not self-reported. The only other alternative, mother's self reported status at age 16 is never significant in these regressions.

[9]These data are publically available from the UK Data Archive (www.data-archive.ac.uk).

[10]Very similar results are obtained when I do not censor the MCS birth weight variable. This is comforting in the sense that it suggests that using the censored data in GUI is not important for the estimates presented in this paper.

Figure 4: Low Birth Weight in the UK and Ireland

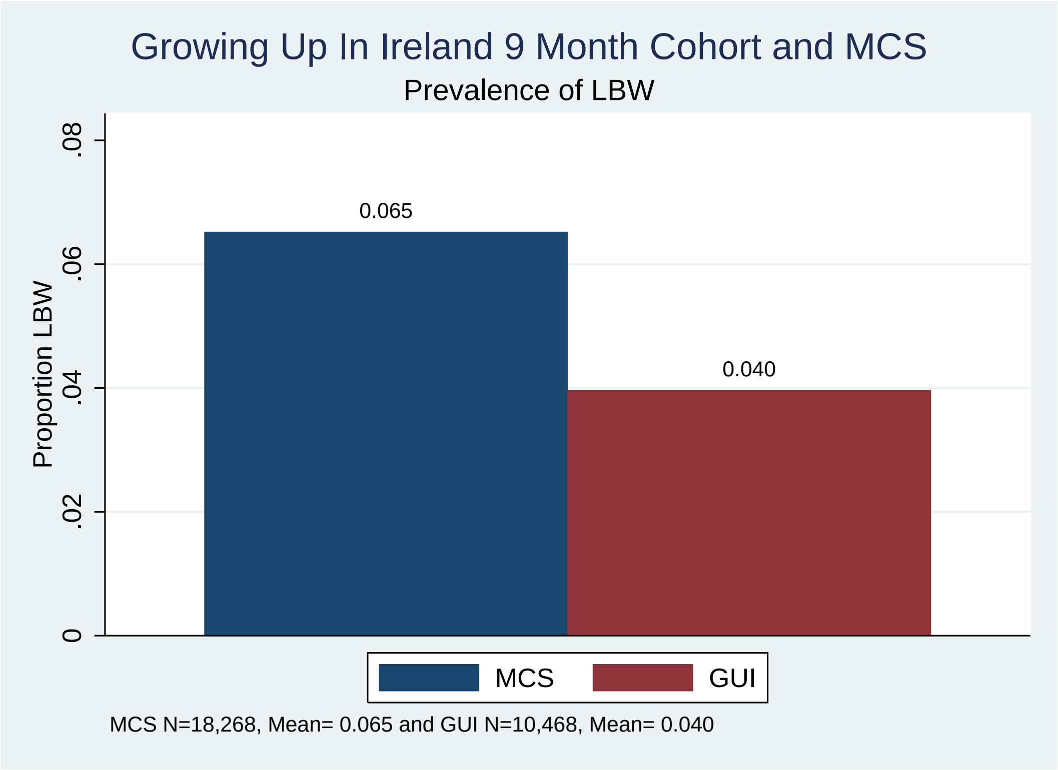
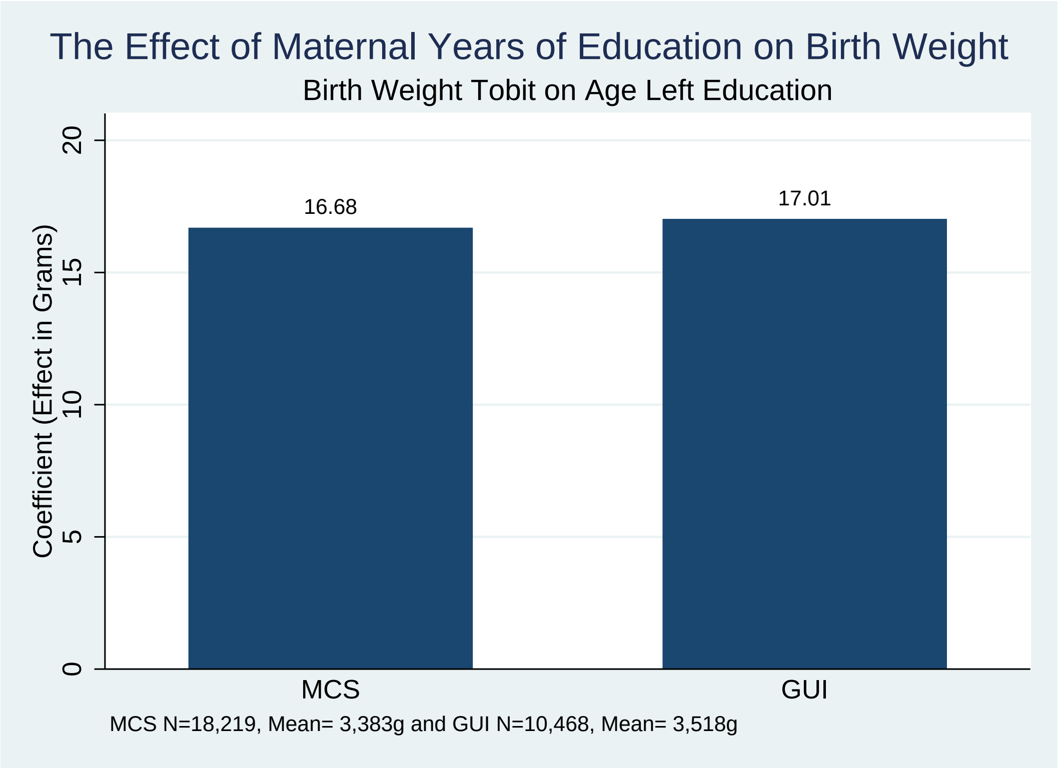


Figure 5: The Socioeconomic Gradient in Birth Weight in the UK and Ireland



5 Consequences of Birth Weight

Next I turn to examine outcomes at age 9 using the second Growing up in Ireland dataset. The main issue of interest will be the effects of birth weight, which is again self reported by the main caregiver. I impose the same restrictions on the data as I did for the analysis of the 9 month cohort, namely I focus on the sample of those children born in Ireland where their mother was identified as the primary caregiver and also exclude non-singleton births. This reduces the sample from 8,568 to 7,282. I present some descriptive statistics and then the results of a regression analysis in table 4. Figure 6 displays the distribution of birth weight in the 9 year data. The mean in the data is 3,546g which is similar to that in the 9 month data.[11] A lower percentage are reported as having been of low birth weight (less than 2,500g) at 3.05%. As evident from figure 6 this varible has also been censored at 1.7kg and 4.9kg.

I focus on four main outcomes, test scores on the official Drumcondra reading and maths achievement exams,[12] the child's health as assessed by the mother, and whether the child had any stays in hospital. It is important to include this final measure which is not subject to any reference bias that could be present in self assessments. Likewise, although the data do contain information on assessments of performance in school by pupils, parents and teachers, the Drumcondra tests are immune to the doubts surrounding this subjective measures. For each of these outcomes there is a strong bivariate association with birth weight. Figure 7 shows that those who are currently described at age 9 as being sometimes/always ill had an average birth weight of 3,327g, compared to an average of 3,583g for those described as being very healthy. A similar relationship exists with whether the child has had any hospital stays, so this is not just an artifact of self reporting. Figure 8 demonstrates that there is also a relationship between initial health and test scores, both in reading and maths. The raw bivariate relationship suggests that a 1kg increase in birth weight is associated with a .44 increase in reading score, and a .54 increase in maths. The scores are a standardised measure to account for the fact that the tests were administered to different classes, and therefore represent Z scores relative to the peers of the children in the sample. In the population these variables have a mean of zero and a standard deviation of one, implying that the magnitude of the impact of birth weight is large and important, at least on the basis of these raw figures.

However, it is important to allow for the fact that birth weight is likely to be correlated with any number of alternative family characteristics, including but not limited to those identified in the previous section. For example, maternal education is an important predictor of birth weight, but is also likely to be related to test scores. Table 3 presents simple estimates of the relationship between birth weight and some proxies for parental investments in their children. I use a simple weighted regression where birth weight is the only dependent variable. The results suggest that lower birth weight is associated with poorer neighbourhoods as rated by either the parents or the children themselves, and poorer school quality. There is no relationship with a measure of the frequency of parent-child interaction, however lower birth weight does predict higher levels of conflict and dependence on the main caregiver, as well as a higher degree of closeness.[13] While these are simple correlations which tend to disappear when controls for other indicators of socioeconomic status are added, and not intended to represent any causal relationship, they do highlight that low birth weight is associated with a number of other disadvantages. Not accounting for these factors could bias estimates of the effect of birth weight. Even if these measures of a child's environment do not fully explain the relationship between initial health and later outcomes, they may be at least compounding the effects of initial disadvantage. Almond and Currie (2010) discuss a framework for conceptualising investments which interact with initial conditions, and also some previous findings in the literature. Overall the evidence is mixed. Datar et al. (2010) is one example of a study which finds some evidence that parents reinforce endowments, and invest less in children of low birth weight.

[11] According to the official perinatal statistics for 2000, the average birth weight for the population in that year was 3,491g.

[12] For further information see: www.erc.ie/index.php?p=33

[13] Further details on the Pianta scores and other measures collected in the data are available from the GUI study documentation (www.ucd.ie/issda/static/documentation/esri/GUI-Guide9YearCohort.pdf).

Figure 6: Birth Weight Histogram (9 Year Cohort)

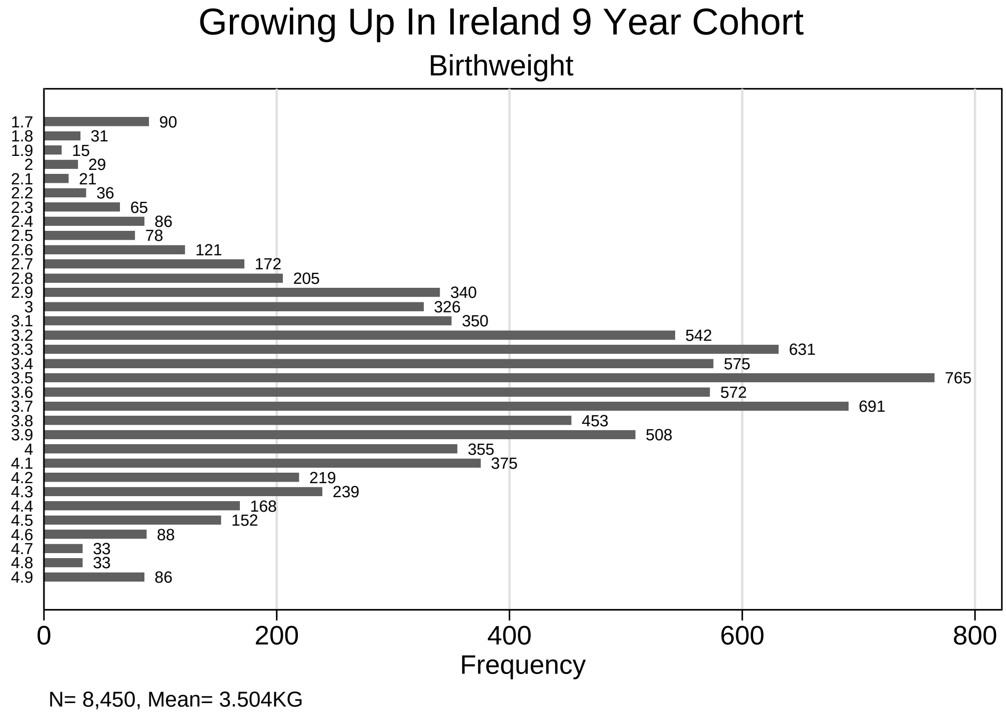


Table 3: Birth Weight and Proxies for Parental Investments

Variables	OLS Neighbourhood	OLS Child's Neighbourhood	OLS School Quality	OLS Parenting Quality	OLS Conflict	OLS Closeness	OLS Dependence
Birth Weight (KG)	0.4640***	0.1491**	0.5240**	0.0474	-0.5910**	-0.2185**	-0.2392***
	(0.107)	(0.060)	(0.256)	(0.071)	(0.252)	(0.106)	(0.093)
Observations	7,200	6,529	5,567	7,227	7,226	7,225	7,225

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

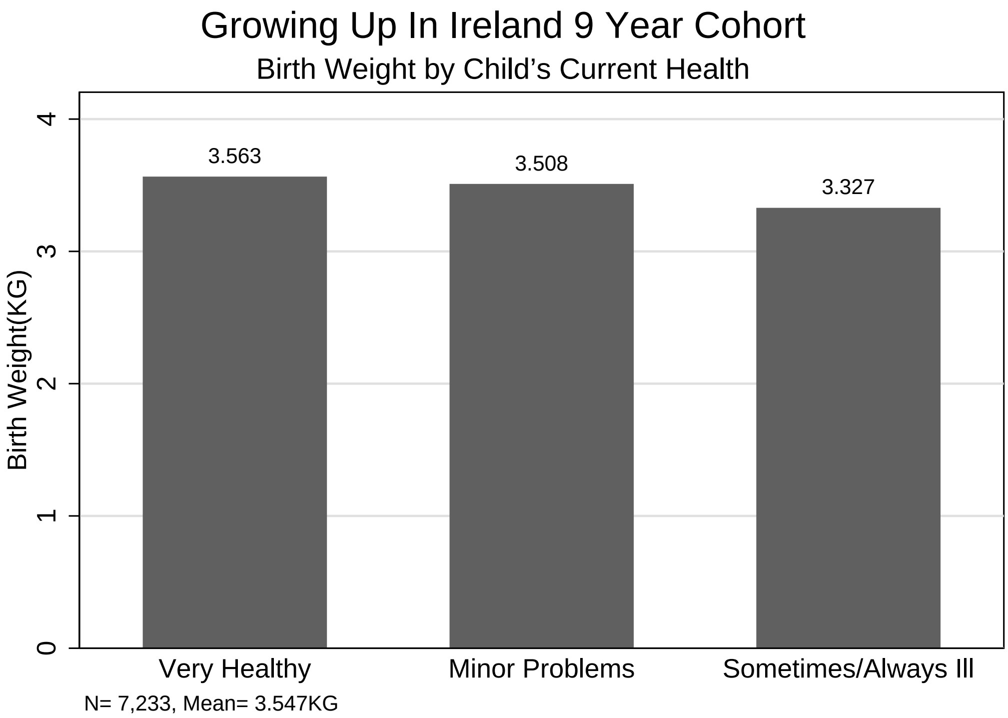
Note: all regressions are weighted. Birth weight is the only independent variable. The neighbourhood quality index is derived from a series of questions on safety in the locality, and is answered by the primary care giver. It ranges from 4 (problems are very common) to 28 (not at all common). The child's rating is derived from a series of questions answered by the child, such as whether they like living in their neighbourhood, and whether the streets are clean. It ranges from 0 (worst) to 15 (best). School quality is measured as the adequacy of school facilities summed across a number of domains, as ranked by the school principal. This index ranges from 17 (poor in all areas) to 68 (excellent in all areas). Parenting quality measures the amount of times per week the family engages in 5 types of activities together, ranging from 5 (all activities everyday) to 20 (never for any activity). Conflict, closeness and dependence with the primary care give are measured using Pianta scores.

Table 4 presents the results from a regression analysis where I model the outcomes described above (namely scores in maths, reading, hospital visits and health at age 9) as a function of birth weight. In the first row I start with a simple specification where I control for the gender of the child, the mother's age and the mother's age squared. As in the previous case all regressions are weighted. The first two columns are OLS regressions where the Drumcondra maths and reading logit scores are the dependent variables, while the third column are the marginal effects from a probit regression of whether the child experienced any stays in hospital, and the final column is an ordered logit showing odds ratios for the mother's assessment of the child's current health. This variable ranges from 1("very healthy") to 3("sometimes/always unwell").[14] For test scores I use a quadratic in birth weight. The coefficient is not significant when doing so for the other outcomes, therefore I conclude that the evidence in favour of

[14] Dichotomising this variable into healthy/unhealthy gives similar results.

non-linearity is restricted to maths and reading scores in these data. Each row presents the coefficient on the birth weight variable only, however the full table for the final specification is presented in the appendix (table 9). For the base specification there is a significant relationship between birth weight and each of the outcomes, for example an increase of 1kg in birth weight is associated with being 5% less likely to have experienced a stay in hospital.[15] As with the 9 month cohort, there are a number of variables with a relatively large proportion of missing values (see table 7 in the appendix), therefore I again compare the results from using a missing value recode to using multiple imputation. As before, results are similar.

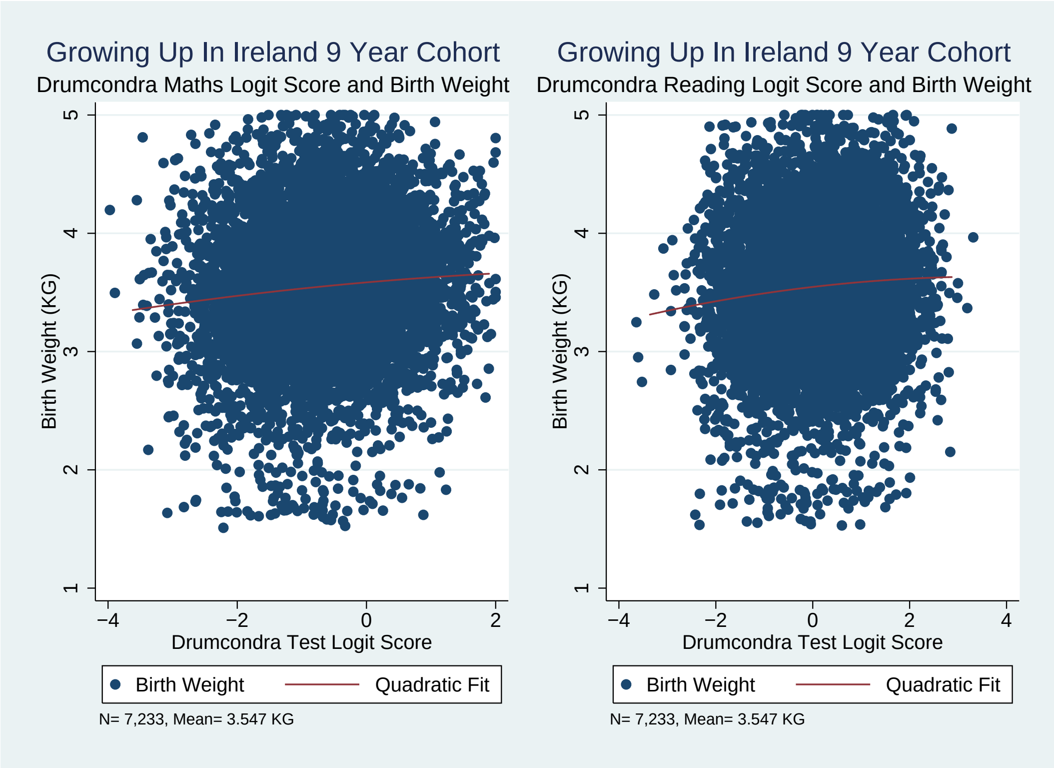
Figure 7: Birth Weight and Health (9 Year Cohort)



The second row adds controls for the current family socioeconomic status and demographics. In addition I also control for neighbourhood and school quality. Specifically, the additional variables include the household's ability to make ends meet, number of siblings in the household, rural location, household type, household social class, household income quintile, mother's and father's education, an index of area quality, the child's perception of their local neighbourhood, an index measuring school quality, and the proportion of parents who attend parent teacher meetings at the child's school. I therefore attempt to account for the possibility that individuals who experience lower birth weights may be more likely to live in areas with more social problems, or attend lower quality schools. Each of these factors has the potential to distort the true relationship between birth weight and later outcomes, but fortunately the data provide a number of measures which proxy for school and area quality, along with parental investments. Adding these control variables has the effect of halving the coefficients for maths and reading scores, although the effect of birth weight remains significant, and the coefficients on hospital stays and health are relatively unaffected. Caution is required interpreting the other coefficients in the regression. As I have employed multiple measures of socioeconomic status in an effort to guard against the possibility of confounding the true effect of birth weight with another factor, several of the remaining variables in the regression are collinear. Despite this concern, there is evidence of a clear social gradient in test scores, for example mothers with postgraduate education had children scoring .55 points higher in maths and .79 points higher in reading (compared to the omitted category of no education/primary school only). Interestingly these effects are absent for hospital stays and health. In the case of health this could

[15] 43% of children in the data had experienced an overnight stay in hospital.

Figure 8: Birth Weight and Test Scores (9 Year Cohort)



also be down to the use of different reference categories across social groups. The results for area and school quality indexes are inconsistent across outcomes, however a proxy for the involvement of parents in their children's schools appears to be important for test scores. Being in a school where all parents attend parent teacher meetings is associated with an increase in reading and maths scores of about .1 (relative to the omitted category of less than 90%). The GUI data include a number of psychological measures which document the relationship between parents and their children. This provides an opportunity to examine a set of variables measuring the quality of parenting which are generally not observed in analysing the effects of early life conditions, specifically the child's level of closeness with their mother, conflict and dependence with their mother, mother's depression score, and mother's parenting style. In addition to this, I also include measures of maternal behaviour, specifically health, smoking and drinking characteristics, along with parental height, as before as a proxy for parents' own early life conditions. The third row in table 2 demonstrates that adding these controls further reduces the coefficient on birth weight for test scores, however the magnitude remains statistically significant. The behavioural variables have relatively little effect, although not drinking alcohol at all appears to be a negative. In addition to the Pianta score which measures the relationship between the main caregiver and study child, I construct a variable which details the level of interaction between parent and child. This relates to 5 questions which outline the frequency with which the family sit down to eat together, play games together, talk about things together, do household activities together, and go on outings together. These are answered on a scale of 1 (everyday) to 5 (rarely or never). The index is generated as their sum. This variable is not significant, apart from the regression for reading score, where it enters positively, which is the opposite direction to that expected. Levels of conflict and dependence have a negative effect on test scores, while parenting style has little effect independent of the other control variables. Higher levels of dependence increase the risk of hospital stays, as does an authoritarian parenting style. For health, conflict enters positively, however as this variable is self assessed it may reflect that fact that these parents are likely to have lower standards for assessing their child's health. Maternal height is significant for test scores.

Table 4: Birth Weight and Later Outcomes (Summary)

		OLS	OLS	Probit MFX	Ologit Odds Ratio
Model Controls	Coefficient	Drumcondra Maths Logit Score	Drumcondra Reading Logit Score	Any Hospital Stays	Mother Assessed Health
Basic	Birth Weight (KG)	0.8167***	0.6789***	-0.0490***	0.7477***
		(0.189)	(0.210)	(0.013)	(0.0476)
	Birth Weight Squared	-0.1024***	-0.0822***		
		(0.027)	(0.030)		
+ SES	Birth Weight (KG)	0.5994***	0.4262**	-0.0435***	0.7999***
		(0.174)	(0.193)	(0.014)	(0.052)
	Birth Weight Squared	-0.0791***	-0.0526*		
		(0.025)	(0.027)		
+ Behaviour/Parenting	Birth Weight (KG)	0.5897***	0.3864**	-0.0419***	0.8060***
		(0.173)	(0.191)	(0.014)	(0.054)
	Birth Weight Squared	-0.0810***	-0.0498*		
		(0.025)	(0.027)		

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: All regressions are weighted. Coefficient presented shows the effect of birth weight on the outcome. The full table for the final specification is presented in the appendix (table 9). The basic model controls for child's gender, mother's age and mother's age squared. The socioeconomic controls are the household's ability to make ends meet, rural area, household type, household social class, household income quintile, mother's education, father's education, area quality, area quality rated by child, school quality, and the proportion of parents who attend school meetings. Model 3 adds mother's health, mother smokes, mother drinks, family interaction with child, child's level of conflict, closeness and dependence with mother, mother's depression score, and parenting style, and parental height. The scale used for the mother's assessment of their child's health ranges from ranges from 1("very healthy") to 3("sometimes/always unwell").

As outlined above, the birth weight variable in the data is censored, therefore I also present results from a regression (using the same specification as the final row of table 4) which uses a dummy variable for low birth weight (less than 2,500g). The results are similar to those for the continuous measure.[16] Being low birth weight has a large impact on test scores, and the probability of having stayed in hospital. Curiously there appears to be no effect on self rated health. I also examine macrosomy, and find that there is little evidence of adverse effects of being born over either 4,000g (approximately 20% of the sample) or 4,500g (approximately 3% of the sample), at least independent of the control variables in the model. However this could be due to the relatively small numbers in this category. I conclude that the effect of birth weight is robust to including a wide range of potential confounding factors including socioeconomic status, neighbourhood and school characteristics, maternal behaviour, and measures of parenting style and interaction with the study child. In an alternative specification I have also controlled for additional psychological variables including measures of the parents' marriage (Dyadic Adjustment Scale), the child's mental health (Piers-Harris self concept scale), temperment(EAS scale), and behaviour (the Strengths and Difficulties questionnaire answered by both the primary caregiver and the teacher). Ideally variables which could represent the pathway through which the effects of birth weight are operating (such as poor behaviour in school) should not be controlled, but in any case adding these additional measures makes little difference to the results. As in section 3 I consider adding further information on paternal characteristics such as health, smoking and employment status and as before, this has little effect.

There is some evidence in the literature that girls are more resilient to poor early life conditions than boys, for example infant mortality is generally higher among males (Drevenstedt et al., 2008). I split the sample by gender and in table 6 present the results from the final specification in table 4. These estimates suggest that males are more adversely affected by low birth weight; for females birth weight only has an effect on mother's assessed health. Consistent with previous evidence (such as Lin and Liu, 2009), effects on reading scores are smaller for each gender.

[16] On the basis of these results, some groups within society are likely to be highly disadvantaged from poor initial health. For example, Irish travellers (Hamid et al., 2010).

Table 5: Low Birth Weight and Later Outcomes

Variables	OLS Maths Logit Score	OLS Reading Logit Score	Probit MFX Any Hospital Stays	Ologit Odds Ratio Self Assessed Health
Low Birth Weight	-0.2144***	-0.1766**	0.1295***	1.2726
	(0.071)	(0.078)	(0.041)	(0.252)
Observations	7,096	7,025	7,190	7,190
R-squared	0.171	0.198		

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
All regressions are weighted. Coefficient shows effect of LBW on outcome, final specification from table 3.

Table 6: Low Birth Weight and Gender

Variables	OLS Maths Logit Score	OLS Reading Logit Score	Probit MFX Any Hospital Stays	Ologit Odds Ratio Self Assessed Health
		Male		
Birth Weight	0.7829***	0.3794	-0.0515***	0.7906**
	(0.236)	(0.256)	(0.019)	(0.075)
Birth Weight Squared	-0.1033***	-0.0477		
	(0.033)	(0.036)		
Observations	3,423	3,393	3,482	3,482
R-squared	0.187	0.197		
		Female		
Birth Weight	0.3764	0.2376	-0.0307	0.8068**
	(0.258)	(0.280)	(0.019)	(0.080)
Birth Weight Squared	-0.0581	-0.0299		
	(0.038)	(0.040)		
Observations	3,643	3,602	3,678	3,678
R-squared	0.177	0.227		

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
All regressions are weighted. Coefficient shows effect of birth weight on outcome, final specification from table 3.

I also investigate heterogeneity in the effects of birth weight by considering how the effect of birth weight varies across the distribution of ability by using quantile regression. Figures 11 and 12 show the OLS (dotted) estimate compared with the quantile estimates in dark green, and the 95% confidence interval for the quantile estimates in grey. For maths, the effect of birth weight is largest at the middle of the ability distribution, and generally statistically different from zero. The effect is not distinguishible from the OLS estimate, apart from a small range between the 20th and 40th deciles. For reading scores there is some evidence of a decreasing effect across ability, however the estimate is never different from the OLS estimate. An important caveat here is that the quantile estimates are not weighted, which is likely to overestimate the effects of birth weight in the population. A tentative conclusion from this analysis is that there is some heterogeneity in the effect of birth weight, in that those in the middle of the ability distribution are most affected, however in a statistical sense these effects do not differ from the average. However, this is likely to be due in part to the reduced sample size in each quantile.

Figure 9: Quantile Regression: Reading Scores

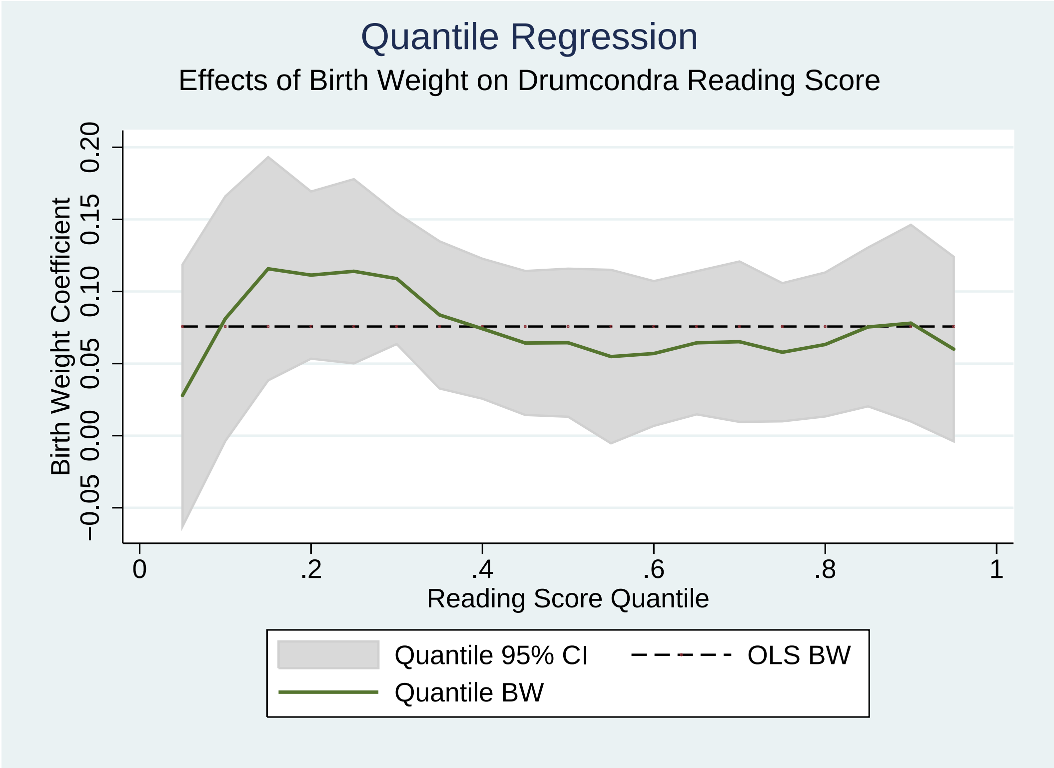
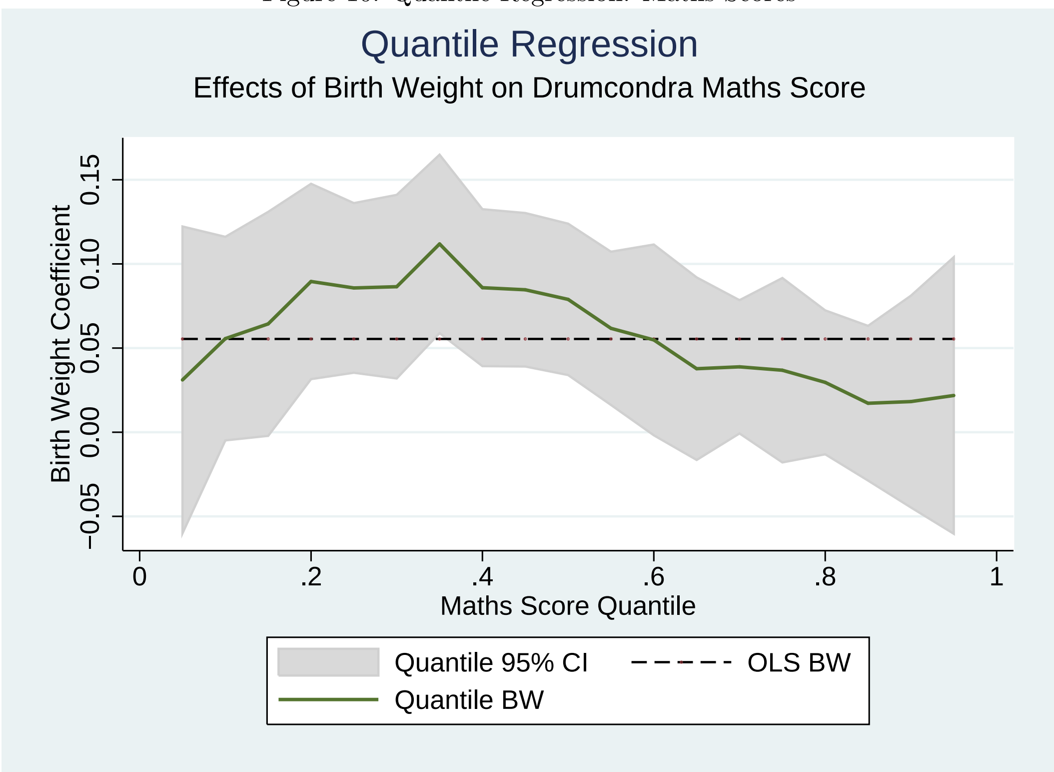


Figure 10: Quantile Regression: Maths Scores



6 Conclusions

There is a strong social gradient in birth weight in Ireland, independent of how socioeconomic status is measured, or whether birth weight is taken as continuous or there being a cut off at 2,500g.[17] There are several important determinants of birth weight, including parental education and behaviour, however the effects of maternal education are rendered statistically insignificant once a proxy for her early life conditions is added. Other important associations include household type, gender, smoking behaviour, absence of a mother's family, maternal health, maternal employment, weight gain during pregnancy, the timing of the birth, and the absence of pregnancy complications. I am unable to address the endogeneity of these inputs using these data. A comparison with the Millennium Cohort Study in the UK reveals similar inequalities in early life conditions. This is important as there is a body of evidence which suggests that there are lasting causal effects of birth weight on later outcomes. I establish that for the Irish data, birth weight predicts a number of measures at age 9 including test scores, and health. These findings are independent of the effects of current socioeconomics status and parental behaviour, and neither are they explained by what are arguably measures of parental investments in their children, specifically the quality of a child's neighbourhood and school, and psychological variables which measure parenting quality and style. The effects of birth weight are non-linear for test scores, and mainly concentrated on males. Using a quantile regression analysis I establish that there some evidence for a degree of heterogeneity in the effect of birth weight by ability. Accounting for missing values with multiple imputation has little impact on the results for either cohort.

There are important limitations to this study. The results presented here are associations, and there is the potential for some omitted variable to be biasing these estimates, therefore it is important to be cautious about drawing any conclusion with respect to causality. In particular, the role of genetics cannot be ruled out on the basis of the models used in this analysis. Nevertheless, I am able to control for a wide range of family background characteristics, many of which are typically not available in survey data. Taken in the context of the previous literature, particularly the results from siblings and twin studies, there is reason to believe that the effects presented here have a causal component. If this is the case then this paper adds further weight to the view that there is scope for improving the outcomes of disadvantaged children by targeting initial health, particularly given the likelihood that birth weight has some component which reflects intergenerational transmission. A summary of potentially effective public polices in this area is outline in Almond and Currie (2010).

[17] I reaffirm the results presented in McAvoy et al. (2006) using richer survey data which for the first time in Ireland includes information on initial health.

7 Appendix

Figure 11: Birth Weight and Sleeplessness (9 Month Cohort)

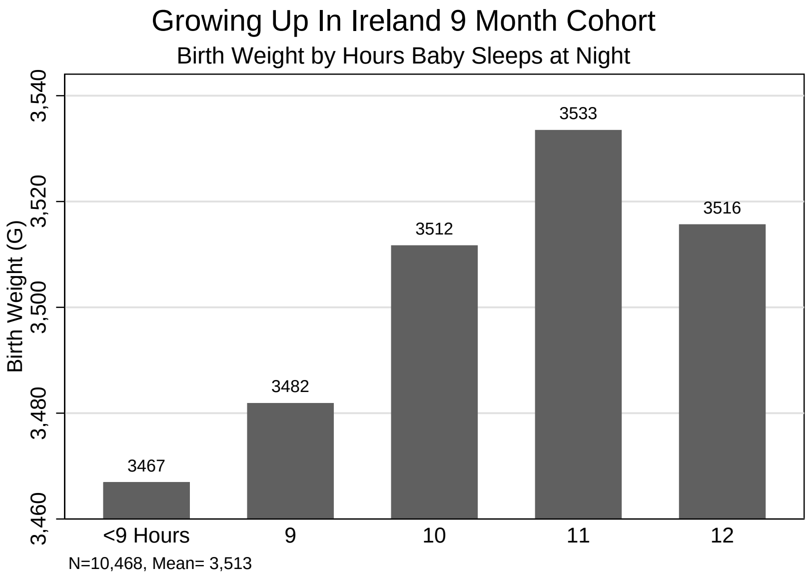


Figure 12: Birth Weight and ASQ Scores (9 Month Cohort)

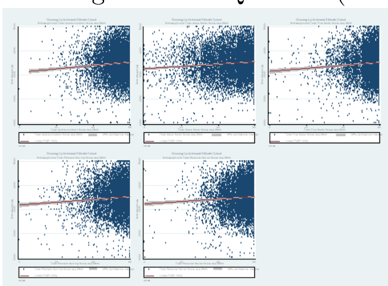


Table 7: Missing Values in GUI

GUI 9 Month Cohort		GUI 9 Year Cohort	
Variable	Missing Values	Variable	Missing Values
Weeks Aware of Pregnancy	266	Drumcondra Reading Logit Score	172
Weeks First Ante-Natal Appointment	331	Household Class	370
Gained Weight During Pregnancy	1409	Equivalised Household Annual Income Quintiles	532
Mother Age Left Education	200	Highest Education Level of Father	1175
Father Age Left Education	2578	Child's Rating of Local Area	712
Mother's Height	389	School Quality Index	1678
Father's Height	2541	Percentage of Parents who Attend Parent Teacher Meetings	453
Equivalised Household Annual Income Quintiles	806	Mother's Depression Score	576
Neighbourhood Safety Problems	131	Mother's Height	375
Birth Weight	114	Father's Height	1421
		Mother's Parenting Style	468

Table shows variables which have more than 100 missing values for each cohort

Table 8: Determinants of Birth Weight - Full Table

Variables	Birth Weight Tobit	Birth Weight Tobit	Birth Weight Tobit	Birth Weight Tobit	Birth Weight Tobit	Birth Weight Tobit (With MI)
Mother's Age	26.1*	18.2	18.6	1.1	6.5	9.6
	(14.115)	(14.663)	(14.288)	(12.622)	(12.390)	(11.253)
Mother's Age Squared	-0.3	-0.3	-0.4	-0.0	-0.1	-0.2
	(0.233)	(0.240)	(0.234)	(0.207)	(0.203)	(0.184)
Mother Over 40	-38.4	-16.5	-19.0	-10.2	-5.0	-4.6
	(33.652)	(33.451)	(33.022)	(29.725)	(30.283)	(27.289)
Female	-123.5***	-130.8***	-131.5***	-134.2***	-124.2***	-117.2***
	(12.371)	(12.295)	(12.074)	(10.930)	(10.849)	(10.347)
HH Income: Missing	-0.6	13.4	7.9	1.2	3.2	
	(29.649)	(30.408)	(29.998)	(27.009)	(26.897)	
HH Income: 2nd Quintile	23.2	21.8	24.8	10.3	10.8	15.5
	(22.141)	(22.468)	(21.938)	(19.940)	(19.977)	(18.313)
HH Income: 3rd Quintile	39.2*	46.4**	41.4*	23.4	19.7	13.0
	(22.137)	(23.391)	(22.896)	(20.409)	(20.251)	(19.044)
HH Income: 4th Quintile	56.9**	92.7***	78.4***	70.0***	65.5***	57.3***
	(22.219)	(24.169)	(23.790)	(21.408)	(21.297)	(19.852)
HH Income: Highest Quintile	9.6	64.1**	44.6*	22.9	9.0	5.1
	(23.133)	(25.625)	(25.345)	(22.501)	(22.434)	(21.727)
Mother Age Left Education	9.2***	11.8***	7.8***	5.6**	0.6	1.1
	(2.606)	(2.683)	(2.667)	(2.412)	(2.429)	(2.252)
Father Age Left Education	6.0**	8.9***	7.4***	7.4***	7.5***	6.3***
	(2.521)	(2.598)	(2.578)	(2.353)	(2.347)	(2.064)
Father's Education Missing	73.8	161.0***	133.3**	129.4***	153.6**	
	(51.560)	(54.722)	(54.226)	(49.551)	(63.660)	
HH Social Class: Managerial and technical		-24.8	-21.8	-17.9	-17.5	-15.6
		(17.348)	(17.281)	(15.822)	(16.036)	(14.756)
HH Social Class: Non-manual		10.6	14.6	21.8	25.2	25.1
		(21.427)	(21.213)	(19.325)	(19.602)	(18.461)
HH Social Class: Skilled manual		-10.6	9.5	11.3	19.7	13.1
		(24.258)	(24.195)	(22.352)	(22.549)	(21.236)
HH Social Class: Semi-skilled		-39.9	-9.3	7.8	9.9	13.4
		(30.769)	(30.030)	(26.887)	(27.117)	(25.013)
HH Social Class: Unskilled		-80.2*	-52.0	-23.6	1.5	-9.2
		(48.653)	(46.638)	(44.396)	(43.779)	(39.260)
HH Social Class: Others occupied		-21.7	-64.6	-50.5	-26.8	-45.7
		(82.529)	(87.777)	(75.078)	(70.964)	(58.076)
HH Social Class: Never worked		-28.7	-1.4	10.6	13.4	17.4
		(38.308)	(37.403)	(34.105)	(33.828)	(31.871)
Number of Siblings in Household		31.0***	31.9***	23.0**	19.1**	19.9**
		(10.852)	(10.637)	(9.715)	(9.690)	(8.714)
HH Type: Parent 1 Child		-99.0**	-69.8	-83.5**	-106.1***	-62.2
		(43.364)	(42.561)	(37.924)	(38.148)	(42.191)
HH Type: Parent 2+Children		-88.6**	-55.4	-31.3	-51.6	-50.6*
		(40.541)	(38.561)	(36.011)	(35.907)	(29.331)
HH Type: 2 Parents 1 Child		-124.8***	-126.2***	-124.0***	-133.4***	-120.9***
		(20.491)	(20.133)	(18.142)	(18.114)	(16.568)
Rural Area		32.5**	29.7**	27.8**	24.1**	21.3**
		(12.823)	(12.668)	(11.381)	(11.288)	(10.282)
Mother Not Born in Ireland		3.1	17.4	1.0	3.2	-11.1
		(15.839)	(17.382)	(15.922)	(16.005)	(14.274)
Nhood Safety Problems		-7.4***	-5.5**	-3.3	-3.3	-2.8
		(2.474)	(2.409)	(2.177)	(2.138)	(1.999)
Someone in HH Smoked During Pregnancy			-36.8**	-36.7***	-28.9**	-25.4**
			(15.239)	(13.623)	(13.517)	(12.239)
Help: Mother doesn't get enough help			21.2	35.4*	22.0	13.7
			(21.966)	(19.453)	(19.270)	(17.791)
Help: Mother doesn't get any help at all			24.9	20.9	3.9	5.8
			(27.956)	(24.336)	(24.150)	(21.585)
Help: Mother doesn't need any help			32.9	18.1	4.3	16.9
			(27.389)	(25.828)	(25.415)	(23.590)
Help: Family not living in the country			-99.5***	-107.0***	-112.4***	-103.2***
			(28.981)	(25.965)	(25.961)	(23.100)
Help: Don't Know about Help			104.2	91.1	29.9	-158.3
			(164.592)	(162.848)	(127.438)	(132.929)
Mother's health: Very good health			-2.3	-2.6	2.4	2.3
			(14.139)	(12.898)	(12.805)	(11.719)
Mother's health: Good			-13.9	-8.8	-2.7	1.2
			(17.069)	(15.571)	(15.523)	(14.094)
Mother's health: Fair			-73.7**	-44.3	-24.8	-9.2
			(30.997)	(26.965)	(26.358)	(24.299)
Mother's health: Poor			-99.5	-151.4**	-132.0*	-86.7
			(76.597)	(72.474)	(69.831)	(59.904)
Mother Smokes: Occasionally			137.4***	118.3***	126.7***	108.5***
			(26.545)	(24.023)	(23.723)	(21.795)
Mother Smokes: Not at all			183.7***	174.5***	180.8***	170.9***
			(19.889)	(17.664)	(17.437)	(15.947)
Mother Drinks: Less than once a month			22.3	11.0	4.4	-1.0
			(20.513)	(18.792)	(18.765)	(17.091)
Mother Drinks: 1-2 times a month			37.5*	28.1	6.3	4.7
			(20.424)	(18.749)	(18.625)	(17.147)
Mother Drinks: 1-2 times a week			32.4	21.6	3.0	-1.3
			(20.899)	(19.047)	(19.029)	(17.198)
Mother Drinks: 3-4 times a week			72.9**	34.3	12.9	3.4
			(33.330)	(29.651)	(29.270)	(27.140)
Mother Drinks: 5-6 times a week			-15.6	-49.3	-77.7	-97.7*
			(82.903)	(59.949)	(57.534)	(56.663)
Weeks before birth mother stopped working				10.5***	9.5***	9.2***
				(2.356)	(2.295)	(2.071)
Weeks before birth NA/Missing				54.3***	46.3**	49.5***
				(19.233)	(18.998)	(17.085)
Weeks become aware of pregnancy				0.7	0.4	0.2
				(2.668)	(2.664)	(2.335)
Weeks first ante-natal appointment				2.8*	2.7	2.3
				(1.625)	(1.654)	(1.468)
Weeks aware missing				-50.5	-26.5	
				(256.731)	(257.795)	
Weeks appointment Missing				-361.1**	-331.4**	
				(157.615)	(161.958)	
Gained weight during pregnancy (kilos)				13.9***	12.2***	11.4***
				(1.057)	(1.041)	(0.921)
Missing weight gain				-1,207.9***	-1,054.8***	
				(92.358)	(91.052)	
Birth Timing: Very early (32 weeks or less)				-1,299.3***	-1,272.7***	-821.3***
				(84.333)	(82.856)	(31.538)
Birth Timing: Somewhat early (33-36 weeks)				-722.6***	-719.9***	-608.4***
				(33.178)	(32.691)	(24.540)
Birth Timing: Late birth (42 weeks or more)				236.5***	228.5***	216.2***
				(16.774)	(16.776)	(15.423)
No Pregnancy Complications				57.3***	55.9***	48.3***
				(11.025)	(10.913)	(10.038)
Mother's Measured Height					14.8***	14.0***
					(0.912)	(0.839)
Father's Measured Height					5.8***	6.0***
					(0.917)	(0.991)
Missing Father's Height					1,008.2***	
					(168.522)	
Constant	2,788.7***	2,990.4***	2,950.8***	2,960.0***	-438.4	-352.8
	(210.165)	(227.095)	(224.158)	(200.373)	(279.827)	(282.355)
Observations	10,272	10,135	10,133	10,129	9,773	10,582

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: the omitted categories are as follows. For household income "1st Quintile", for household social class "Professional", for household type "2 Parents 2+ Children", for help "mother gets enough help", for maternal health "excellent health", for maternal smoking "smoke daily", and for maternal drinking "never drink". The final column presents results where missing values are imputed from all the other variables in the model. A tobit is used, however as before OLS gives similar results. 5 imputations are used, however results are also similar to when 50 imputations are employed. I use the chained equation approach detailed in Royston (2009).

Table 9: Effects of Birth Weight - Full Table

Variables	OLS Drumcondra Maths Logit Score	OLS Drumcondra Reading Logit Score	Probit MFX Any Hospital Stays	Ologit Odds Ratio Mother's Assessed Health
Birth Weight (KG)	0.5897***	0.3864**	-0.0419***	0.8060***
	(0.173)	(0.191)	(0.014)	(0.054)
Birth Weight Squared	-0.0810***	-0.0498*		
	(0.025)	(0.027)		
Female	-0.0709***	0.0737***	-0.0713***	0.9507
	(0.026)	(0.028)	(0.015)	(0.068)
Mother's Age	0.0412	0.0409	0.0048	1.1133
	(0.028)	(0.031)	(0.017)	(0.090)
Mother's Age Squared	-0.0003	-0.0003	-0.0001	0.9986
	(0.000)	(0.000)	(0.000)	(0.001)
Number of Siblings in Household	-0.0275	-0.0998***	-0.0455***	0.8932**
	(0.020)	(0.020)	(0.012)	(0.051)
HH Make Ends Meet: With difficulty	0.0244	0.3142***	0.0490	1.5890
	(0.114)	(0.122)	(0.071)	(0.491)
HH Make Ends Meet: With some difficulty	0.1174	0.2675***	0.0259	1.3385
	(0.100)	(0.101)	(0.062)	(0.368)
HH Make Ends Meet: Fairly easily	0.1122	0.2386**	0.0224	1.1501
	(0.101)	(0.102)	(0.062)	(0.317)
HH Make Ends Meet: Easily	0.1627	0.2173**	0.0464	1.2301
	(0.103)	(0.104)	(0.064)	(0.344)
HH Make Ends Meet: Very easily	0.0869	0.1883*	0.0344	1.1694
	(0.107)	(0.110)	(0.066)	(0.345)
Rural	-0.0709***	-0.0758***	0.0148	1.0109
	(0.027)	(0.028)	(0.015)	(0.074)
HH Type: Single Parent 1 or 2 children	-0.0409	0.0758	-0.0484	0.9687
	(0.084)	(0.089)	(0.048)	(0.221)
HH Type: Single Parent 3 or more children	-0.1318	-0.0400	-0.1289**	0.6891
	(0.097)	(0.100)	(0.051)	(0.181)
HH Type: Couple 1 or 2 children	-0.0739*	-0.0568	-0.0249	1.0055
	(0.039)	(0.042)	(0.023)	(0.109)
HH Social Class: Missing	-0.1100	-0.0805	0.1319***	1.4124
	(0.086)	(0.091)	(0.049)	(0.309)
HH Social Class: Managerial and Technical	-0.0394	-0.0162	0.0232	0.8455
	(0.045)	(0.044)	(0.025)	(0.105)
HH Social Class: Non-manual	-0.0770	-0.0738	0.0104	0.8913
	(0.054)	(0.054)	(0.030)	(0.129)
HH Social Class: Skilled manual	-0.1520***	-0.1593***	0.0402	0.8423
	(0.057)	(0.058)	(0.032)	(0.132)
HH Social Class: Semi-skilled	-0.0950	0.0113	-0.0275	1.0071
	(0.065)	(0.065)	(0.037)	(0.182)
HH Social Class: Unskilled	-0.0293	-0.0678	0.0817	0.8989
	(0.103)	(0.109)	(0.062)	(0.252)
HH Income: Missing	0.0683	0.0701	0.0046	0.9047
	(0.060)	(0.062)	(0.036)	(0.149)
HH Income: 2nd Quintile	0.0865*	0.0885*	0.0167	1.1002
	(0.049)	(0.053)	(0.029)	(0.146)
HH Income: 3rd Quintile	0.0625	0.0703	-0.0009	1.0043
	(0.050)	(0.054)	(0.030)	(0.139)
HH Income: 4th Quintile	0.1393***	0.1445**	-0.0232	0.8064
	(0.051)	(0.057)	(0.030)	(0.117)
HH Income: Highest Quintile	0.1247**	0.1050*	-0.0005	0.7243**
	(0.055)	(0.059)	(0.032)	(0.112)
Mother's Education: Lower Sec	0.1610**	0.2254***	0.0049	0.9868
	(0.072)	(0.077)	(0.041)	(0.179)
Mother's Education: Hi Sec/TechVoc/UppSec+Tech/Voc	0.3547***	0.3385***	0.0134	0.8458
	(0.070)	(0.075)	(0.041)	(0.156)
Mother's Education: Non Degree	0.3954***	0.4496***	0.0349	0.9108
	(0.074)	(0.081)	(0.044)	(0.178)
Mother's Education: Primary	0.5439***	0.6577***	0.0492	1.0112
	(0.077)	(0.084)	(0.047)	(0.212)
Mother's Education: Postgrad	0.4699***	0.6923***	0.0046	0.9861
	(0.082)	(0.089)	(0.049)	(0.223)
Father's Education: Missing	0.0945	0.1449	-0.0404	0.7229
	(0.106)	(0.103)	(0.061)	(0.192)
Father's Education: Lower Sec	0.0045	0.1104	0.0202	0.7993
	(0.065)	(0.069)	(0.040)	(0.137)
Father's Education: Hi Sec/TechVoc/UppSec+Tech/Voc	0.1935***	0.3366***	0.0345	0.7665
	(0.065)	(0.069)	(0.040)	(0.135)
Father's Education: Non Degree	0.1284*	0.2807***	-0.0301	1.0146
	(0.070)	(0.075)	(0.042)	(0.193)
Father's Education: Primary	0.1928***	0.4151***	-0.0123	0.9842
	(0.074)	(0.078)	(0.045)	(0.194)
Father's Education: Postgrad	0.2694***	0.4632***	-0.0449	0.6902*
	(0.077)	(0.082)	(0.046)	(0.145)
Area Index	0.0039	0.0029	-0.0015	0.9774**
	(0.004)	(0.004)	(0.002)	(0.010)
Child Area Index	0.0216***	0.0066	-0.0036	0.9751
	(0.007)	(0.007)	(0.004)	(0.018)
Child Area Index Missing	0.2657***	0.0501	-0.0341	0.8371
	(0.094)	(0.103)	(0.055)	(0.214)
School Quality Index	0.0006	-0.0008	-0.0001	1.0006
	(0.002)	(0.002)	(0.001)	(0.004)
School Quality Index Missing	0.0651	-0.0574	0.0005	1.0871
	(0.082)	(0.085)	(0.046)	(0.234)
% Parents Attend School Meetings: Missing	0.1497***	0.2451***	0.0078	1.1632
	(0.058)	(0.062)	(0.034)	(0.186)
% Parents Attend School Meetings: 91 - 95%	0.0594*	0.0830**	0.0115	1.1729
	(0.036)	(0.038)	(0.021)	(0.115)
% Parents Attend School Meetings: 96 - 98%	0.0574	0.0255	0.0252	1.0222
	(0.042)	(0.043)	(0.024)	(0.114)
% Parents Attend School Meetings: 99 - 99%	0.0642	0.0762*	-0.0038	1.1050
	(0.039)	(0.044)	(0.024)	(0.125)
% Parents Attend School Meetings: 100%	0.0917**	0.1117***	0.0216	0.9751
	(0.042)	(0.042)	(0.024)	(0.113)
Mother's Health: Very good	0.0208	0.0123	0.0103	1.4824***
	(0.029)	(0.031)	(0.017)	(0.130)
Mother's Health: Good	-0.0151	-0.0712*	0.0505**	2.0262***
	(0.038)	(0.039)	(0.021)	(0.206)
Mother's Health: Fair	-0.0601	-0.1500**	0.0652*	2.3267***
	(0.066)	(0.066)	(0.037)	(0.354)
Mother's Health: Poor	0.0779	0.1602	0.1536*	6.5647***
	(0.169)	(0.243)	(0.083)	(2.144)
Mother Smokes: Occasionally	-0.0527	-0.0499	0.0118	1.0591
	(0.056)	(0.059)	(0.034)	(0.161)
Mother Smokes: Not at all	0.0391	0.0847**	-0.0194	1.0144
	(0.035)	(0.036)	(0.020)	(0.094)
Mother Drinks: Less than once a month	0.1422***	0.0408	-0.0323	1.3742**
	(0.046)	(0.048)	(0.027)	(0.174)
Mother Drinks: 1-2 times a month	0.0153	-0.0443	-0.0277	1.0996
	(0.044)	(0.046)	(0.026)	(0.137)
Mother Drinks: 1-2 times a week	0.0673	0.0714*	-0.0566**	1.1149
	(0.041)	(0.043)	(0.024)	(0.128)
Mother Drinks: 3-4 times a week	0.1119**	0.1460***	-0.0749**	1.0884
	(0.054)	(0.056)	(0.030)	(0.164)
Mother Drinks: 5-6 times a week	0.2015**	0.1199	-0.0447	1.2215
	(0.089)	(0.118)	(0.061)	(0.365)
Mother Drinks: Everyday	-0.0855	0.0990	-0.0838	0.9623
	(0.143)	(0.186)	(0.092)	(0.404)
Family Interaction With Child Index	0.0084	0.0193***	-0.0045	1.0118
	(0.005)	(0.006)	(0.003)	(0.015)
Level of conflict with primary caregiver	-0.0079***	-0.0068***	0.0000	1.0147***
	(0.002)	(0.002)	(0.001)	(0.004)
Level of closeness with primary caregiver	-0.0007	0.0067*	0.0008	0.9840*
	(0.004)	(0.004)	(0.002)	(0.009)
Level of dependence with primary caregiver	-0.0120***	-0.0116***	0.0050**	1.0152
	(0.004)	(0.004)	(0.002)	(0.011)
Total depression score for primary caregiver	-0.0033	0.0022	0.0038	1.0137
	(0.004)	(0.004)	(0.002)	(0.011)
Depression Score Missing	-0.1132**	-0.1014*	0.0012	1.0222
	(0.051)	(0.054)	(0.029)	(0.137)
Parenting Style: Missing	-0.0431	-0.0077	-0.0351	1.0443
	(0.055)	(0.062)	(0.029)	(0.154)
Parenting Style: Authoritarian	-0.0164	0.0611	0.0828**	0.7921
	(0.071)	(0.076)	(0.042)	(0.153)
Parenting Style: Permissive	-0.0691*	-0.0989***	-0.0217	0.9518
	(0.036)	(0.036)	(0.020)	(0.097)
Parenting Style: Neglectful	-0.1838**	-0.2029**	0.0848	0.9533
	(0.092)	(0.099)	(0.059)	(0.264)
Primary caregivers measured height in cms	0.0088***	0.0068***	0.0025*	0.9969
	(0.002)	(0.002)	(0.001)	(0.006)
PCG Height Missing	1.4479***	1.0755***	0.3268*	0.6563
	(0.389)	(0.401)	(0.182)	(0.682)
Secondary caregivers measured height in cms	0.0038*	0.0041*	-0.0013	0.9951
	(0.002)	(0.002)	(0.001)	(0.006)
SCG Height Missing	0.6910*	0.7316*	-0.1678	0.4356
	(0.384)	(0.404)	(0.217)	(0.480)
Constant	-5.6667***	-4.8249***		
	(0.823)	(0.923)		
Observations	7,066	6,995	7,160	7,160
R-squared	0.171	0.200		

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: the omitted categories are as follows. For making ends meet "with great difficulty", for household income "1st Quintile", for household social class "professional", for household type "2 Parents 2+ Children", for maternal and paternal education "none/primary", for attendance at school meetings "<90%", for maternal health "excellent", for maternal smoking "smoke daily", for maternal drinking "never drink", and for parenting style "authoritative". Mother's assesment of their child's health ranges from ranges from 1("very healthy") to 3("somtimes/always unwell").

Table 10: Effects of Birth Weight - Full Table MI

Variables	OLS Drumcondra Maths Logit Score	OLS Drumcondra Reading Logit Score	Probit MFX Any Hospital Stays	Ologit Odds Ratio Mother's Assessed Health
Birth Weight (KG)	0.6122***	0.4103**	-0.0404***	0.8084***
	(0.180)	(0.192)	(0.014)	(0.055)
Birth Weight Squared	-0.0852***	-0.0545**		
	(0.026)	(0.027)		
Female	-0.0686***	0.0781***	-0.0743***	0.9276
	(0.026)	(0.028)	(0.015)	(0.066)
Mother's Age	0.0546*	0.0705**	0.0109	1.1781**
	(0.029)	(0.031)	(0.017)	(0.094)
Mother's Age Squared	-0.0005	-0.0007*	-0.0002	0.9978**
	(0.000)	(0.000)	(0.000)	(0.001)
Number of Siblings in Household	-0.0249	-0.0924***	-0.0479***	0.8871**
	(0.020)	(0.021)	(0.012)	(0.052)
HH Make Ends Meet: With difficulty	0.0176	0.2992**	0.0440	1.4118
	(0.112)	(0.118)	(0.072)	(0.433)
HH Make Ends Meet: With some difficulty	0.1039	0.2498**	0.0257	1.1904
	(0.098)	(0.099)	(0.063)	(0.323)
HH Make Ends Meet: Fairly easily	0.0905	0.2159**	0.0275	1.0261
	(0.099)	(0.100)	(0.063)	(0.280)
HH Make Ends Meet: Easily	0.1319	0.1983*	0.0459	1.0703
	(0.101)	(0.102)	(0.064)	(0.296)
HH Make Ends Meet: Very easily	0.0587	0.1639	0.0404	1.0589
	(0.106)	(0.108)	(0.067)	(0.310)
Rural	-0.0725***	-0.0815***	0.0148	1.0104
	(0.027)	(0.029)	(0.015)	(0.074)
HH Type: Single Parent 1 or 2 children	0.0728	0.1393*	-0.0428	0.9636
	(0.073)	(0.078)	(0.041)	(0.186)
HH Type: Single Parent 3 or more children	-0.0408	-0.0164	-0.0947**	0.7672
	(0.086)	(0.087)	(0.044)	(0.163)
HH Type: Couple 1 or 2 children	-0.0705*	-0.0367	-0.0190	1.0183
	(0.039)	(0.043)	(0.023)	(0.112)
HH Social Class: Managerial and Technical	-0.0273	-0.0027	0.0198	0.8578
	(0.047)	(0.047)	(0.026)	(0.111)
HH Social Class: Non-manual	-0.0583	-0.0521	0.0038	0.8832
	(0.059)	(0.057)	(0.031)	(0.137)
HH Social Class: Skilled manual	-0.1245**	-0.1229*	0.0396	0.8743
	(0.063)	(0.063)	(0.034)	(0.144)
HH Social Class: Semi-skilled	-0.0878	0.0114	-0.0219	0.9813
	(0.073)	(0.075)	(0.041)	(0.188)
HH Social Class: Unskilled	-0.0287	-0.0277	0.0701	0.9024
	(0.128)	(0.139)	(0.074)	(0.276)
HH Income: 2nd Quintile	0.0776	0.0886*	-0.0076	1.0422
	(0.047)	(0.051)	(0.027)	(0.136)
HH Income: 3rd Quintile	0.0547	0.0596	-0.0306	0.9200
	(0.051)	(0.053)	(0.028)	(0.123)
HH Income: 4th Quintile	0.1369***	0.1373**	-0.0511*	0.7561*
	(0.051)	(0.055)	(0.029)	(0.108)
HH Income: Highest Quintile	0.1205**	0.0885	-0.0264	0.6641***
	(0.057)	(0.061)	(0.032)	(0.102)
Mother's Education: Lower Sec	0.1477**	0.2470***	0.0269	1.0583
	(0.070)	(0.077)	(0.041)	(0.185)
Mother's Education: Hi Sec/TechVoc/UppSec+Tech/Voc	0.3475***	0.3607***	0.0377	0.9036
	(0.068)	(0.076)	(0.040)	(0.158)
Mother's Education: Non Degree	0.3833***	0.4571***	0.0611	0.9604
	(0.072)	(0.081)	(0.043)	(0.179)
Mother's Education: Primary	0.5258***	0.6583***	0.0743	1.0770
	(0.076)	(0.085)	(0.046)	(0.218)
Mother's Education: Postgrad	0.4519***	0.6976***	0.0350	1.0530
	(0.082)	(0.090)	(0.049)	(0.231)
Father's Education: Lower Sec	0.0713	0.1293*	-0.0040	0.8128
	(0.061)	(0.069)	(0.039)	(0.140)
Father's Education: Hi Sec/TechVoc/UppSec+Tech/Voc	0.2483***	0.3563***	0.0055	0.7620
	(0.064)	(0.073)	(0.040)	(0.141)
Father's Education: Non Degree	0.1924***	0.3252***	-0.0504	0.9536
	(0.068)	(0.078)	(0.042)	(0.189)
Father's Education: Primary	0.2628***	0.4592***	-0.0385	0.9780
	(0.075)	(0.083)	(0.045)	(0.201)
Father's Education: Postgrad	0.3418***	0.5189***	-0.0676	0.7476
	(0.080)	(0.088)	(0.047)	(0.172)
Area Index	0.0041	0.0022	-0.0010	0.9788**
	(0.004)	(0.004)	(0.002)	(0.011)
Child Area Index	0.0215***	0.0069	-0.0036	0.9832
	(0.007)	(0.007)	(0.004)	(0.017)
School Quality Index	0.0004	-0.0005	-0.0002	0.9996
	(0.002)	(0.002)	(0.001)	(0.005)
% Parents Attend School Meetings: 91 - 95%	0.0596*	0.0807**	0.0157	1.1877*
	(0.035)	(0.038)	(0.021)	(0.116)
% Parents Attend School Meetings: 96 - 98%	0.0722*	0.0353	0.0313	1.0666
	(0.042)	(0.043)	(0.023)	(0.118)
% Parents Attend School Meetings: 99 - 99%	0.0712*	0.0743*	0.0013	1.0880
	(0.039)	(0.044)	(0.024)	(0.126)
% Parents Attend School Meetings: 100%	0.0913**	0.0992**	0.0210	0.9873
	(0.041)	(0.042)	(0.024)	(0.113)
Mother's Health: Very good	0.0190	0.0005	0.0014	1.4695***
	(0.029)	(0.031)	(0.017)	(0.129)
Mother's Health: Good	-0.0289	-0.0859**	0.0524**	2.0056***
	(0.038)	(0.039)	(0.021)	(0.203)
Mother's Health: Fair	-0.0634	-0.1860***	0.0669*	2.4484***
	(0.064)	(0.065)	(0.037)	(0.375)
Mother's Health: Poor	-0.0806	0.0325	0.2637***	3.8934***
	(0.209)	(0.231)	(0.080)	(1.570)
Mother Smokes: Occasionally	-0.0314	-0.0168	0.0033	1.0462
	(0.056)	(0.060)	(0.034)	(0.158)
Mother Smokes: Not at all	0.0570	0.0963***	-0.0289	1.0055
	(0.035)	(0.037)	(0.020)	(0.092)
Mother Drinks: Less than once a month	0.1224***	0.0251	-0.0354	1.3360**
	(0.047)	(0.048)	(0.027)	(0.167)
Mother Drinks: 1-2 times a month	-0.0039	-0.0580	-0.0327	1.0242
	(0.045)	(0.046)	(0.026)	(0.127)
Mother Drinks: 1-2 times a week	0.0445	0.0609	-0.0601**	1.0704
	(0.042)	(0.043)	(0.024)	(0.122)
Mother Drinks: 3-4 times a week	0.1039*	0.1474***	-0.0811***	1.0473
	(0.055)	(0.056)	(0.030)	(0.157)
Mother Drinks: 5-6 times a week	0.1894**	0.1231	-0.0609	1.1741
	(0.087)	(0.114)	(0.059)	(0.353)
Mother Drinks: Everyday	-0.1643	0.0248	-0.1115	0.8528
	(0.149)	(0.186)	(0.087)	(0.351)
Family Interaction With Child Index	0.0093*	0.0197***	-0.0058*	1.0067
	(0.005)	(0.006)	(0.003)	(0.015)
Level of conflict with primary caregiver	-0.0088***	-0.0068***	0.0001	1.0128***
	(0.002)	(0.002)	(0.001)	(0.004)
Level of closeness with primary caregiver	-0.0008	0.0085**	-0.0001	0.9800**
	(0.004)	(0.004)	(0.002)	(0.009)
Level of dependence with primary caregiver	-0.0103***	-0.0104**	0.0034	1.0141
	(0.004)	(0.004)	(0.002)	(0.011)
Total depression score for primary caregiver	-0.0030	0.0011	0.0031	1.0180
	(0.004)	(0.004)	(0.002)	(0.011)
Parenting Style: Authoritarian	-0.0068	0.0667	0.0716*	0.8432
	(0.069)	(0.073)	(0.041)	(0.163)
Parenting Style: Permissive	-0.0551	-0.0685*	-0.0211	0.9711
	(0.037)	(0.037)	(0.021)	(0.100)
Parenting Style: Neglectful	-0.1734*	-0.1751*	0.0714	0.9631
	(0.091)	(0.097)	(0.057)	(0.261)
Primary caregivers measured height in cms	0.0081***	0.0072***	0.0030**	0.9950
	(0.002)	(0.002)	(0.001)	(0.006)
Secondary caregivers measured height in cms	0.0041*	0.0041	-0.0012	0.9978
	(0.002)	(0.003)	(0.001)	(0.007)
Constant	-5.9050***	-5.5801***		
	(0.845)	(0.929)		
Observations	7,275	7,275	7,275	7,275

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The omitted categories are the same as table 7. This table presents results where missing values are imputed from all the other variables in the model. 5 imputations are used, however results are also similar to when 50 imputations are employed. I use the chained equation approach detailed in Royston (2009).

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