The Economic and Social Review, Vol. 45, No. 1, Spring, 2014, pp. 25–64

Socio-economic Inequalities in Child Health in Ireland

ANNE NOLAN*
Economic and Social Research Institute, Dublin
Trinity College, Dublin

RICHARD LAYTE
Economic and Social Research Institute, Dublin
Trinity College, Dublin

Abstract: In the literature on the links between socio-economic status (SES) and child health, there is evidence that the SES gradient is weaker for objective indicators of child health (e.g., height) than for subjective indicators (e.g., parental-assessed health). In this paper, we use cross-sectional micro-data from the *Growing Up in Ireland* study to examine the SES gradient in height, weight, general health status and chronic illness incidence. Using household income and mother's education as indicators of SES, we find only limited support for the contention that the SES gradient in child health in Ireland is stronger for more subjective indicators of child health.

I INTRODUCTION

There is extensive empirical evidence on the link between socio-economic status (SES) and health outcomes in both children and adults. For adults, the observed SES gradient in health status has been found to be robust to the definition of both SES (income, wealth, education, social class, etc.) and health

Acknowledgements: This research was carried out as part of the research programme "The Longitudinal Analysis of Child Health and Development" (2010-2013), funded by the Health Research Board. The authors would like to thank the Central Statistics Office (CSO) for access to the micro-data, and the reviewers of this paper, as well as participants at the Irish Economics Association Annual Conference 2012 for helpful comments.
* Address for correspondence: Economic and Social Research Institute, Whitaker Square, Sir John Rogerson's Quay, Dublin 2, Ireland. Telephone: + 353 18632022; Fax: + 353 18632100; Email: anne.nolan@esri.ie

(mortality, morbidity) (Palloni *et al.*, 2009; Stowasser *et al.*, 2011). The evidence for adults is also consistent within and across countries, at all ages and at all points in the distribution of SES (see Case and Paxson (2010) for a summary). In terms of child health inequalities, there is some debate in the international literature over the extent to which the SES gradient widens as children age (Case *et al.*, 2002); over whether the gradient may be weaker in countries with universal access to free/heavily subsidised public health care (Propper *et al.*, 2007); and over the extent to which the gradient may be weaker for objective indicators of child health (Currie *et al.*, 2007).

Explanations for the observed link between SES and health include the direct effect of SES (i.e., via access to health care, housing quality, etc.); the influence of early childhood circumstances (e.g., in-utero conditions); the influence of parental health and behaviours; and reverse causation between health and SES (see Smith (1999), among others, for a review). Distinguishing among these explanations is important as it has direct implications for public policy; for example, if a causal link between economic resources and health is identified, this advances the case for universal access to health care (Stowasser *et al.*, 2011). Strong causal links between childhood health and later health, education and labour market outcomes have been demonstrated (Case *et al.*, 2005). In this context, an understanding of the links between SES and child health is important not only for policymakers seeking to improve child health, but also for efforts to improve health and other outcomes throughout the lifecycle (Chen *et al.*, 2006). In recognition of the importance of child health inequalities, numerous national and international policy documents contain targets for reducing child health inequalities (DoHC, 2001; WHO, 2008).

While a large international literature has examined the link between SES and child health, the study countries are usually the UK and US, two countries with very different health-care systems to that of Ireland. The evidence for Irish children is also less well developed (exceptions include Institute of Public Health (2006), Layte and Clyne (2010) and McGovern (2013)).[1] In addition, previous research has tended to concentrate on inequalities in a single indicator, although as discussed below, the international evidence suggests that the strength of the inequality often depends on whether objective or subjective indicators are examined. The purposes of this paper are therefore to:

[1] Various publications from the Lifeways Cross-Generation Cohort Study (www.ucd.ie/phpps/research/clinicalepidemiologygroup/lifewayscross-generationcohortstudy/) and the Health Behaviour in School-aged Children Study (www.nuigalway.ie/hbsc/) are also relevant (see for example, Niedhammer *et al.* (2011) and Walker *et al.* (2012)).

- examine the SES gradient in child health outcomes in the Republic of Ireland; and
- examine whether the SES gradient differs for objective and subjective indicators of health.

We use detailed cross-sectional micro-data on two cohorts of Irish children (aged nine months and nine years) from the nationally-representative *Growing Up in Ireland* study to examine these issues. In the absence of longitudinal data, we cannot examine whether SES gradients narrow or widen as children age. Section II discusses previous research on SES inequalities in child health, while Section III describes the data employed in this paper. Section IV outlines the methodology. Section V presents the empirical results while Section VI concludes by discussing the main findings.

II PREVIOUS RESEARCH

As noted, there is a large international literature on SES inequalities in child health. The age at which the SES gradient in child health emerges has been the subject of much recent discussion. One of the first studies to examine this issue was that by Case *et al.* (2002), which examined the SES gradient in child general health status in the US and found a steepening gradient as children age. Case *et al.* (2002) found that the "origin of the gradient" was partly explained by the incidence and impact of chronic conditions across children with different SES. Similar results have also been observed in Canada (Currie and Stabile, 2003; Allin and Stabile, 2012) and in the US using a different data source (Murasko, 2008), but no evidence for a steeping gradient with age has been found in a number of studies focusing on the UK (Currie *et al.*, 2007; Propper *et al.*, 2007), Germany (Reinhold and Jurges, 2011) and Indonesia (Cameron and Williams, 2009). Using Australian data, Khanem *et al.* (2009) found that while there was a steeping SES gradient with age, SES became a statistically insignificant predictor of child health once controls for parental health were included in the model. Chen *et al.* (2006) found a steeping SES gradient with age for a number of acute health conditions, but not for general health status.[2] A longitudinal study of child height in England and Scotland in the 1970s concluded that child height inequalities were established before the age of five years (Smith *et al.*, 1980)

[2] As Chen *et al.* (2006) used the same data as Case *et al.* (2002), the result for general health status was puzzling. A follow-up analysis by Case *et al.* (2007) attributed the differences to the inclusion of a small number of young adults in the Chen *et al.* (2006) study.

while Howe *et al.* (2010) found that the SES gradient in height during childhood arose largely via inequalities in birth length, with small increases in the inequality from differences in growth in later childhood.

A related debate has examined the extent to which SES gradients in child health may be weaker in countries with universal access to free or heavily subsidised public health care. For example, Currie *et al.* (2007) and Propper *et al.* (2007) maintained that the absence of a SES gradient in parental assessed general health status in the UK (in contrast to the strong gradient found by Case *et al.* (2002) for the US) may be due to the differing health-care financing structures in the two countries.[3] In this context, a series of studies from the US have examined the causal impact of public health insurance on child health outcomes (Currie, 1995; Currie and Gruber, 1996; Currie *et al.*, 2008; Lin, 2009), and found statistically significant effects.

The extent to which the SES gradient in child health persists when controls for other influences on child health, particularly mother's health, are included, is the subject of conflicting findings. For example, studies by Case *et al.* (2002), Currie *et al.* (2007) and Reinhold and Jurges (2011) found that the statistically significant SES gradient in general health status was robust to the inclusion of controls for parental health, while Khanem *et al.* (2009) and Propper *et al.* (2007) found that it was not. There is also some debate in the literature over whether parental health is truly exogenous (i.e., the SES gradient in child health might be observed if parents with poorer health have lower earnings, and poor health is transmitted from parents to children) (Case *et al.*, 2002).

Part of the ambiguity in research findings stems from differences in the indicators of child health that are examined. While most studies examine SES inequalities in a single indicator, some recent studies have examined both objective and subjective indicators of child health and have found that the SES gradient is stronger for subjective indicators of child health. For example, Reinhold and Jurges (2011) examined the SES gradient in child health in German children aged 0-17 years using various indicators of health (parental assessed general health, blood pressure, obesity, height-for-age, blood haemoglobin, ferritin, vitamin D), and found a statistically significant SES gradient for parental assessed general health and vitamin D levels, weak evidence for ferritin levels and no significant gradient for the other objective indicators. A similar study by Currie *et al.* (2007) found a statistically significant (although small) SES gradient in parental assessed general health

[3] However, a response by Case *et al.* (2008) to the Currie *et al.* (2007) study found that the differences between England and the US were reduced when data from the same time period were examined.

in England, but no evidence for indicators collected from nurse examinations and blood test results (birth weight, height, obesity, blood pressure, haemoglobin count, ferritin level). While difficult to explain, it has been noted that parental assessments of child health (and incidence of doctor-diagnosed conditions) may be biased due to a) differential reporting of health status between low- and high-SES parents and/or b) differences in diagnosis of health conditions between low- and high-SES children which may reflect differences in access to health care (Reinhold and Jurges, 2011).[4]

The extent to which the relationship between SES and child health may be interpreted as causal when using cross-sectional data is obviously limited. If available, a source of exogenous variation in SES could be used to identify causal effects. For example, Lindeboom *et al.* (2009) exploited an exogenous change in the school-leaving age in the UK in 1947 to examine the impact of parental education on child health (using a regression discontinuity design). Instrumental variable approaches are another alternative, although finding appropriate instruments is always a challenge (for example, the papers by Currie and Gruber (1996) and Currie *et al.* (2008) used variations in the extension of Medicaid eligibility to children in the US across states and time as instruments for public health insurance). An alternative strategy using cross-sectional data is to control for unobserved factors using "within family fixed effects" (Joyce *et al.*, 2000). This requires detailed information on siblings within families (which is not available in the data used in this study). Ideally, longitudinal data, which contain repeated measures on individuals over time, would be used to make causal inferences. However, Propper *et al.* (2007) has questioned the validity of using longitudinal data analysis techniques such as fixed effects estimation for analyses using children, as individual characteristics which may be considered fixed (time-invariant) for adults may only become so during childhood (e.g., allergies).

In the Irish context, the available evidence is relatively undeveloped. A number of studies have examined the SES gradient in various health outcomes at time of birth, such as perinatal mortality, birth weight and pre-term delivery (Nolan, 1994; Institute of Public Health, 2006; Layte and Clyne, 2010; Niedhammer *et al.*, 2011; McGovern, 2013). The most recent study by McGovern (2013) uses the same data employed in this study to examine the

[4] Reinhold and Jurges (2011) discuss a number of mechanisms by which parental-reported doctor-diagnosed conditions may be higher among children from higher-income families. First, higher income parents might be more likely to identify ill-health among their children and thus take them to their doctor. Second, conditional on perceived health, they might be more likely to visit a doctor. Third, conditional on visiting, doctors might be more likely to diagnose a condition if the parents have higher SES. Fourth, low-income parents might be less able to report correctly any diagnosis their child's doctor has made.

determinants of birth weight among nine month old children. He finds that both household income and father's education are statistically significant predictors of infant birth weight, although the relationship between income and birth weight is non-linear. Mother's education becomes insignificant once controls for mother's height (to account for the intergenerational transmission of birth weight) are included in the model.[5]

III DATA

In this paper we use micro-data from a nationally-representative survey of children in the Republic of Ireland. *Growing Up in Ireland* (GUI) surveys two cohorts of children (i.e., an Infant Cohort, and a Child Cohort). Currently, the micro-data from the first wave of each cohort are available for analysis.[6] The Infant Cohort is made up of the families of 11,134 nine month old children. The children were born between 1st December 2007 and the 30th June 2008 and data collection for that group took place between September 2008 and April 2009 (Quail *et al.*, 2011). The sampling frame for the Infant Cohort was the Child Benefit Register. The achieved sample of over 11,000 nine month olds represents approximately 27 per cent of eligible children over that period (Quail *et al.*, 2011).

The Child Cohort represents 8,568 children born between 1 November 1997 and 31 October 1998. Data collection for this group took place between August 2007 and May 2008, meaning that the children were aged nine years old on average. The sampling frame for the Child Cohort was the primary school system. Additional data from the teacher and principal in the school was collected, and various academic achievement tests were administered in a group setting (thus reducing respondent burden in the home). The sample design was based on a two-stage selection process in which the school was the primary sampling unit and the children in the school were the secondary units. The achieved sample of over 8,500 nine year olds represents approximately 14 per cent of the total population of Irish nine year olds (Murray *et al.*, 2011).

Consistent with previous research in the area (e.g., Violato *et al.* (2011); McGovern (2013)), we concentrate on singleton children only in this study.

[5] While we also examine SES inequalities in birth weight, we also examine SES inequalities in other health indicators (and among a second, older, cohort of children from the same study), in an attempt to ascertain whether SES inequalities differ for "objective" and "subjective" indicators.
[6] The second wave of the GUI Infant Cohort data became available in June 2013, too late for the analysis carried out in this paper.

This results in the exclusion of 398 children from the Infant Cohort sample and 275 children from the Child Cohort sample. We do not pool the data from the two cohorts as some of the variables are constructed from underlying questions with differences in wording and response categories. After excluding observations with missing data (largely due to missing data on household income), final samples of approximately 9,000 (nine month olds) and 6,000 (nine year olds) are available for analysis (final sample sizes differ due to differences in the number of missing observations for different variables). For the main analysis, we run the models using the same set of independent variables for both samples to ensure comparability between the results.

We focus on four broad indicators of child health in this study; two "objective" (length/height and weight/BMI) and two "subjective" (parental assessed child health and chronic illness incidence).

3.1 *Length/Height*

In the Infant Cohort, the length of the infant was measured by the interviewer using a SECA 210 measuring mat, and measured in centimetres (Quail *et al.*, 2011). In the Child Cohort, height was measured by the interviewer using a standard measuring stick (Leicester portable height measure), and recorded in centimetres (*Growing Up in Ireland*, 2009). In common with other studies (Rona *et al.*, 1978; Chinn *et al.*, 1989; Finch and Beck, 2011; Reinhold and Jurges, 2011), we analyse child length/height in the form of a length/height-for-age z score or standard deviation score; this is calculated for each child as the difference between his length/height and the median length/height of a population of the same age and sex divided by the standard deviation for that population. It removes the effects of age and sex on length/height, while also standardising for the increasing variance between length/height and age as children grow older. We use the Stata do files supplied by the WHO to generate length/height-for-age z scores (www.who.int/growthref/tools/en/) (last accessed 12 June 2013).

3.2 *Weight/BMI*

In the Infant Cohort, we calculate a weight-for-length z score based on measured length and weight (child weight was recorded by the interviewer using SECA 835 weighing scales) (Quail *et al.*, 2011). For the Child Cohort, we calculate a BMI-for-age z score based on measured height and weight (child weight was recorded by the interviewer using medically approved weighing scales, i.e., SECA 761 flat mechanical scales) (Thornton *et al.*, 2011). Once again, we use data from the WHO to construct these indicators.

3.3 *General Health Status*

Assessments of the child's general health status were provided for both cohorts by the primary caregiver.[7] The Infant Cohort information refers to the child's general health at the time of interview (i.e., at nine months), while the Child Cohort information refers to the child's general health over the previous year.

3.4 *Chronic Illness Incidence*

The indicators of chronic illness incidence are very different for the two cohorts. In the Infant Cohort, the primary caregiver is asked whether the child has ever been diagnosed with a number of specified health conditions (e.g., eczema or a skin allergy, asthma, etc.). It is debatable whether this indicator is really "subjective" but as the information is collected via parental reports, we regard it as "subjective". In the Child Cohort, the primary caregiver is asked more generally whether the child has any on-going chronic physical or mental health problem, illness or disability.

Table 1 contains further details on each of the dependent variables used in our analysis. Table 1 also presents summary statistics on each of the four main dependent variables for both cohorts, separately for males and females. For both length/height and weight/BMI, Irish children are above average (as the z score is greater than zero). With the exception of the weight of nine year olds, boys are longer/taller/heavier than girls. In terms of parental assessments of child health, over 80 per cent of infants are regarded as currently "very healthy", while just over three-quarters of nine year olds are regarded as having been "very healthy" over the previous year. The majority of Irish children do not have a chronic illness (whether doctor-diagnosed, or based on the assessment of their primary caregiver), although boys have a higher incidence than girls in both cohorts.

3.5 *Independent Variables*

Our primary indicator of SES in this paper is household income but we also examine the gradient in child health by mother's highest level of education. Household income is net weekly household income, adjusted for the composition of the household using equivalence scales. GUI uses the "ESRI" equivalence scale which assigns a value of 1 to the first adult in the household, 0.66 to all others aged 14 years and over, and 0.33 to all children aged 13 years and younger. Figure A1 (in the Online Appendix[8]) illustrates the distribution

[7] In most cases, the primary caregiver is the child's biological mother. In the GUI Infant sample, 99.9 per cent of observations have the biological mother as the primary caregiver, while in the GUI Child sample, 98.9 per cent of cases have the biological mother as the primary caregiver.
[8] Online Appendix is available at: www.esr.ie

Table 1: *Dependent and Independent[a] Variable Definitions and Summary Statistics[b]*

	GUI Infant Cohort (Average Age 9 Months)			*GUI Child Cohort (Average Age 9 Years)*		
		Males	*Females*		*Males*	*Females*
LFAZ score	Length-for-age z score	0.833	0.741	n/a	n/a	n/a
HFAZ score	n/a	n/a	n/a	Height-for-age z score	0.773	0.627
WFLZ score	Weight-for-length z score	0.951	0.903	n/a	n/a	n/a
BMIFAZ score	n/a	n/a	n/a	BMI-for-age z score	0.684	0.693
Very healthy[c]	=1 if very healthy, no problems (reference group)	81.3	84.5	=1 if very healthy, no problems (reference group)	72.9	73.2
Healthy[c]	=1 if healthy but a few minor problems	17.4	14.6	=1 if healthy but a few minor problems	25.9	24.9
Ill[c]	=1 if sometimes quite ill/almost always unwell	1.3	0.9	=1 if sometimes quite ill/almost always unwell	1.2	1.9
No chronic illness[d]	=1 if no chronic illness (reference group)	72.6	78.5	=1 if no chronic illness (reference group)	87.9	90.2
Chronic illness[d]	=1 if at least one chronic illness	27.3	21.5	=1 if at least one chronic illness	12.1	9.85
Income	Weekly household equivalised income (€)	415.6		Weekly household equivalised income (€)	366.05	
Primary	=1 if primary education	3.6		=1 if primary education	6.4	
Lower secondary	=1 if lower secondary education	14.0		=1 if lower secondary education	23.8	
Upper secondary	=1 if upper secondary education	33.2		=1 if upper secondary education	36.7	
Non degree	=1 if non-degree education	19.9		=1 if non-degree education	15.9	
Degree	=1 if degree education	17.6		=1 if degree education	11.2	
Postgraduate	=1 if postgraduate education (reference group)	11.6		=1 if postgraduate education (reference group)	6.0	

Notes: [a] Summary statistics for the key SES independent variables (household income and mother's highest level of education) are presented. LFAZ, HFAZ, WFLZ, BMIFAZ and household income are continuous variables (and thus the sample mean is reported); the remaining variables are categorical, so the summary statistics refer to the proportion of the sample in each category.

[b] Sample weights are employed.

[c] In the Infant Cohort, the variable is constructed from responses to the question 'In general, how would you describe [Baby's] Current Health?', while the corresponding question in the Child Cohort is 'In general, how would you describe the Study Child's health in the past year?'.

[d] In the Infant Cohort, the variable is constructed from responses to the question 'Has a medical professional ever told you that <baby> has any of the following conditions?, with 16 conditions specified (e.g., asthma, diabetes, epilepsy, etc.). In the Child Cohort, the variable is constructed from the responses to the question 'Does the Study Child have any on-going chronic physical or mental health problem, illness or disability?', and respondents are asked to specify up to three conditions.

of net weekly household income for both cohorts; as the data are right-skewed, we use logged weekly income in our regressions. Sections IV and V return to the issue of missing observations for income. Mother's education is a six-category variable based on the ISCED[9] level of the mother's highest level of education. We also test the influence of alternative indicators of SES (i.e., social class, housing tenure, father's education, eligibility for free public health care, household deprivation and mother's SES during her childhood). Table 1 also contains summary statistics on household equivalised income and mother's highest level of education for both Cohorts.

Additional independent variables include child characteristics such as age and sex (where appropriate) and birth order (to proxy increased exposure to infections/less investment in child health). A set of variables representing circumstances of birth and the early life of the child, namely, birth weight, gestation length, breastfeeding status and mother's smoking and alcohol consumption during pregnancy are also included. There are strong genetic influences on child health, which we account for by variables describing mother's health. We do not include father's health as a much larger proportion of observations are missing information on father's health in both cohorts. We also include indicators for mother's age, lone parent status and ethnic/cultural background. As with child's height and weight, parental heights and weights are also measured by the interviewer in the GUI (*Growing Up in Ireland*, 2009). Wherever possible, variables are constructed in such a way as to minimise differences in definition across the two analyses.

IV METHODS

We estimate simple cross-sectional reduced form models of child health for each cohort as follows:

$$y_i = \alpha_0 + \alpha_1 I_i + \alpha_2 E_i + \alpha_3 X_i + u_i \tag{1}$$

where y_i represents the health of child i, I_i represents household equivalised income, E_i represents mother's education and X_i represents the vector of additional control variables (i.e., gestation, etc.). Robust standard errors are calculated for the Infant Cohort and the standard errors are adjusted for the clustering of observations by the primary sampling unit (i.e., the school) for the Child Cohort. All models are estimated using Stata 12.1. For the analyses of the objective indicators of child health (length/height; weight/BMI), we use

[9] International Standard Classification of Education (www.uis.unesco.org/Education/Pages/international-standard-classification-of-education.aspx) [last accessed 8 August 2013].

OLS estimation techniques. For the analysis of general health status, we estimate an ordered logit model, while for the analysis of chronic illness incidence, we estimate a binary probit model.

We begin by estimating restricted versions of the models that control for household income only, i.e., assuming that $\alpha_2 = 0$ and $\alpha_3 = 0$. We then add controls for a) mother's education, b) child and mother characteristics, including the relevant indicator of mother's health (e.g., for the analysis of child height, we include mother's height; for the analysis of child general health status, we include mother's assessment of her own health, etc.) and c) additional mother's health variables. While the results for the models with household income and mother's education (a), and including all controls c), are presented in Tables 2-5, the unrestricted versions of the models are superior in terms of model fit (and in most cases, the models with the full set of mother's health variables are preferred). Nonetheless, we also discuss the results from the restricted models, as many of our control variables are potentially correlated with our SES indicators (e.g., smoking behaviour, mother's health, etc.). Tables 2-5 present the results for the main SES indicators (i.e., household income and mother's education) and the remaining control variables; Tables A2-A5 in the online appendix present the full set of model results (i.e., for the restricted and three unrestricted versions of the models a) to c)).

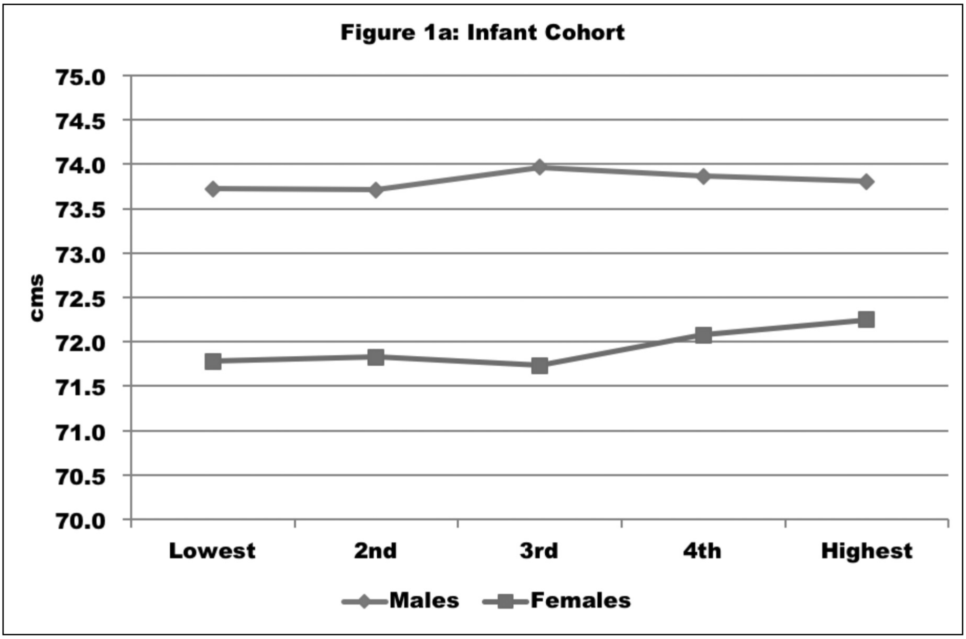
As noted above, inferring a causal relationship between SES and health outcomes is impossible with the data available. However, to some extent if the results for SES (income, education) are robust to the inclusion of additional variables reflecting initial health conditions and parental behaviours, then we can be more assured that we are actually measuring the causal effect of SES (Reinhold and Jurges, 2011). While the availability of longitudinal data can allow the researcher to control for time-invariant unobserved effects, there is some debate in the literature over the applicability of longitudinal data techniques to analyses of children (Propper *et al.*, 2007).

V EMPIRICAL RESULTS

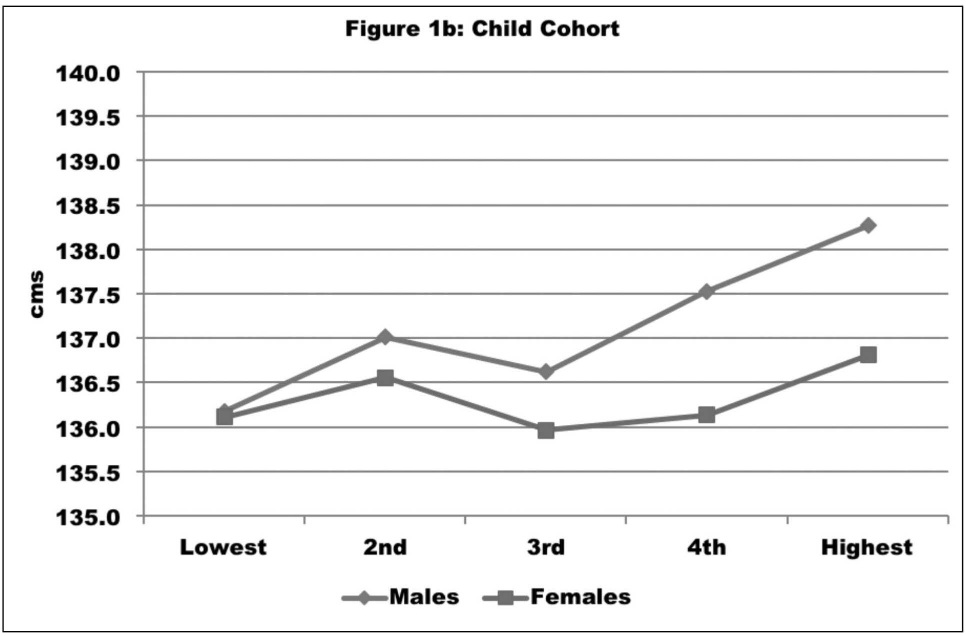
5.1 *Bivariate Results*

Before presenting the results of the multivariate OLS models, Figures 1 to 4 plot the relationship between each of our four indicators of child health and household equivalised income (divided into quintiles for ease of illustration). As is evident from the figures, there is some evidence of an SES gradient in child length/height for both cohorts, particularly for the nine year olds, and particularly for boys. For example, nine year old boys in the highest income

Figure 1: *Child Height/Length (cms) by Equivalised Income Quintile*



Sample weights are employed.



Sample weights are employed.

quintile are 2.1cms taller on average than boys in the lowest income quintile (or 1.5 per cent taller). The relationship between SES and weight is relatively flat for infants (albeit with some evidence that those in the lowest income quintile are heavier than those in the highest income quintile), but differs considerably between boys and girls for the nine year olds. While boys from the highest income quintile are heavier than their counterparts in the lower income quintile, the opposite is the case for girls. Note that the data in Figure 2 relate to weight in kilograms, unadjusted for length/height. This effect is particularly strong for nine year old girls, where girls in the highest income quintile are nearly 1.2kgs (or 3.4 per cent) lighter than their counterparts in the lowest income quintile. In contrast, nine year old boys in the higher income quintiles are heavier than their counterparts in the lower income quintiles. For parental assessed health status, and chronic illness incidence, an interesting pattern emerges. While the patterns for the Infant Cohort suggest little relationship between SES and parental-assessed child health (and a positive SES gradient for chronic illness incidence), for the Child Cohort there is a clear SES gradient with respect to both parental assessed health and chronic illness incidence (i.e., children from better-off families are healthier on average). However, SES is correlated with numerous other factors that might influence child health (e.g., mother's behaviour during pregnancy), and therefore, a full multivariate analysis is necessary to untangle the independent effect of SES on child health.

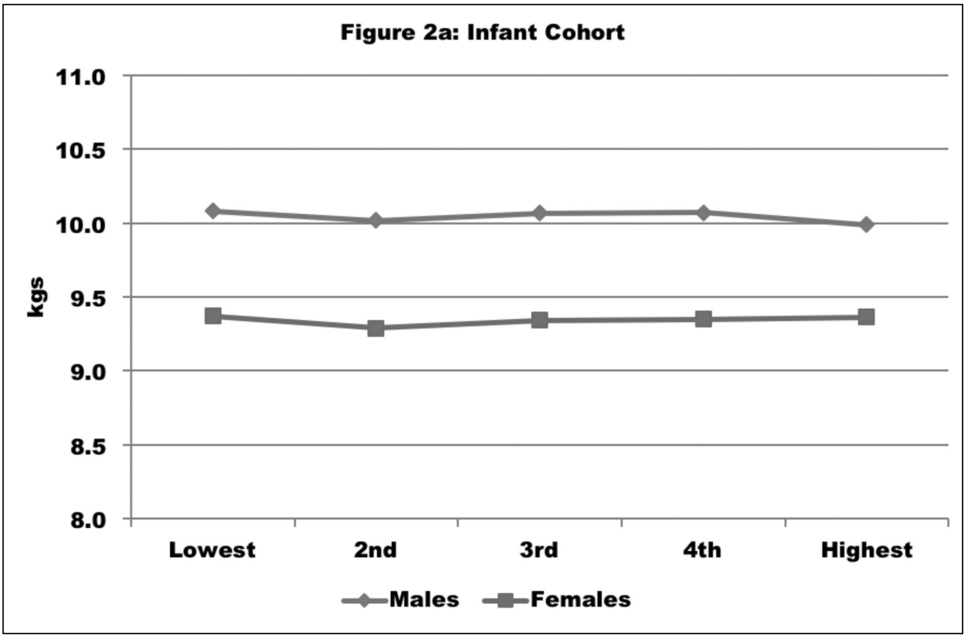
5.2 *Multivariate Results*

Tables 2-5 present the results of the multivariate analyses for each of our four indicators of child health. In each table, column (1) presents the results of the model with indicators for household equivalised income and mother's education only. Column (2) adds all other controls, i.e., child characteristics (i.e., age, sex, birth order, childcare arrangements);[10] pregnancy/early life characteristics (i.e., birth weight, gestation, breastfeeding, mother's smoking and drinking during pregnancy); mother characteristics (age, lone parent status, ethnic/cultural background, health), including the full set of mother's health variables. In the majority of cases, the models with the full set of independent variables (i.e., the models presented in column (2)) are preferred.[11]

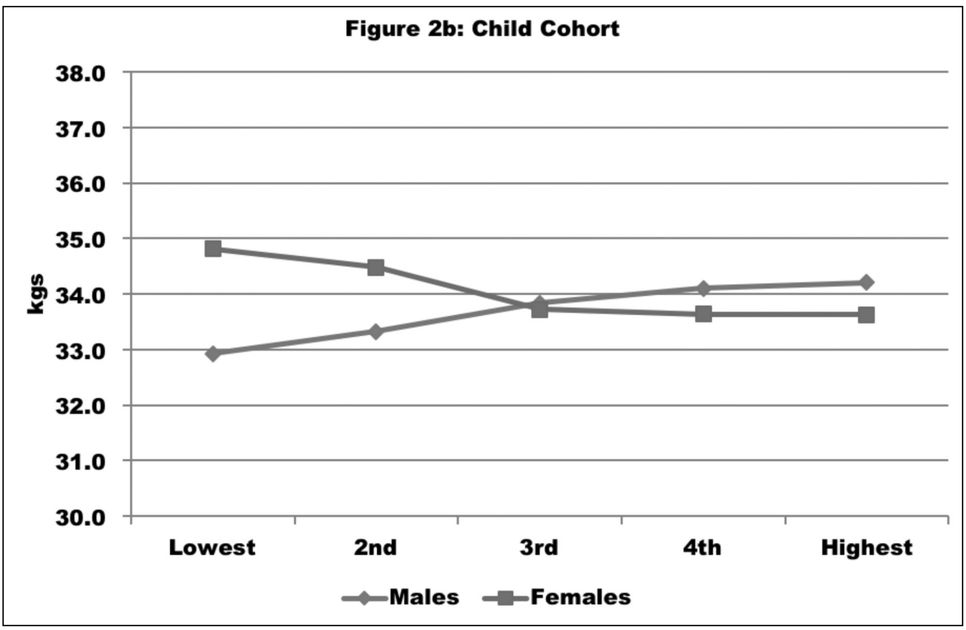
Beginning with length/height in Table 2, the results indicate that there is a statistically significant raw income gradient in child length/height. For both

[10] As the dependent variables in the height/length-for-age and weight/BMI-for-age models are already adjusted for the age and sex of the child, age and sex are excluded from these models.
[11] The exceptions are the models of infant length and weight, and child BMI. Results of these model selection tests are available on request from the authors.

Figure 2: *Child Weight (kgs) by Equivalised Income Quintile*

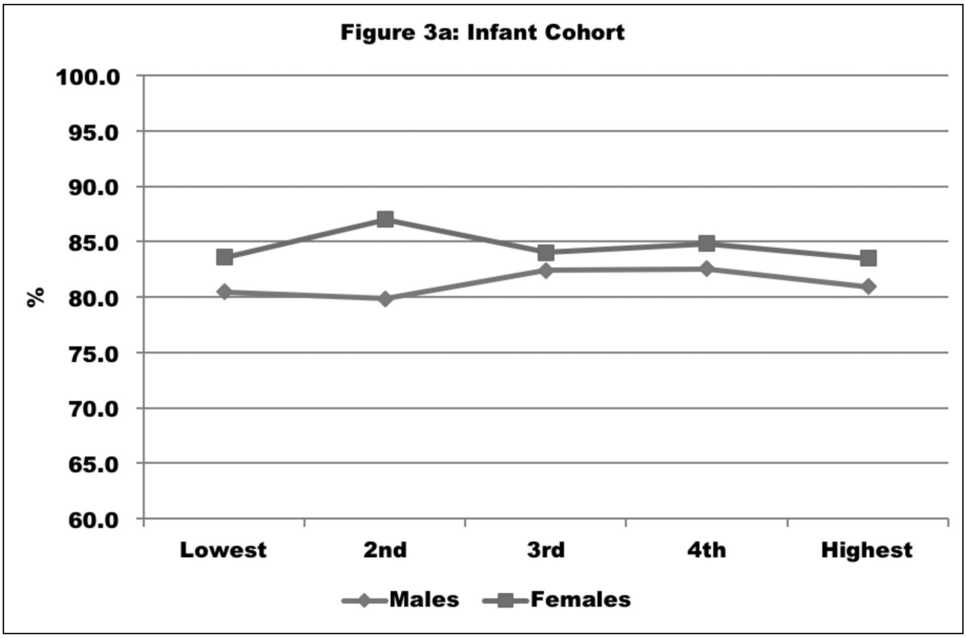


Sample weights are employed.

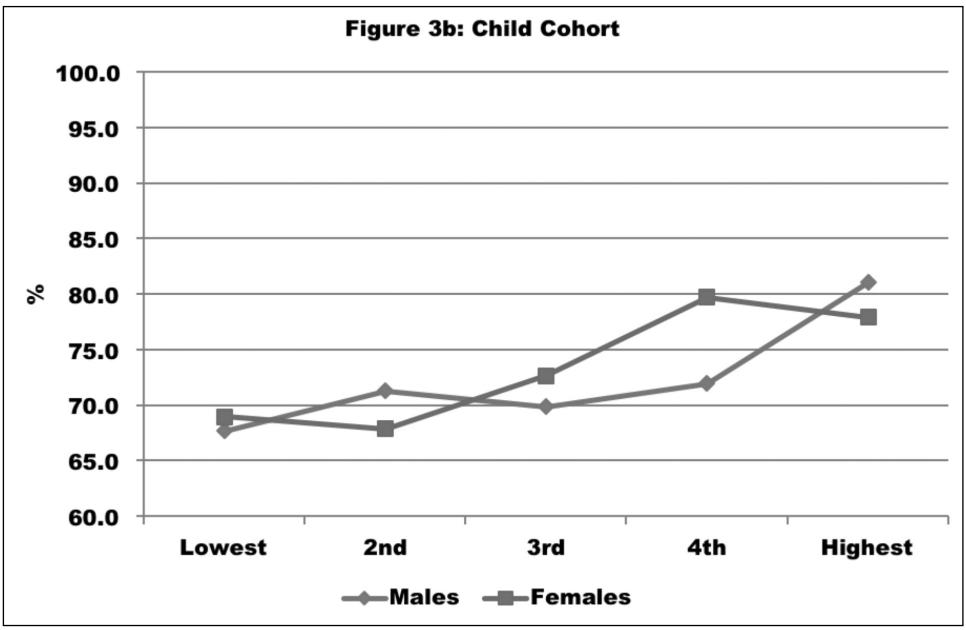


Sample weights are employed.

Figure 3: *Child General Health (% "Very Healthy") by Equivalised Income Quintile*

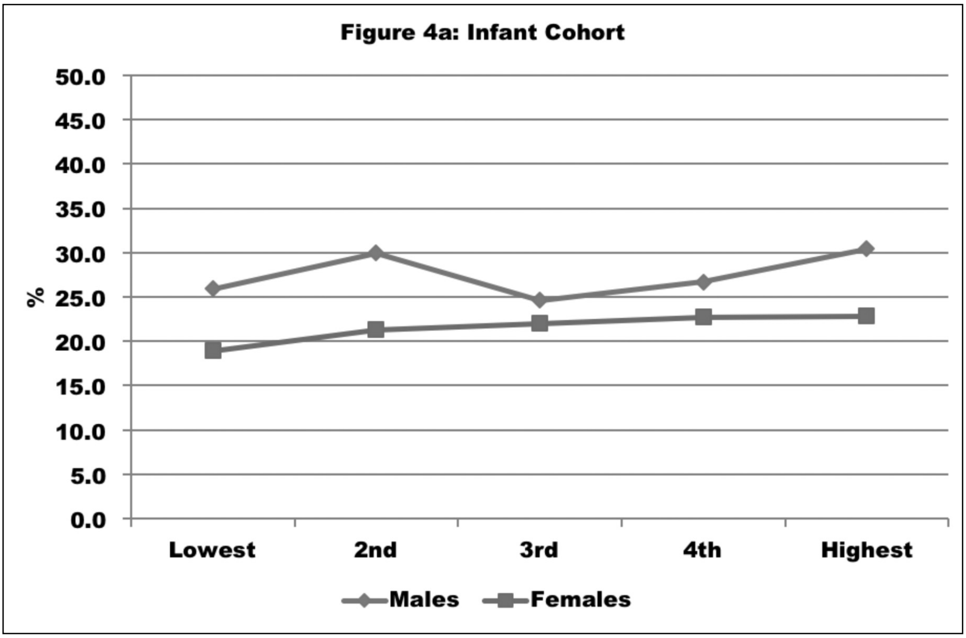


Sample weights are employed.

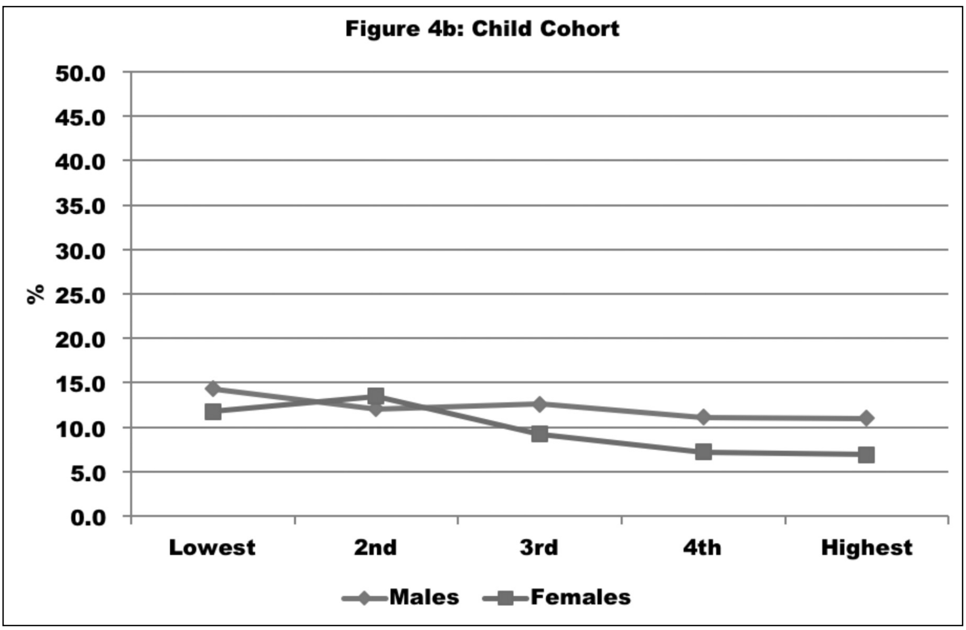


Sample weights are employed.

Figure 4: *Child Chronic Illness (% "Yes") by Equivalised Income Quintile*



Sample weights are employed.



Sample weights are employed.

cohorts, children from higher income families are significantly longer/taller than children from lower income families. After adjustment for other factors that influence length/height, income becomes insignificant in determining length at age nine months, but remains significant in explaining variations in child height at age nine years. In contrast, while mother's education is initially significant for both cohorts, it becomes insignificant once additional controls are added to the models. The remainder of the independent variables have effects that are largely consistent with expectations (higher order children are shorter, children that were heavier at birth are longer/taller, etc.). For both cohorts, mother's height is highly significant, reflecting the strong genetic influence of parental height. There are a number of instances in which effects differ across the two cohorts, although in the absence of longitudinal data, it is impossible to determine whether this reflects an age or a cohort effect, or a combination of both. For example, the children of lone parents are shorter in infanthood, but taller at age nine, and we have no clear explanation for either result (except that we may have expected lone parenthood to act as an additional proxy for SES) (as found in other studies such as Gorman and Braverman (2008)). In addition, mother's age is only significant for nine year olds, and prenatal smoking and drinking are only significant for nine month olds. The effect for type of childcare (while only significant for the infants) suggests that children who are cared for in centre-based childcare are significantly shorter than children who are cared for at home by their parent(s), which might indicate a role for increased exposure to infections in impeding the growth of young children.

Examining the results for child weight-for-length/BMI-for-age in Table 3 reveals once again that the children of higher income families are statistically significantly lighter than their counterparts from lower income families. However, these effects become insignificant once other controls are added to the models. However, the results indicate that mother's education is the more important SES influence, and for nine year olds, it remains highly significant even after the inclusion of a variety of child and mother characteristics. The children of lower educated mothers have a significantly higher BMI than the children of mothers with a postgraduate qualification, and the effect is broadly linear. Again, one of the strongest influences on child weight is mother's BMI, and the marginal effect is particularly large for the nine year olds. Most of the remaining independent variables have effects that are consistent with expectations, although it is difficult to explain why the children of mothers who smoked during pregnancy should be heavier at nine months (except via the high correlation between low SES and smoking during pregnancy).

Turning to the first of our "subjective" indicators of child health in Table 4, the results for parental assessed child health illustrate that while household

Table 2: *OLS Models of LFAZ/HFAZ Scores*

	Infant Cohort (Average Age 9 Months)		*Child Cohort (Average Age 9 Years)*	
	(1)	*(2)*	*(1)*	*(2)*
SES				
Equivalised income	0.052	–0.008	0.053	0.063
	(0.027)**	(0.029)	(0.026)**	(0.030)**
Primary	–0.204	0.154	–0.225	0.078
	(0.093)**	(0.097)	(0.086)***	(0.098)
Upper secondary	–0.186	0.043	–0.234	–0.027
	(0.065)***	(0.068)	(0.053)***	(0.057)
Upper secondary	–0.069	0.020	–0.095	0.006
	(0.048)	(0.049)	(0.045)**	(0.047)
Non degree	–0.062	0.038	–0.017	0.029
	(0.053)	(0.053)	(0.045)	(0.046)
Degree	–0.045	0.007	–0.007	0.016
	(0.049)	(0.047)	(0.050)	(0.051)
Postgraduate	ref	ref	ref	ref
Child Characteristics				
Birth order		–0.075		–0.057
		(0.017)***		(0.014)***
Care at home	ref	ref	ref	ref
Care by au pair/relative		0.084		0.027
		(0.034)**		(0.030)
Centre-based care		–0.107		–0.012
		(0.046)**		(0.063)
Pregnancy/early life characteristics				
Birth weight		0.731		0.305
		(0.034)***		(0.024)***
Early		0.105		0.141
		(0.079)		(0.043)***
On time	ref	ref	ref	ref
Late		0.046		–0.070
		(0.044)		(0.029)**
No breastfeeding		0.058		0.025
		(0.033)*		(0.027)
Breastfeeding	ref	ref	ref	ref
Smoking		–0.095		0.008
		(0.042)**		(0.034)
No smoking	ref	ref	ref	ref
Drinking		–0.062		–0.024
		(0.036)*		(0.025)
No drinking	ref	ref	ref	ref

Table 2: *OLS Models of LFAZ/HFAZ Scores (Contd.)*

	Infant Cohort (Average Age 9 Months)		*Child Cohort (Average Age 9 Years)*	
	(1)	*(2)*	*(1)*	*(2)*
Mother characteristics				
Age		–0.002		0.011
		(0.003)		(0.003)***
Lone parent		–0.155		0.106
		(0.054)***		(0.044)**
Two parent	ref	ref	ref	ref
White	ref	ref	ref	ref
Black		0.302		0.351
		(0.099)***		(0.134)***
Asian		0.088		0.399
		(0.083)		(0.106)***
Other		0.216		–0.186
		(0.174)		(0.344)
Height		0.046		0.059
		(0.003)***		(0.002)***
BMI		0.001		0.019
		(0.003)		(0.003)***
Depression score		0.005		0.001
		(0.004)		(0.004)
Excellent	ref	ref	ref	ref
Very good		0.019		0.010
		(0.035)		(0.027)
Good		–0.007		0.025
		(0.043)		(0.036)
Fair/poor		0.064		0.119
		(0.064)		(0.061)*
Chronic illness	ref	ref	ref	ref
No chronic illness		–0.029		–0.054
		(0.044)		(0.040)
N	9,777	8,986	7,373	6,271
R^2	0.002	0.145	0.008	0.171

Notes:
(i) Standard errors, which are adjusted for clustering on the primary sampling unit for the Child Cohort, are presented in parentheses.
(ii) * significant at 10 per cent; ** significant at 5 per cent; *** significant at 1 per cent.
(iii) The results (in column 1) include controls for household income and mother's education only. Column (2) adds controls for child and mother characteristics, including the full set of mother's health variables.

Table 3: *OLS Models of WFLZ/BMIFAZ Scores*

	Infant Cohort (Average Age 9 Months)		*Child Cohort (Average Age 9 Years)*	
	(1)	*(2)*	*(1)*	*(2)*
SES				
Equivalised income	–0.018	0.017	–0.022	0.056
	(0.023)	(0.028)	(0.033)	(0.036)
Primary	0.025	–0.016	0.343	0.297
	(0.084)	(0.094)	(0.106)***	(0.123)**
Upper secondary	0.111	0.022	0.400	0.347
	(0.054)**	(0.063)	(0.067)***	(0.073)***
Upper secondary	0.112	0.059	0.224	0.202
	(0.040)***	(0.045)	(0.053)***	(0.058)***
Non degree	0.093	0.060	0.213	0.205
	(0.046)**	(0.050)	(0.056)***	(0.059)***
Degree	0.093	0.119	0.096	0.116
	(0.048)*	(0.050)**	(0.055)*	(0.058)**
Postgraduate	ref	ref	ref	ref
Child Characteristics				
Birth order		–0.002		–0.038
		(0.016)		(0.018)**
Care at home	ref	ref	ref	ref
Care by au pair/relative		0.078		0.073
		(0.039)**		(0.038)*
Centre-based care		–0.079		0.144
		(0.041)*		(0.0702)**
Pregnancy/early life characteristics				
Birth weight		0.399		0.249
		(0.031)***		(0.029)***
Early		0.151		0.021
		(0.084)*		(0.051)
On time	ref	ref	ref	ref
Late		–0.061		–0.051
		(0.056)		(0.035)
No breastfeeding		0.053		0.099
		(0.033)		(0.034)***
Breastfeeding	ref	ref	ref	ref
Smoking		0.254		0.043
		(0.048)***		(0.044)
No smoking	ref	ref	ref	ref
Drinking		–0.065		0.006
		(0.037)*		(0.031)
No drinking	ref	ref	ref	ref

Table 3: *OLS Models of WFLZ/BMIFAZ Scores (Contd.)*

	Infant Cohort (Average Age 9 Months)		*Child Cohort (Average Age 9 Years)*	
	(1)	*(2)*	*(1)*	*(2)*
Mother characteristics				
Age		–0.001		–0.004
		(0.003)		(0.003)
Lone parent		0.120		0.155
		(0.056)**		(0.053)***
Two parent	ref	ref	ref	ref
White	ref	ref	ref	ref
Black		0.245		0.060
		(0.108)**		(0.175)
Asian		–0.367		0.246
		(0.068)***		(0.158)
Other		–0.255		–0.270
		(0.156)		(0.200)
Height		–0.001		0.002
		(0.002)		(0.003)
BMI		0.008		0.062
		(0.003)***		(0.003)***
Depression score		–0.002		–0.005
		(0.005)		(0.005)
Excellent	ref	ref	ref	ref
Very good		–0.066		0.003
		(0.040)*		(0.034)
Good		–0.050		0.079
		(0.045)		(0.044)*
Fair/poor		–0.062		0.119
		(0.065)		(0.076)*
No chronic illness	ref	ref	ref	ref
Chronic illness		–0.058		–0.038
		(0.063)		(0.053)
N	9,763	8,975	7,352	6,260
R^2	0.001	0.031	0.009	0.096

Notes:
(i) Standard errors, which are adjusted for clustering on the primary sampling unit for the Child Cohort, are presented in parentheses.
(ii) * significant at 10 per cent; ** significant at 5 per cent; *** significant at 1 per cent.
(iii) The results (in column 1) include controls for household income and mother's education only. Column (2) adds controls for child and mother characteristics, including the full set of mother's health variables.

Table 4a: *Ordered Logit Models of Parental-Assessed Child Health Status (Infant Cohort)*

	Infant Cohort (Average Age 9 Months)					
		(1)			*(2)*	
	Probably (Very Healthy)	*Probably (Healthy)*	*Probably (Ill)*	*Probably (Very Healthy)*	*Probably (Healthy)*	*Probably (Ill)*
SES						
Equivalised income	0.001	–0.001	–0.000	0.000	–0.000	–0.000
	(0.007)	(0.006)	(0.001)	(0.001)	(0.008)	(0.001)
Primary	–0.002	0.001	0.000	0.037	–0.035	–0.003
	(0.026)	(0.023)	(0.002)	(0.029)	(0.027)	(0.002)
Upper secondary	0.031	–0.028	–0.002	0.073	–0.068	–0.006
	(0.017)*	(0.016)*	(0.001)*	(0.019)***	(0.017)***	(0.001)***
Upper secondary	0.038	–0.035	–0.003	0.057	–0.052	–0.004
	(0.012)***	(0.011)***	(0.001)***	(0.013)***	(0.012)***	(0.001)***
Non degree	0.021	–0.020	–0.002	0.030	–0.028	–0.002
	(0.013)*	(0.012)*	(0.001)*	(0.013)**	(0.012)**	(0.001)**
Degree	0.039	–0.036	–0.003	0.044	–0.041	–0.003
	(0.012)***	(0.011)***	(0.001)***	(0.012)***	(0.012)***	(0.001)***
Postgraduate	ref	ref	ref	ref	ref	ref
Child Characteristics						
Age				n/a	n/a	n/a
Male				ref	ref	ref
Female				0.035	–0.032	–0.003
				(0.008)***	(0.007)***	(0.001)***
Birth order				–0.012	0.011	0.001
				(0.004)***	(0.004)***	(0.000)***

Table 4a: *Ordered Logit Models of Parental-Assessed Child Health Status (Infant Cohort) (Contd.)*

	Infant Cohort (Average Age 9 Months)					
	(1)			*(2)*		
	Probably (Very Healthy)	*Probably (Healthy)*	*Probably (Ill)*	*Probably (Very Healthy)*	*Probably (Healthy)*	*Probably (Ill)*
Care at home				ref	ref	ref
Care by au pair/relative				–0.010	0.009	0.001
				(0.009)	(0.009)	(0.001)
Centre-based care				–0.116	0.107	0.009
				(0.011)***	(0.011)***	(0.001)***
Pregnancy/early life characteristics						
Birth weight				0.014	–0.013	–0.001
				(0.008)*	(0.007)*	(0.001)
Early				–0.048	0.045	0.004
				(0.017)***	(0.016)***	(0.001)***
On time				ref	ref	ref
Late				0.008	–0.007	–0.001
				(0.012)	(0.011)	(0.001)
No breastfeeding				0.007	–0.007	–0.001
				(0.009)	(0.008)	(0.001)
Breastfeeding				ref	ref	ref
Smoking				–0.006	0.006	0.000
				(0.011)	(0.010)	(0.001)
No smoking				ref	ref	ref

Table 4a: *Ordered Logit Models of Parental-Assessed Child Health Status (Infant Cohort) (Contd.)*

	Infant Cohort (Average Age 9 Months)					
		(1)			*(2)*	
	Probably (Very Healthy)	*Probably (Healthy)*	*Probably (Ill)*	*Probably (Very Healthy)*	*Probably (Healthy)*	*Probably (Ill)*
Drinking				–0.008	0.007	0.001
				(0.010)	(0.009)	(0.001)
No drinking				ref	ref	ref
Mother characteristics						
Age				0.003	–0.002	–0.000
				(0.001)***	(0.001)***	(0.000)***
Lone parent				–0.007	0.006	0.001
				(0.013)	(0.012)	(0.001)
Two parent				ref	ref	ref
White				ref	ref	ref
Black				0.076	–0.070	–0.006
				(0.029)***	(0.026)***	(0.002)***
Asian				–0.014	0.012	0.001
				(0.024)	(0.022)	(0.002)
Other				0.121	–0.112	–0.009
				(0.083)	(0.077)	(0.006)
Height				0.000	–0.000	–0.000
				(0.001)	(0.001)	(0.000)
BMI				–0.001	0.001	0.000
				(0.001)	(0.001)	(0.000)

Table 4a: *Ordered Logit Models of Parental-Assessed Child Health Status (Infant Cohort) (Contd.)*

	Infant Cohort (Average Age 9 Months)					
		(1)			*(2)*	
	Probably (Very Healthy)	*Probably (Healthy)*	*Probably (Ill)*	*Probably (Very Healthy)*	*Probably (Healthy)*	*Probably (Ill)*
Depression score				–0.004	0.004	0.000
				(0.001)***	(0.001)***	(0.000)***
Excellent				ref	ref	ref
Very good				–0.070	0.065	0.005
				(0.010)***	(0.009)***	(0.001)***
Good				–0.116	0.107	0.009
				(0.011)***	(0.010)***	(0.001)***
Fair/poor				–0.136	0.126	0.010
				(0.017)***	(0.014)***	(0.002)***
No chronic illness				ref	ref	ref
Chronic illness				–0.044	0.041	0.003
				(0.012)***	(0.011)***	(0.001)***
N		9,880			9,021	
Pseudo-R^2		0.001			0.044	

Notes:
(i) Results are presented in the form of marginal effects.
(ii) Standard errors, which are adjusted for clustering on the primary sampling unit for the Child Cohort, are presented in parentheses.
(iii) * significant at 10 per cent; ** significant at 5 per cent; *** significant at 1 per cent.
(iv) The results (in column 1) include controls for household income and mother's education only. Column (2) adds controls for child and mother characteristics, including the full set of mother's health variables.

Table 4b: *Ordered Logit Models of Parental-Assessed Child Health Status (Child Cohort)*

	Infant Cohort (Average Age 9 Months)					
		(1)			*(2)*	
	Probably (Very Healthy)	*Probably (Healthy)*	*Probably (Ill)*	*Probably (Very Healthy)*	*Probably (Healthy)*	*Probably (Ill)*
SES						
Equivalised income	0.057	–0.053	–0.004	0.040	–0.037	–0.003
	0.011)***	(0.010)***	(0.001)***	(0.012)***	(0.011)***	(0.001)***
Primary	–0.086	0.080	0.006	–0.007	0.006	0.000
	(0.032)***	(0.030)***	(0.002)**	(0.036)	(0.034)	(0.003)
Upper secondary	–0.066	0.061	0.005	– 0.043	0.040	0.003
	(0.022)***	(0.021)***	(0.002)***	(0.026)	(0.024)	(0.002)
Upper secondary	–0.002	0.001	0.000	0.013	–0.012	–0.001
	(0.019)	(0.018)	(0.001)	(0.022)	(0.020)	(0.001)
Non degree	–0.016	0.015	0.001	–0.014	0.013	0.001
	(0.020)	(0.018)	(0.001)	(0.021)	(0.020)	(0.001)
Degree	–0.017	0.016	0.001	–0.012	0.011	0.001
	(0.020)	(0.018)	(0.001)	(0.021)	(0.020)	(0.001)
Postgraduate	ref	ref	ref	ref	ref	ref
Child Characteristics						
Age				–0.057	0.053	0.004
				(0.044)	(0.040)	(0.003)
Male				ref	ref	ref
Female				0.010	–0.009	–0.001
				(0.011)	(0.010)	(0.001)

Table 4b: *Ordered Logit Models of Parental-Assessed Child Health Status (Child Cohort) (Contd.)*

	Infant Cohort (Average Age 9 Months)					
		(1)			*(2)*	
	Probably (Very Healthy)	*Probably (Healthy)*	*Probably (Ill)*	*Probably (Very Healthy)*	*Probably (Healthy)*	*Probably (Ill)*
Birth order	0.015–0.014	–0.001				
				(0.006)**	(0.005)**	(0.000)*
Care at home				ref	ref	ref
Care by au pair/relative				–0.020	0.018	0.001
				(0.013)	(0.012)	(0.001)
Centre-based care				–0.036	0.034	0.003
				(0.029)	(0.027)	(0.002)
Pregnancy/early life characteristics						
Birth weight				0.032	–0.030	–0.002
				(0.010)***	(0.010)***	(0.001)***
Early				0.015	–0.014	–0.001
				(0.019)	(0.017)	(0.001)
On time				ref	ref	ref
Late				–0.014	0.013	0.001
				(0.013)	(0.012)	(0.001)
No breastfeeding				–0.002	0.002	0.000
				(0.012)	(0.011)	(0.001)
Breastfeeding				ref	ref	ref
Smoking				–0.035	0.033	0.002
				(0.014)**	(0.013)**	(0.001)**
No smoking				ref	ref	ref

Table 4b: *Ordered Logit Models of Parental-Assessed Child Health Status (Child Cohort) (Contd.)*

			Infant Cohort (Average Age 9 Months)			
		(1)			*(2)*	
	Probably (Very Healthy)	*Probably (Healthy)*	*Probably (Ill)*	*Probably (Very Healthy)*	*Probably (Healthy)*	*Probably (Ill)*
Drinking				–0.005	0.004	0.000
				(0.011)	(0.010)	(0.001)
No drinking				ref	ref	ref
Mother characteristics						
Age				0.001	–0.001	–0.000
				(0.001)	(0.001)	(0.000)
Lone parent				–0.003	0.003	0.000
				(0.018)	(0.017)	(0.001)
Two parent				ref	ref	ref
White				ref	ref	ref
Black				0.035	–0.033	–0.003
				(0.056)	(0.053)	(0.004)
Asian				–0.058	0.054	0.004
				(0.043)	(0.040)	(0.003)
Other				0.142	–0.132	–0.010
				(0.136)	(0.129)	(0.001)
Height				0.000	–0.000	–0.000
				(0.001)	(0.001)	(0.000)
BMI				–0.000	0.000	0.000
				(0.001)	(0.001)	(0.000)

Table 4b: *Ordered Logit Models of Parental-Assessed Child Health Status (Child Cohort) (Contd.)*

			Infant Cohort (Average Age 9 Months)			
		(1)			*(2)*	
	Probably (Very Healthy)	*Probably (Healthy)*	*Probably (Ill)*	*Probably (Very Healthy)*	*Probably (Healthy)*	*Probably (Ill)*
Depression score				–0.009	0.008	0.001
				(0.001)***	(0.001)***	(0.000)***
Excellent				ref	ref	ref
Very good				–0.090	0.083	0.006
				(0.014)***	(0.013)***	(0.001)***
Good				–0.147	0.136	0.010
				(0.015)***	(0.014)***	(0.002)***
Fair/poor				–0.180	0.169	0.013
				(0.023)***	(0.021)***	(0.002)***
No chronic illness				ref	ref	ref
Chronic illness				–0.042	0.039	0.003
				(0.016)**	(0.015)**	(0.001)***
N		7,694			6,330	
Pseudo-R^2		0.008			0.043	

Notes:
(i) Results are presented in the form of marginal effects.
(ii) Standard errors, which are adjusted for clustering on the primary sampling unit for the Child Cohort, are presented in parentheses.
(iii) * significant at 10% per cent; ** significant at 5 per cent; *** significant at 1 per cent.
(iv) The results (in column 1) include controls for household income and mother's education only. Column (2) adds controls for child and mother characteristics, including the full set of mother's health variables.

Table 5: *Probit Models of Chronic Illness Incidence*

	Infant Cohort (Average Age 9 Months)		*Child Cohort (Average Age 9 Years)*	
	(1)	*(2)*	*(1)*	*(2)*
SES				
Equivalised income	0.018	0.020	–0.013	–0.001
	(0.008)**	(0.010)**	(0.007)*	(0.001)
Primary	–0.005	0.002	0.060	0.027
	(0.030)	(0.034)	(0.021)***	(0.026)
Upper secondary	0.002	–0.027	0.048	0.041
	(0.019)	(0.022)	(0.014)***	(0.016)**
Upper secondary	–0.024	–0.036	0.018	0.011
	(0.015)*	(0.016)**	(0.013)	(0.014)
Non degree	–0.015	–0.019	0.013	0.010
	(0.015)	(0.016)	(0.013)	(0.014)
Degree	–0.038	–0.031	0.013	0.005
	(0.015)***	(0.015)**	(0.014)	(0.016)
Postgraduate	ref	ref	ref	ref
Child Characteristics				
Age	n/a	n/a	0.030	(0.024)
Female		–0.058		–0.042
		(0.009)***		(0.008)***
Male	ref	ref	ref	ref
Birth order		–0.001		–0.00
		(0.005)		(0.004)
Care at home	ref	ref	ref	ref
Care by au pair/relative		–0.006		0.018
		(0.011)		(0.009)*
Centre-based care		0.020		0.020
		(0.015)		(0.019)
Pregnancy/early life characteristics				
Birth weight		0.003		–0.013
		(0.009)		(0.007)*
Early		0.086		0.025
		(0.021)***		(0.011)**
On time	ref	ref	ref	ref
Late		0.005		0.006
		(0.014)		(0.009)

Table 5: *Probit Models of Chronic Illness Incidence (Contd.)*

	Infant Cohort (Average Age 9 Months)		*Child Cohort (Average Age 9 Years)*	
	(1)	*(2)*	*(1)*	*(2)*
No breastfeeding		0.018		–0.009
		(0.010)*		(0.008)
Breastfeeding	ref	ref	ref	ref
Smoking		–0.020		0.009
		(0.013)		(0.009)
No smoking	ref	ref	ref	ref
Drinking		0.000		–0.013
		(0.011)		(0.008)
No drinking	ref	ref	ref	ref
Mother characteristics				
Age		–0.001		–0.000
		(0.001)		(0.001)
Lone parent		0.007		0.027
		(0.016)		(0.012)**
Two parent	ref	ref	ref	ref
White	ref	ref	ref	ref
Black		–0.103		–0.016
		(0.032)***		(0.034)
Asian		–0.037		–0.037
		(0.029)		(0.033)
Other		–0.020		n/a
		(0.072)		
Height		–0.001		–0.000
		(0.001)		(0.001)
BMI		–0.000		0.002
		(0.001)		(0.001)**
Depression score		0.003		0.003
		(0.001)**		(0.001)**
Excellent	ref	ref	ref	ref
Very good		0.046		0.016
		(0.011)***		(0.009)*
Good		0.058		0.025
		(0.013)***		(0.012)**

Table 5: *Probit Models of Chronic Illness Incidence (Contd.)*

	Infant Cohort (Average Age 9 Months)		*Child Cohort (Average Age 9 Years)*	
	(1)	*(2)*	*(1)*	*(2)*
Fair/poor		0.057		0.044
		(0.021)***		(0.017)***
No chronic illness	ref	ref	ref	ref
Chronic illness		0.047		0.056
		(0.015)***		(0.011)***
N	9,907	9,035	7,694	6,316
Pseudo-R^2	0.001	0.016	0.006	0.042

Notes:
(i) Results are presented in the form of marginal effects.
(ii) Standard errors, which are adjusted for clustering on the primary sampling unit for the Child Cohort, are presented in parentheses.
(iii) * significant at 10 per cent; ** significant at 5 per cent; *** significant at 1 per cent.
(iv) The results (in column 1) include controls for household income and mother's education only. Column (2) adds controls for child and mother characteristics, including the full set of mother's health variables.

income is never statistically significant in explaining infant general health status, it is highly significant in explaining general health status at age nine years, and remains significant even after controlling for a variety of child and mother characteristics. Mother's education emerges as a more important predictor of general health status among infants, while it is insignificant for the older children. The effect of mother's education for infants suggests that the children of lower educated mothers are significantly more likely to be reported as "very healthy", which is perhaps contrary to initial expectations. However, it is possible that higher-educated mothers of infants are displaying the phenomenon of the "worried well", and that this is reflected in their assessments of their child's general health status. For both cohorts, there is a significant association between indicators of mother's health and her child's health, particularly mother's self-assessed general health and depression score. Once again, there are some interesting differences in the effects between the two cohorts; for example, higher-order infants are significantly less likely to be "very healthy", while the opposite is the case for higher-order nine year olds who are significantly more likely to be "very healthy".

Finally, the results for the incidence of a chronic illness are presented in Table 5. As with the more objective indicators, there is a statistically significant raw income gradient in chronic illness incidence for both cohorts, although the effect for infants is perhaps contrary to expectations. This result most likely reflects the nature of the underlying question, which asks about the incidence of 16 specific "doctor diagnosed" chronic conditions; in a health-care system where only 30-40 per cent of the population have access to free primary care, it is perhaps not surprising that we observe this effect for household income.[12] The results for mother's education, in addition to its effect as a proxy for SES, again possibly reflect the "worried well" phenomenon, where the children of mothers with lower levels of education are less likely to have a "doctor-diagnosed" chronic illness. Both these effects persist for the Infant Cohort even after the inclusion of additional controls. In contrast, household income is insignificant in determining chronic illness incidence among the Child Cohort sample (where the question simply asks whether the child has a chronic illness), and mother's education is largely insignificant in determining chronic illness incidence at age nine years. For both cohorts, as with all other indicators, mother's health is significant in determining child health, with mother's depression score, self-assessed health, BMI (for the nine year olds only) and her own chronic illness incidence all highly significant. Future work will examine whether the gradients differ for different types of chronic illness, e.g., asthma versus diabetes.

5.3 *Robustness Checks*

To ensure that our results are robust to differences in variable construction, sample coverage, etc., we run a number of robustness checks. First, we test for the existence of a SES gradient in child health using various other indicators of SES, such as social class, housing tenure, father's education, access to free public health care, household deprivation and the financial situation of the mother's family when she was aged 16. The latter is intended to capture the possibility that the childhood SES of the mother is a stronger influence on the health of her children than current SES. The results for household income and mother's education are robust to the inclusion of alternative indicators of SES, which are generally statistically insignificant. The exception is household deprivation and the financial situation of the mother's family when she was aged 16, where these effects were significant in the models of chronic illness incidence (Infant Cohort) and height (Child Cohort). Replacing logged income with a categorical variable (i.e., income

[12] Complementary research by the authors using the same data has shown that while GP visits are concentrated among low income children in Ireland (because lower income children are more likely to have medical or GP visit cards), there is evidence (particularly for nine month olds) that among those children without medical or GP visit cards, GP visiting is significantly higher among children from higher-income families (Layte and Nolan, 2013).

divided into quintiles) makes no difference to the results. Second, the effect of the exclusion of missing observations on income needs to be examined. In both cohorts, approximately 7-8 per cent of observations are missing information on household income. In all cases, the inclusion of an indicator for missing income cases does not change the results from the models presented in Tables 2-5. Third, a common criticism of research on SES inequalities in health is that the observed relationship between SES and health may be subject to reverse causation. While the problem is less pressing when examining child health (because children do not work) (Case *et al.*, 2002; Reinhold and Jurges, 2011), it is still possible that child health is correlated with parental labour supply and by extension, household income. It is less likely for mother's education, as most mothers should have completed their education before starting a family. Nevertheless, as per Currie *et al.* (2007), we therefore repeat the analysis excluding children with severe or limiting chronic illnesses, as it is possible that parental labour supply, particularly on the part of the mother, might be affected if a child has a condition that requires more intensive care on the part of parents, and find no difference in the model results. Fourth, the results are also consistent with models including only household income or mother's education as the indicator of SES. Results from the various robustness checks are available from the authors. Finally, we also test for significant differences in SES gradients between boys and girls by including interactions between gender and household income, and between gender and mother's education; with two exceptions (height and weight for nine year olds, where the income interaction is significant at the 10 per cent level), all interactions are insignificant. Table A6 in the online appendix presents the results of this robustness check.

VI DISCUSSION AND CONCLUSIONS

There is extensive empirical evidence on the link between SES and health outcomes in adults. The evidence for children is less conclusive, with recent debates focusing on the extent to which SES gradients in child health increase as children age, whether the gradient is observed for objective as well as subjective indicators of health status, and whether the gradient is weaker in countries with universal access to free or subsidised primary care services. Using detailed cross-sectional micro-data on two cohorts of children from the nationally-representative *Growing Up in Ireland* study (aged nine months and nine years), the purpose of this paper was to add to this debate in two areas; first, by examining the SES gradient in various objective and subjective indicators of child health (length/height, weight/BMI, general health status and chronic illness incidence), and second, examining the degree to which any observed gradient may be stronger for objective indicators of child health. As noted, the available evidence on this issue in Ireland is very sparse and this is the first paper to examine SES patterns across a variety of indicators of child health, and across two cohorts of children.

While the GUI contains rich information on child health and family circumstances, there are a number of data limitations that must be noted. First, the analysis in this paper is cross-sectional, and therefore can only make inferences about the association between SES and child health, rather than about the possible causal mechanisms. However, the inclusion of additional variables representing early life conditions, parental behaviours and parental health status allows us to examine the factors that may mediate the relationship between SES and child health. Second, much of the research in this area examines the extent to which SES inequalities in child health widen as children age (see Section II); with cross-sectional snapshots, albeit of children of different ages, we cannot shed any light on this debate here. Third, the international research also examines the extent to which SES gradients may be stronger in countries that do not have universal access to free public, and particularly primary, health care. Ireland is unusual in Europe in requiring the majority of the population (including children) to pay the full out-of-pocket cost of primary care, but in the absence of longitudinal data which would capture changing eligibility for free primary care over time, we cannot examine this issue here. Finally, caution is necessary in comparing across cohorts for the chronic illness indicator as the underlying questions and response categories differ substantially.

Notwithstanding these data limitations, the results of this analysis confirm that for nine month old infants, there is little evidence of a statistically significant income gradient in child health (the exception is for chronic illness where higher-income children are more likely to have a "doctor diagnosed" chronic illness). This is in contrast to much of the international literature that finds a statistically significant SES gradient in objective indicators of child health such as height and weight (see for example, Currie *et al.* (2007) and Reinhold and Jurges (2011)). The effects for mother's education are more significant overall, and persist even when other influences on child health (such as child and mother characteristics) are included in the models of general health status and chronic illness incidence, lending some support to the international research findings in this area.

However, the evidence is quite different when examining the findings from the Child Cohort analysis. For this cohort, a statistically significant income gradient in height is observed, and this effect persists when other influences on child height are included in the models. In contrast, while there is a strong and statistically significant income gradient in parental-assessed child health, there is no such effect for chronic illness incidence. Mother's education is highly significant in explaining variations in child BMI-for-age, and these effects persist when other important influences on child health (including mother's BMI) are included in the models. In general, mother's education is insignificant in explaining variations in the other indicators.

For both cohorts, these results are robust to the inclusion of additional indicators of SES, to the exclusion of observations with missing values on income and to the exclusion of children with moderate or severe chronic/longstanding illnesses (to discount the possibility of reverse causation). The relative statistical significance of the additional controls sheds some light on the possible factors that mediate the relationship between SES and child health, albeit based on cross-sectional associations (with birthweight and mother's health the most important mediating factors in general). The statistical significance of parental health in explaining child health has also been found for other countries. For example, Propper *et al.* (2007) also found that once they controlled for "maternal inputs into child health" (i.e., smoking, employment, diet, housing, pre-birth self-assessed health, mental health, anthropomorphic measures, partner's health), there was no direct effect of low income on four of the five child health outcomes at age seven (the exception was BMI). Similarly, Khanam *et al.* (2009) found that including parental health (particularly mother's health) reduced the income coefficient to zero in an examination of the parental-reported health and chronic condition incidence of Australian children. However, studies by Case *et al.* (2002), Currie *et al.* (2007) and Reinhold and Jurges (2011) found that the statistically significant SES gradient in general health status was robust to the inclusion of controls for parental health (a similar finding was observed for our nine year olds).

To some extent the variables for mother's health are also capturing the cumulative impact of parental childhood SES, and as such represent an over-adjustment. To disentangle the genetic and socio-economic contributions of the mother's health variables would require detailed data on the SES of mothers (and partners) when they themselves were children. In the absence of such data, we investigated the use of a variable describing mother's financial background (i.e., her self-assessment of the financial status of her household when she was aged 16) as such an indicator. It is possible that the childhood SES of the mother is a stronger influence on the health of her children than current SES. For example, Propper *et al.* (2007) found that adverse events in the mother's early life were highly correlated both with income and with child health. In our analysis, with the exception of the Infant Cohort chronic illness model, and the Child Cohort height model, the mother's financial background variable was always statistically insignificant in explaining child health.[13] Similarly, it is possible that the more appropriate indicator of SES is a measure of permanent rather than current SES. For example, Cameron and Williams (2009) distinguish between income, consumption and wealth effects, albeit in a developing country, although Khanam *et al.* (2009) (Case *et al.*, 2002; Currie *et al.*, 2007) all found statistically significant effects for both permanent and current income in Australia, the UK and USA respectively. Propper *et al.* (2007) tried to distinguish the impact of current and permanent low income and found a statistically significant effect for persistent financial hardship on child health. We investigated the use of an indicator of deprivation and found that it was only statistically significant in explaining chronic illness incidence among infants, and height of nine year olds. Future research using the longitudinal GUI data should allow us to construct a more accurate indicator for permanent income and deprivation.

The data used in this analysis are cross-sectional, and therefore the extent to which conclusions about causal mechanisms can be drawn is limited. Nonetheless, as a first step in documenting the extent of SES inequalities in child health in the Republic of Ireland, and contributing to the international debate on whether the gradient may be stronger for objective indicators of health, the results shed some light on the possible causal mechanisms (such as birth characteristics and parental health), that will be investigated further as extra waves of both data-sets become available.

REFERENCES

ALLIN, S. and M. STABILE, 2012. "Socioeconomic Status and Child Health: What is the Role of Health Care, Health Conditions, Injuries and Maternal Health?", *Health Economics, Policy and Law,* Vol. 7, pp. 227-242.

CAMERON, L. and J. WILLIAMS, 2009. "Is the Relationship Between Socioeconomic Status and Health Stronger for Older Children in Developing Countries?", *Demography,* Vol. 46, pp. 303-324.

CASE, A. and C. PAXSON, 2010. "Causes and Consequences of Early Life Health", *Demography,* Vol. 47, pp. S65-S85.

CASE, A., A. FERTIG and C. PAXSON, 2005. "The Lasting Impact of Childhood Health and Circumstance", *Journal of Health Economics,* Vol. 24, pp. 365-389.

CASE, A., D. LEE and C. PAXSON, 2008. "The Income Gradient in Children's Health: A Comment on Currie, Shields and Wheatley Price", *Journal of Health Economics,* Vol. 27, pp. 801-807.

[13] We also tested interactions between mother's financial situation as a child and current education/income (e.g., we might expect the effect of parental childhood disadvantage to persist even when current socio-economic position improves). However, all interactions were insignificant.

CASE, A., D. LUBOTSKY and C. PAXSON, 2002. "Economic Status and Health in Childhood: The Origins of the Gradient", *American Economic Review,* Vol. 92, pp. 1308-1334.

CASE, A., C. PAXSON and T. VOGL, 2007. "Socioeconomic Status and Health in Childhood: A Comment on Chen, Martin and Matthews 'Socioeconomic Status and Health: Do Gradients Differ Within Childhood and Adolescence?'", *Social Science and Medicine*, Vol. 64, pp. 757-761.

CHEN, E., A. MARTIN and K. MATTHEWS, 2006. "Socioeconomic Status and Health: Do Gradients Differ Within Childhood and Adolescence?" *Social Science and Medicine*, Vol. 62, pp. 2161-2170.

CHINN, S., R. RONA and C. PRICE, 1989. "The Secular Trend in Height of Primary School Children in England and Scotland 1972-79 and 1979-86", *Annals of Human Biology*, Vol. 16, pp. 387-395.

CURRIE, J., 1995. "Socio-Economic Status and Child Health: Does Public Insurance Narrow the Gap?", *Scandinavian Journal of Economics*, Vol. 97, pp. 603-620.

CURRIE, J. and J. GRUBER, 1996. "Health Insurance Eligibility, Utilization of Medical Care, and Child Health", *The Quarterly Journal of Economics*, Vol. 111, pp. 431-466.

CURRIE, J. and M. STABILE, 2003. "Socioeconomic Status and Child Health: Why is the Relationship Stronger for Older Children?", *American Economic Review*, Vol. 93, pp. 1813-1823.

CURRIE, J., S. DECKER and W. LIN, 2008. "Has Public Insurance for Older Children Reduced Disparities in Access to Care and Health Outcomes?", *Journal of Health Economics*, Vol. 27, pp. 1567-1581.

CURRIE, J., M. SHIELDS and S. WHEATLEY PRICE, 2007. "The Child Health/ Family Income Gradient: Evidence from England", *Journal of Health Economics*, Vol. 26, pp. 213-232.

DEPARTMENT OF HEALTH AND CHILDREN, 2001. *Quality and Fairness: A Health System for You*, Dublin: The Stationery Office.

FINCH, B. and A. BECK, 2011. "Socio-economic Status and z-score Standardized Height-for-age of US-born Children (Ages 2-6)", *Economics and Human Biology*, Vol. 9, pp. 272-276.

GORMAN, B. and J. BRAVERMAN, 2008. "Family Structure Differences in Health Care Utilization Among US Children", *Social Science and Medicine*, Vol. 67, pp. 1766-1775.

GROWING UP IN IRELAND, 2009. Guide to the Datasets *Wave 1 of the Nine-Year Old Cohort of Growing up in Ireland,* Dublin: Economic and Social Research Institute and Trinity College Dublin.

HOWE, L., K. TILLING, B. GALOBARDES, G. DAVEY SMITH, D. GUNNELL and D. LAWLOR, 2010. "Socioeconomic Differences in Child Heigh Trajectories: At What Age do Height Inequalities Emerge?", *Journal of Epidemiology and Community Health*.

INSTITUTE OF PUBLIC HEALTH, 2006. *Unequal at Birth: Inequalities in the Occurance of Low Birthweight Babies in Ireland,* Dublin: Institute of Public Health in Ireland.

JOYCE, T., R. KAESTNER and K. SANDERS, 2000. "The Effect of Pregnancy Intention on Child Development", *Demography*, Vol. 37, pp. 83-94.

KHANAM, R., H. NGHIEM and L CONNELLY, 2009. "Child Health and the Income Gradient: Evidence from Australia", *Journal of Health Economics*, Vol. 28, pp. 805-817.

LAYTE, R. and B. CLYNE, 2010. "Did the Celtic Tiger Decrease Socio-Economic Differentials in Perinatal Mortality in Ireland?", *The Economic and Social Review,* Vol. 41, pp. 173-199.

LAYTE, R. and A. NOLAN, 2013. "Income-Related Inequity in the Use of GP Services: A Comparison of Ireland and Scotland", ESRI Working Paper No. 454, Dublin: Economic and Social Research Institute.

LIN, W., 2009. "Why has the Health Inequality Among Infants in the US Declined? Accounting for the Shrinking Gap", *Health Economics*, Vol. 18, pp. 823-841.

LINDEBOOM, M., A. LLENA-NOZAL and B. VAN DER KLAAUW, 2009. "Parental Education and Child Health: Evidence from a Schooling Reform", *Health Economics*, Vol. 28, pp. 109-131.

MCGOVERN, M.,2013. "Still Unequal at Birth? Birth Weight, Socio-economic Status and Outcomes at Age 9", *The Economic and Social Review*, Vol. 44, pp. 53-84.

MURASKO, J., 2008. "An Evaluation of the Age-Profile in the Relationship Between Household Income and the Health of Children in the United States", *Journal of Health Economics*, Vol. 27, pp. 1489-1502.

MURRAY, A., C. MCCRORY, M. THORNTON, J. WILLIAMS, A. QUAIL, L. SWORDS, E. DOYLE and E. HARRIS, 2011. "Growing Up in Ireland National Longitudinal Study of Children", *Design, Instrumentation and Procedures for the Child Cohort.* Dublin: Office of the Minister for Children and Youth Affairs.

NIEDHAMMER, I., C. MURRIN, D. O'MAHONY, S. DALY, J. MORRISON, C. KELLEHER and T.L.C.-G.C.S.S. GROUP, 2011. "Explanations for Social Inequalities in Preterm Delivery in the Prospective Lifeways Cohort in the Republic of Ireland", *The European Journal of Public Health*, Vol. 22, pp. 533-538.

NOLAN, B., 1994. "Perinatal Mortality and Low Birthweight by Socio-Economic Background: Evidence for Ireland", *The Economic and Social Review*, Vol. 25, pp. 321-341.

PALLONI, A., C. MILESI, R. WHITE and A. TURNER, 2009. "Early Childhood Health, Reproduction of Economic Inequalities and the Persistence of Health and Mortality Differentials", *Social Science and Medicine*, Vol. 68, pp. 1574-1582.

PROPPER, C., J. RIGG and S. BURGESS, 2007. "Child Health: Evidence on the Roles of Family Income and Maternal Mental Health from a UK Birth Cohort", *Health Economics*, Vol. 16, pp.1245-1269.

QUAIL, A., J. WILLIAMS, C. MCCRORY, A. MURRAY and M. THORNTON, 2011. *A Summary Guide to Wave 1 of the Infant Cohort (at 9 Months) of Growing Up in Ireland*, Dublin: Economic and Social Research Institute.

REINHOLD, S. and H. JURGES, 2011. "Parental Income and Child Health in Germany", *Health Economics,* Forthcoming.

RONA, R., A. SWAN and D. ALTMAN, 1978. "Social Factors and Height of Primary Schoolchildren in England and Scotland", *Journal of Epidemiology and Community Health*, Vol. 32, pp. 147-154.

SMITH, A., S. CHINN and R. RONA, 1980. "Social Factors and Height of Primary Schoolchildren in England and Scotland", *Annals of Human Biology*, Vol. 7, pp. 115-124.

SMITH, J., 1999. "Healthy Bodies and Thick Wallets: The Dual Relation between Health and Economic Status", *Journal of Economic Perspectives*, Vol. 13, pp. 145-166.

STOWASSER, T., F. HEISS, D. MCFADDEN and J. WINTER, 2011. "Healthy, Wealthy and Wise?" Revisited: An Analysis of the Causal Pathways from Socio-economic Status to Health", NBER Working Paper No.17273. Washington: NBER.

THORNTON, M., J. WILLIAMS, C. MCCRORY, A. MURRAY and A. QUAIL, 2011. *Guide to the Datasets Wave 1 of the Nine-Year Cohort of Growing Up in Ireland*, Dublin: Economic and Social Research Institute.

VIOLATO, M., S. PETROU, R. GRAY and M. REDSHAW, 2011. "Family Income and Child Cognitive and Behavioural Development in the United Kingdom: Does Money Matter?", *Health Economics*, Vol. 20, pp. 1201-1225.

WALKER, L., A. GAVIN, C. KELLY, M. MOLCHO, D. AWOBIYI and S. NICGABHAINN, 2012. "Health Behaviour in School-aged Children (HBSC) Ireland study 2010", *Middle Childhood Study: Socio-Demographic Patterns in the Health Behaviours, Risk Behaviours, Health Outcomes and Social Contexts of Young People's Lives*. Galway: Health Promotion Research Centre, NUIG.

WORLD HEALTH ORGANISATION, 2008. "Closing the Gap in a Generation", *Health Equity Through Action on the Social Determinants of Health,* Geneva: World Health Organisation.