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The Impact of Low-Income on Child Health: Evidence from a Birth Cohort Study

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Abstract

There is a growing literature that shows that higher family income is associated with better health for children. Wealthier parents may have more advantaged children because they have more income to buy health care or because parental wealth is associated with beneficial behaviours or because parental health is associated with both income and children's health. The policy implications of these transmission mechanisms are quite different. We attempt to unpick the correlation between income and health by examining routes by which parental disadvantage is transmitted into child disadvantage. Using a UK cohort study that has rich information on mother's early life events, her health, her behaviours that may affect child health, and her child's health, we examine the impact of being in low income compared to that of mother child health related behaviours and mother's own health on child health. We find children from poorer households have poorer health. But we find the direct impact of income is small. A larger role is played by mother's own health and events in her early life. No clear role is played by mother child health production behaviours.

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1. Introduction

There is a huge literature on the relationship between socio-economic status and health (e.g. Marmot and Wilkinson 1999). There is now a growing literature that shows that higher family income is associated with better health for children (Case et al (2002) for the US, Currie and Stabile (2002) for Canada). Wealthier parents may have healthier children for a host of reasons. They may have more income to buy health care. They may have more income to buy goods, other than healthcare, that produce better health. These are both causal links: more income will result in better child health. But the link with income may not be causal: instead income may be correlated with other factors which themselves affect child health. An obvious example is a genetic factor that results in both health and wealth advantage. However, there may be other non-genetic factors, such as events that occurred early in the life of the parent which affect her ability to produce child health from a given set of inputs. The policy implications of these routes are quite different. If the transmission is primarily through the purchasing power of income, policies to reduce the costs of palliative care for poor parents will increase their children's health. On the other hand, if the transmission mechanism is primarily via specific behaviours, or events that occur early in the life of the parents, or genetic inheritance, current increases in income may have little effect on the relationship.

In this paper, we focus on the link between parental behaviours, mother health, and income in the production of child health. We go further than recent papers in exploring the link between income, these factors, and child health. Currie and Stabile (2002) show that children in low socio-economic status (SES) households have more health shocks, but recover at similar rates from these shocks to children in higher SES households. Case et al (2002) show that certain contemporaneous parental behaviours are associated with both better child health and higher income, but do not remove the effect of income on child health. We unpick the correlation between income and health further by examining the routes by which parental disadvantage is transmitted into child disadvantage. We focus on two sets of factors that may affect child health. We examine the impact of these when they occur early in the child's life or before the child's birth. The first set are behaviours of the mother that may reduce the health of the child: early inputs into the child health production function. The second set are the mother's own health, including her mental health, prior to the child's birth. Poor maternal health may reduce the effectiveness of any other inputs devoted to the production of child health. Both sets of factors

are likely to be associated with household income. If the association is negative, such that wealthier mothers feed their children better diets or have better mental health, then omission of these factors will suggest a bigger causal role for current income than is in fact the case.

We examine the effect of these factors using data from the UK for a cohort of children born in the early 1990s. These data, hitherto little analysed by social scientists, provide rich information on mother's health (including her responses to adverse events in her early life), her behaviours that may affect her child's health, and her child's health.

We begin by examining the impact of being in low income on her child's health. We find the expected correlation between current income and the current health of the child: children from poorer households have poorer health. But we find little evidence of a link between the timing of low income and child outcomes: the impact of income is very similar whenever in a child's early life financial hardship occurred. We do find evidence that being in financial hardship repeatedly appears to affect health. Korenman and Miller (1997) find similar links for US data. Taken together, this suggests that current income has relatively little impact on health but there is a role for permanent income.

We then explore the impact of the factors identified above on this relationship between income and child health. In the first set, we examine the impact of behaviours early in the child's life - diet, breast-feeding, early maternal employment, housing conditions. In the second, we examine the health of the mother pre-birth - anthropomorphic measures of the mother's health, her own assessment of her mental and physical health, and her responses to adverse events that occurred early in her own childhood. We find little evidence to suggest that the transmission mechanism from income to child health is through mother child health related behaviours. While these are associated with income, they do not change the estimated effect of income. Nor, in the main, do they have much direct impact on child health, after controlling for income. In contrast, we find that mother's own mental health and her responses to events in her early life are highly correlated both with income and with child health. Once we allow for these, the estimated impact of income falls considerably, suggesting that a considerable part of the observed correlation between income and child health is not causal, but is due to the correlations between poor mother health pre-birth, poor child health and low income.

The paper is organised as follows. Section 2 outlines our approach and evidence on the association between parental income (or SES) and child health. Section 3 presents the data used in the analysis. Section 4 presents our results as to the impact of income and Section 5 presents our conclusions.

2. The relationship between child health and parental SES

2.1 Our approach

The relationship between child health and parental income can be thought of as having two components. The first is a child health production function, in which parental and other inputs are used to produce child health given an initial health stock (Grossman 2000). Income will affect the goods that are purchased and may also affect the productiveness of these inputs. The child health's health at time t can be written as:

$$h_{ct} = a_0 + a_1 X_{mt} + a_2 Y_{mt} + h_{c0} + e_c + w_{ct} \quad (1)$$

where *m* indexes the parent and *c* the child, h_{ct} is the health of the child at time t, the vector X_{mt} represents parental inputs other than income at time t, Y_{mt} is parental income, h_{c0} is initial (observed) child health, e_c is a unobserved, time invariant, child effect and w_{ct} is random error.

Parental income Y_{mt} is a function of both observed and unobserved parental characteristics. These characteristics will include parental health (e.g. Smith 1998):

$$Y_{mt} = b_0 + b_1 Z_{mt} + a_2 h_m + e_m + w_{mt} \quad (2)$$

where Z_{mt} contains both time varying and time invariant parental characteristics other than health, h_m is (observed) mother health, e_m is a unobserved, time invariant, mother effect and w_{mt} is random error.

From (1) and (2) an association between income and health may arise because income directly affects child health, because income affects the things parents buy and the time inputs they make, or because there is an association between adult health and child health which is picked up by income. It seems unlikely that more income per se will affect child health, but income may well affect health through the association between income and the goods and services

parents buy and the time they spend with their children. These goods may not necessarily be medical care. In the UK medical care is free at point of delivery so we would not expect to see a large association between income and the use of medical care. But income may be used to buy goods such as a better diet, heating, better quality housing, or vacations, all of which may contribute to the health of the child. But income and child health may also be associated not because income produces child health, but because parental health and child health that are linked through the fact that parental income is associated with parental health.

The problem of estimating the direct channel from health to income in equation (1) for adults is that health affects income and income affects health (Adams et al 2003; Adda et al 2003; Smith 1999). This problem is largely absent for child health as children in the UK do not contribute to family income (though there may be some effect on parental labour supply of having an ill child). But there may be bias because Y_{mt} and e_c are correlated (say through genetic endowments common to the mother and her child). In an adult context, one way to deal with this would be to use panel data and difference out the fixed effects. However, in the child context this strategy is less plausible. Individual characteristics, which might be thought of as fixed in adults, may only become so during childhood (for example, development of allergies). More generally, child development takes place at different rates across children. First differencing is therefore not likely simply to remove a fixed effect.

The strategy we therefore follow here is to use (1) to examine the association of parental income and child health controlling for a small set of 'standard' background controls, which attempt to capture aspects of the child's initial endowment of health (birth weight and birth order), the household demographic structure, and the education of the mother. Education and income are heavily correlated, and to estimate the effect of income without allowing for the impact of education will be to overestimate the effect of income. This specification follows the approach in existing literature on parental income and child health (e.g. Case et al 2002). With this specification we examine first the contemporaneous association of income and child health. We then use the high frequency of our data to see if when a child is in low income matters and whether persistence of low income matters.

We then exploit our rich data set to attempt to unpack the estimated effect of income by introducing measures of the mother's child health production behaviours (X_{mt}) and her health (h_m) into our estimation of equation (1). Examining these directly allows us to explain how

income is operating and to differentiate between a behavioural channel (which could be influenced by policy) and a mother health related channel (which may be rather less open to policy manipulation) for the transmission of income to child health.

2.2 Previous research on the association between child health and parental income

Case et al (2002) use cross sectional US data to examine whether the relationship between income and health found in adults exists for children. They show that this relationship is present for children and, further, that the gradient deepens with age. Currie and Stabile (2002) use panel data to investigate this and find the same deepening of difference across SES with age. However, they also show that this deepening is due to a greater incidence of health shocks among children in low SES households, rather than a slower recovery rate from a shock. Koreman and Miller (1997) investigate the timing of income and find that being long term in low income has a deterious effect on child health as measured by stunting, wasting and obesity among a sample of children aged 5-7.

Case et al (2002) examine the effect of a set of both child health parental health related behaviours on the income-child health link. The measures they use are mainly contemporaneous. The child health related behaviours are whether the child has seen a doctor in the last year, whether they have a regular place for sick and health care, whether they have a regular bedtime and whether they wear a seat belt. The parental health behaviours are parental BMI, whether the parent smokes and whether the mother has visited a doctor in the last 12 months. These are all correlated with child health and do reduce the association between income and child health, but not to a very large degree.

For the UK, there is strong evidence of an association between SES and health in adults (e.g. the Black report (Townsend and Davidson 1982) and its follow up (Independent Inquiry into Inequalities 1998), and that this difference persists into old age (Marmot and Nazroo 2001). Van Doorslaer et al (1997) show that this relationship holds for income as well as more general measures of SES. However, there is much less research which has looked at children. Much of this research has looked at the impact of poor child health on later outcomes using the UK cohort studies. Currie and Hyson (1999) examine the impact of low birth weight on later outcomes. They find that low birth weight has a persistent negative effect on a range of outcomes post childhood. However, they found that there was little evidence that the impact of low birth weight (which is associated with lower SES) had a differential effect for children from

low SES families. Hobcraft (2003) looks at low SES and poor ability scores in childhood and finds these to be associated with poor mental health at ages 23 and 33.

West (1997) reviews earlier literature on the link between childhood illness and SES, all of which uses cross-sectional data. He finds an association between SES and childhood illhealth, particularly as measured by mortality, but also as measured by the presence of one (or more) chronic conditions. He also finds this gradient in childhood illness by SES disappears in adolescence, only to re-emerge in adulthood.

Finally, it should be noted that these SES differentials in the UK arise in a health care system where health care is free at the point of delivery. Evidence based on large scale national surveys suggest that access to health care, given medical need, is not strongly associated with income for adults (O'Donnell and Propper 1991, van Doorslaer et al 2000). Yet differentials in health remain.

3. The Data

3.1 The Avon Longitudinal Study of Parents and Children (ALSPAC)

We use a very rich UK data set on a cohort of children born in one region of the UK in the early 1990s. The Avon Longitudinal Study of Parents and Children (ALSPAC; Golding, 1996) is a local, population-based study investigating a wide range of socio-economic, environmental and other influences on the health and development of children. Pregnant women resident in the former Avon Health Authority were invited to participate if their estimated date of delivery was between the 1st of April 1991 and the 31st of December 1992. Approximately 85% of eligible mothers enrolled, resulting in a cohort of 14,893 pregnancies. Our estimation samples are somewhat smaller than this, representing late miscarriages, stillbirths and post-birth sample attrition and non-response to questionnaire items[1].

[1] The cross-sectional representation of the ALSPAC sample has been investigated by comparison with the 1991 National Census data of mothers with infants under one year of age who were resident in the county of Avon. In general, the ALSPAC sample performed reasonably well, although mothers who were married or cohabiting, owned their own home, did not belong to any ethnic minority and lived in a car-owning household were slightly over-represented. As these are typically characteristics that are positively associated with income the initial ALSPAC sample is likely to contain a lower number of mothers with low-income than the population.

Respondents were interviewed at high frequency compared to any of the UK cohort studies.[2] They were given questionnaires pre-birth and then at regular intervals after the birth of their child. Here we use data from 18 questionnaires (10 mother-based and 8 child-based) covering the dates between 8 weeks gestation and the 85th month of the child.

3.2 Measures of child health

Mothers were asked at frequent intervals to provide a general assessment of their child's health as well as stating whether their child had recently experienced any of a list of between 16 and 21 (depending on age) symptoms of poor health. We use this detailed information to construct five indicators of poor child health, available for when the child is aged 6, 18, 30, 42 and 81 months old. All are binary variables, with one denoting poor health.

The first three measures are based on the number of symptoms of poor health mothers say their child has experienced over the past year[3]. The incidence of symptoms by age of child is shown in Table A1. The symptoms are wide ranging, both in the dimensions of health they capture as well as their prevalence. For instance, scarcely any children stop breathing (experienced by just 0.21 per cent of the 81 month sample), whereas it was rare for children not to have experienced a cold (typically over 90 per cent of children had a cold in the past year). The proportion of children by number of symptoms of poor health and age of child is reported in Table A2. At all ages, the number of symptoms of poor health is approximately normally distributed. Roughly one fifth of children experience the modal number of symptoms: 3 symptoms at 6 and 18 months and 5 symptoms at 30, 42 and 81 months.

We cut this distribution of symptoms into three and define ill health as being in the top 40% of the distribution, the top 20% and the top 5% at time *t* respectively. A straightforward count of number of symptoms has the benefit of simplicity and is likely on the whole to provide a fairly reliable proxy for quality of health. This assumes that all symptoms have an identical impact on quality of health and that, either all symptoms are independent, or, where symptoms may be interdependent in some circumstances (such as, ear ache and ear discharge), the impact on health is twice as large as the presence of either symptom alone.

[2] For example, the UK NCDS interviewed at birth and then again at 7. The UK BCS70 has a similar gap.
[3] At 6 months, the question refers to "first few months" rather than "past year".

The fourth and fifth measures of poor child health are both based on mothers' assessment of their child's health in the past year. Mothers were asked to classify their child health into one of "very healthy, no problems", "healthy, but a few minor problems", "sometimes quite ill" or "almost always unwell". Approximately 50 to 60 per cent of children were classified in one of the two healthiest categories. By contrast, less than five per cent of mothers rated their child as "sometimes quite ill" or "almost always unwell". Table A3 provides details. From these responses, we compute two binary outcome variables indicating poor child health. The first includes the two least healthy categories "sometimes quite ill" and "almost always unwell", which we label mother-reported very poor health. The second indicator, labelled mother-reported poor child health, additionally includes children described as "healthy, but a few minor problems". The excluded category are those children who experience 'no problems"[4]. Currie and Stabile (2002) use very similar measures to those used here.

There are no physician measures of ill health, so we rely on mother's reports (controlling for anthropomorphic measures of child health at birth). Dadds et al (1995) present evidence that maternal mental health does not influence mother's reports of child health. Case et al (2002) provide additional evidence on this issue, comparing physician reported and mother reported data, and conclude that the income gradients they find in their various sources of data are not due to mother reporting error.

3.3 Low-income indicators

Our low-income indicator is based on mothers' replies to a series of routinely asked questions about financial hardship. The questions are asked shortly before birth (32 weeks gestation) and after birth when the child is aged 8, 21, 33, 61 and 85 months old. Thus, information on financial hardship is available on six separate occasions, spanning a period of just over seven years.

Mothers are asked "How difficult at the moment do you find it to afford": food, heating, clothing, rent or mortgage and things for the baby/child. The available responses are "Very difficult", "fairly difficult" "slightly difficult", or "not difficult". In constructing our financial hardship scores, we assign a value of 3 for "very difficult", 2 for "fairly difficult", 1 for "slightly

[4] The cross-correlation between the measures based on symptoms and those based on mother general assessment of child health are all significantly different from zero and range between 0.1 and 0.3.

difficult" and 0 for "not difficult". These individual scores are aggregated to form an overall score with a maximum of 15 points[5].

The distributions of aggregate financial hardship scores at different ages in given Table A4. We define a child as in low income if living in a household with a financial hardship score of five or more. The proportion of children with low-income based on this definition ranges from 25 to 30 percent in the first few years of childhood, falling to less than 17 percent by the time the children are 81 months old. In part, this decline in the rate of low-income may arise from 'genuine' phenomena: national rates of child poverty fell slightly over this period. In addition, the decline in low-income rates in Table A4 is also likely to reflect differential attrition as there is increased risk of sample dropout amongst children in families with low-income (see table A5).

ALSPAC also contains mother reported data on actual family income. There are serious constraints on the use of this data as income amounts are recorded in five broad bands. Moreover, data on net family income in ALSPAC is only available when children are aged 33, 47 and 85 months. Hence, detailed analysis of the dynamics between low-income and child health, including most notably the consequences of low-income around the time of birth, is limited using direct measures of income. But we can use this data as a check on the financial hardship based low-income measures. Information is available on both financial hardship and family income when the children are aged 33 and 85 months. This enables us to compare the degree of overlap in the composition of the low-income samples according to different low-income indicators. Table A7 reveals a close association between low actual income and having a financial hardship score of five or more. The precise timing, and matching, of the health and low-income is discussed in Table A8.

3.4 Controls for child initial health, household composition and mother's education

Controls for gender, birth weight, birth order, and ethnicity allow us to control for initial child health (and to remove as much of the unobserved child fixed effect as possible). Controls for household composition, mother's age at birth and education allow us to isolate the impact of income, controlling for mother human capital. However, our data allow us to go further and to

[5] "Paid directly by social security" was introduced as an additional response to the heating and rent or mortgage questions in the 21 and 33-month questionnaires and this is coded as 3. All financial hardship questions in the 61 and 85-month questionnaires specified, "did not pay" as an alternative. There were few respondents who ticked this box, except for the rent or mortgage question. All "did not pay" responses were coded as 3 since these are likely to reflect payments made on the parent's behalf by social security.

examine the impact of both mother's health and her child health related behaviours on the income-child health relationship.

3.5 Mother's health

The data set contains measures of mother's physical and mental health, recorded early in the pregnancy, but which mostly measure health prior to pregnancy. Mothers answered a standard self-assessed general health question (shown in other work to predict mortality for adults) at 8 weeks into pregnancy.[6] At 18 weeks gestation the mothers are asked to answer 23 questions, on a five-point scale, which measure their free-floating anxiety, depression and somaticism[7]. This scale has been shown to be a measure of psycho-neurotic pathology in community settings. The mothers also provide answers to 31 questions on whether she experiences particular events before she was seventeen years old, and if so, whether the event affected her a lot, moderately, mildly or did not affect her at all or did not occur. These events include the death of a parent or sibling, the occurrence of physical or mental illness in the mother's family, being in trouble with the law, becoming pregnant. The maximum possible score is 124. We divide this score into quartiles[8]. The data set also contains anthropomorphic measures of mother's health (birth weight and BMI prior to pregnancy) and whether or not she was pre-term.

3.6 Mothers' child health related behaviours

We have data on three types of behaviour of the mother that may affect her child's health. First, we have information on the type of diet the mother fed to her child. We have information on breast-feeding behaviour from which we construct indicators of whether the child was breast fed, and if so, the duration of breast-feeding. We also have information on the solid food fed to the child at 38 months. Following North (2000) we classify solid food intake into 4 types of diet: healthy, junk, traditional and snack. Second, we have information on the total time input of the mother. Gregg and Washbrook (2003) have shown that mothers who return to work spend less time with their children than those who are not working so we measure whether, when and for what proportion of the week the mother returned to work before her child was three. Third, we have data on mother's consumption which may affect her child's health: specifically we have data on whether the mother was a smoker at 5 dates during the gestation and the first five years

[6] The question asks the mother to rate her 'usual' health pre-pregnancy.
[7] This is the Crown-Crisp Experiential Index. Details are available from the authors.
[8] These three measures of mother's health are associated but correlations between them are all below 0.17.

of the sample child's life[9]. Finally, we have information on the housing conditions of the home the child at the same dates. We use this to construct an indicator of whether the home ever had serious damp, condensation or mould problems.

Summary statistics for the sample are in Table 1.

4. The effect of income

4.1 Low-income and poor child health: the contemporaneous association

We begin our analysis by examining the contemporaneous relationship between low-income and poor child health. Table 2 presents the coefficient on low income for the five measures of child health, with and without the background controls. Income and child health are contemporaneously associated. Without controls, being in financial hardship is associated with all measures of child health at all ages. Across the two types of measure, income is somewhat more strongly associated with the number of symptoms than with the mother's assessment of her child's general health. Within the two types of measure of health, the association falls as the measure of health becomes more severe. However, this pattern in the coefficients is not significant statistically. The children with very poor health are outliers in the child health distribution and the lack of association with current income may be the result of considerable heterogeneity within this small group.

There is no clear pattern in the income coefficients over time if we take the youngest and oldest age of the child in the data. Comparing 8 months and 81 months, the association between income and health falls for health measured as being in the top 40 percent of symptoms of poor health, but rises for health measured as being in the top 5 percent of the symptom distribution and for poor mother reported health. On the other hand, if we compare the change from 21 to 81 months, there is some steepening of the association between income and child health. However, the income coefficients are not significantly different from each other. [10] So, unlike Case et al (2002) for the US and Currie and Stabile (2002) for Canada, we find no evidence of a significant deepening of the contemporaneous income effect as children age. We do examine a younger age

[9] The data also contain information on alcohol and substance abuse. The numbers reporting ever experiencing drug addiction and/or alcoholism are too small to make use of these measures.

[10] To check for robustness to attrition, Table 2 was re-estimated using only the children for whom health outcomes and low-income measures are available at all four points. The results are very similar to those in Table 2.

range than either of these North American papers and it may be that income related differences do not manifest themselves till later in childhood.

The second set of columns in the table include controls for child birth weight, child birth order, mother's age at birth, household composition and mother's education. Interestingly, these controls hardly change the estimated effect of contemporaneous income. Of the background controls, only child gender, birth order, and mother's age at birth are significantly associated with low health, given the effect of income. We would expect education to have both a direct effect on health, if better educated mothers are better at producing child health, and an indirect effect, though the association of education with income. The results here suggest that once low income is taken into account, mother's education has no further direct effect on health outcomes[11].

4.2 The effect of low-income persistence

Our data allow us to go beyond current income. Among children with non-missing low-income observations at all six points in time, just less than half (45 percent) never experience low-income. Around one-quarter (27 percent) experience low-income either once or twice, whilst just over six percent are continuously observed with low-income. To examine whether a temporary experience of low-income is as harmful for child health as persistent low-income Table 3 presents the regression coefficients of the number of times the household is in low income on health outcomes at 81 months. The results are estimated using the same set of background controls as in Table 2.

The top panel of the table reports estimates for the number of low-income experiences in increments of one. In increments of one, the income effects are not always well defined. However, there is some evidence that the impact of being poor several times has more impact on child health than being poor once. As the numbers of children experiencing high counts of low-income are relatively small we repeat the analysis distinguishing only between no experience, 1 to 2, and 3 to 6 experiences of low-income. This evidence is reported in the lower panel of Table 3. Results from this more parsimonious specification suggest the importance of low-income persistence as a predictor of poor child health at age 7. The marginal effects indicate that a child

[11] This finding accords with results for child development from Korenman et al (1995) using data for the US, but contrasts with Currie and Stabile (2002) and Case et al (2002).

continuously observed in low-income is at 1.0 to 6.3 percentage points (depending on the health outcome) greater risk of having poor health at 81 months than a child never in low-income. For all the health measures, the estimated marginal impact of financial hardship increases with the persistence of financial hardship. For poor health measured as being in the top 40 percent of the symptom distribution, the marginal effect of being in low income once or twice is 4 percent, while the impact of being in low-income three to six times in the 7 year window times is 6 percent. For poor health measured as being in the top 5 percent of the symptom distribution, the impact of being in low-income three times or more is twice that of being in low-income twice or less over the 7 year window.

4.3 The importance of when low-income occurs

Interpretation of being persistently in financial hardship as an income effect is complicated by the fact that permanent low income may be an individual fixed effect. To delve deeper into the impact of income we examine the impact of the timing of low-income on child health. If timing matters, then this is more indication of the impact of income than of a fixed effect. So we examine whether for a given number of spells of low-income, the sequence of low-income observations matters. To answer this we examine focus on low income early in life and examine the importance of different low-income sequences between 32 weeks gestation and 33 months (a total of four low-income observations) on poor child health at 81 months. We identify the importance of timing by comparing differences between low-income occurring at the start and the end of the low-income observation window, for a total of one, two and three low-income experiences.

The results, in Table 4, hint that low-income around the time of birth is more harmful for child health at 81 months than low-income later in infancy. For one-spell sequences, timing of the low income spell appears unimportant. For two and three spell sequences, an early sequence appears to have a bigger negative impact than a later sequence. But this finding is quite weak. The far stronger finding is one that echoes that from Table 3: the importance of the persistence of low-income. The estimated impact of being in low-income at all four times during the first 33 months of the child's life is larger in magnitude than all the other sequences of low-income. Further, this result holds across all five measures of ill health.

5. The effect of maternal behaviours and health

The results so far indicate that the cross-sectional association between current income and child health may really be picking up a relationship between persistent low-income and child health. But, as the latter may be a fixed effect, it is difficult to know whether there is any direct impact of income. To explore this, we focus on the mechanisms by which low income is translated into poor child health. The transmission mechanism may be from observed mother health to child health i.e. operating through the association of H_m and Y_{mt} in equation (2). If this is the case the association with current income may simply be picking up the association between poor mother and child health. Or it may be that there are particular mother behaviours, which are associated with low income and lead to poorer health outcomes. These are part of the production function of child health (the X_{mt} vector of equation (1)). Finally, there may well also be a role for unobserved heterogeneity. We cannot explore this last route further. But we can try to unpack the income effect into two separate components, a 'mother health' effect and a 'child health production behaviour' effect.

To drive an observed income effect, the observed mother health and her child health production behaviours must be associated with low-income. Table 5 presents these associations by estimating an ordered probit regression of the number of times a child experiences low-income between 32 weeks gestation and 81 months for each of these behaviours and maternal health measures. Several aspects of mother's poor health are strongly associated with persistent low income. Mothers who do not report always having excellent health, who have a high CCEI score during pregnancy or who have a high weighted life event score until aged seventeen years, are all more likely to experience low-income during their child's first seven years of life. [12] On the other hand, there is no clear pattern of association between the anthropomorphic measures of maternal health – her birthweight or BMI pre-pregnancy – and persistent low income. Certain behaviours are associated with low income. Mothers who smoke and who feed their children less healthy diets are in low income more frequently. On the other hand, returning to work before the child is three or so is not necessarily associated with low income. Mothers who return

[12] These coefficients translate into large differences in the predictions of the probability of the number of low-income experiences by mother-related characteristics. A mother who reports herself as 'always well', has a 59 percent chance on average of never being in low-income, compared to 42 percent for a mother who describes herself as sometimes, often or always unwell. A mother who describes herself as 'always well' is almost two and a half times more likely to be continuously observed in low-income, compared to a mother who describes herself as sometimes, often or always unwell. Similar differences in predicted times in low income are associated with the variation in disruption during mother's own childhood and for a mother's health, the impact is even larger. A mother in the highest compared to the lowest quartile of the CCEI score is almost six and a half (8.4/1.3) times more likely on average to be observed in low-income on all six occasions between 32 weeks gestation and 85 months.

to work when their child is between 18 and 33 months are more likely to have low income while those who return in the first 6 months after birth have higher income[13]. Poor housing conditions are associated with low income.

Table 6 examines the association between current financial hardship and child health, allowing for these measures of mother health and her behaviours. It is clear that these variables account for a large part of the observed contemporaneous association between income and child health. In Table 6 current low income is associated with only three of the measures of child health and only for health at some ages. Compared to table 2, which allows only for the more restricted controls available in social surveys, the estimated size of the income effect has fallen by around 50 percent and has lost significance in more than half the cases in which it was previously significantly associated with child health. Current income is significantly associated with the number of symptoms of the child, but not with mother assessed health. For the symptoms measures, there is a significant association with being in the top 40 percent of the symptom distribution at 8 and 81 months, and with being in the top 20 percent of the symptom distribution at 8 and 81 months. The coefficients are around half the size of those with only the background controls.

We conclude from this that there is some direct effect of current income, once we allow for mother health and behaviours, but the association is not large and not consistent over time. We therefore focus our attention on whether the impact of income remains if we use a longer term measure of low income. To assess how much maternal health and child health production behaviours account for the explanatory power of persistent low-income on poor child health at age 7, we first examine the change in the estimated marginal effects of persistent low-income. We control for each measure of mother health and child health production behaviours separately. The first column of Table 7 reports the coefficient of persistent low income from the model with standard controls. The other columns report this income effect after adding each maternal health or child health production behaviour measure separately to these controls. The table shows the effect of income falls when we allow for mother self-assessed health, particularly her mental health. Comparing across columns, the income coefficient falls most when the mother self reported health variables are added. There is little impact on the income effect after allowing for the anthropomorphic measures of mother health, or her behaviours in

[13] This reflects the interaction of the maternity rights legislation in operation in the 1990s and heterogeneity in the working mothers population (Burgess et al 2002).

terms of breast feeding or diet, or when she started work, or her smoking frequency or her housing conditions.

Table 8 presents the estimated impact of regularly experiencing financial hardship, allowing for all other variables - the background controls plus measures of mother self assessed health, anthropomorphic measures of mothers health, and the impact of her behaviours on child health. It is clear that jointly allowing for mother's health and behaviours reduces the estimated impact of income on income. There is no longer any indication of any effect of income on child health as measured by the mother reported general health of the child. For child health measured by number of symptoms, an income effect remains. But in contrast to table 3, there is no longer any gradient across the number of times the household is in low income. The effect of being in low income once or twice is the same as being in low income three or more times. The coefficients are of a similar size to those in Table 6. Being in low income appears to increase the probability of a child being in poor health by around 3 percent.

In terms of the marginal effects on child health, mother's self-assessed own health prior to the child's birth, including her mental reaction to adverse life events that occurred before she was age 17, have the largest impact on her child's health. For example, the marginal effect of having a poor mental health before the birth – a CCEI score in the upper compared to the lowest quartile – for the probability the child will be in the top 40 percent of the symptom distribution is nearly three times the size of the estimated income effect. A highly disruptive life for the mother up to age seventeen, captured by the high weighted life events score, also considerably outweighs the impact of low-income during her child's life. If a mother is in the upper half of the weighted life events score, this raises the probability of her child having high number of symptoms of poor health at 81 months by over seven percentage points compared to if the mother was in the lowest quartile of the weighted life events score. There is also a clear gradient in the severity on child health of mother's ill health: the poorer the mother's reported health or her mental health the larger the association with child poor health. So a mother who is usually well, compared to one who is always well, is around 7 percent more likely to have a child in the op two quartiles of the symptoms of poor health distribution, while a mother who is sometimes, often or always unwell is just under 12 percent more likely to have such a child. In contrast,

there is no effect of the anthropomorphic measures of mother's health or her BMI on her child's health.[14]

There is some indication that behaviours have an effect on child health, but the coefficients on the mother's behaviours tend to be less clear in pattern and less well estimated than those on mother reported health. Working has no detrimental impact on child health[15]. In fact, there is some indication that going back to work before the child is three years old is associated with better child health. As we examine child health outcomes at 81 months, reverse causation – the impact of poor child health on a mother working – will be reduced. Mothers who smoke do not have children in worse health. There is some indication that diets other than healthy ones are associated with poorer health. Junk, traditional and snack diets are all associated with higher number of symptoms of ill health, though diet has no impact on mother assessed child health. Breast-feeding does not appear to be consistently associated with better health: in fact, mother who breast feed appear to report that their children are in poor health but are also less likely to report that their children are in very poor health. Poor housing conditions do not appear to affect child health.

Finally, the table shows the impacts of the background controls. The child's sex and birth order are more important than income. Childbirth weight and ethnicity, in contrast, are unimportant. While the effect of birth weight runs counter to much of the focus on birth weight as an indicator of child health, using a sample of twins and so removing the genetic component of any transmission mechanism, Almond et al (2002) also find birth weight to be unimportant for later child health. The age of mother at birth, the household structure in early pregnancy and mother's education are also unimportant[16].

5. Conclusions

[14] Miller and Korenman (1994), for the US, also found a only small effect for mother's height and weight on more anthropomorphic measures of children's health – stunting (low weight for age) and wasting (low weight for height).
[15] This is in contrast to Anderson et al (2003), who find that maternal employment has a negative impact on child health, as measured by the child's BMI.
[16] Koreman et al (1997) found that differences in the abilities of poor and non-poor children were not due to differences in the education of the children's mothers, the structure of the children's families or the age of the mother. US studies on child health as measured by obesity tend to find significant relationships between family structure and obesity but results across studies are not consistent about the sign of the effect (Anderson et al 2003).

We have shown that low family income and child health are contemporaneously correlated, even when we control for child health at birth and the education of the mother. Unlike Case et al (2002) for the US and Currie and Stabile (2002) for Canada we find no evidence of a significant deepening of the contemporaneous income effect as children age. However, when we use our rich data to look at this further, we find a rather weaker association between income and child health. When the child is in low income appears to be unimportant for health outcomes at age 7. Controlling for mother's own health, current income has relatively little impact on child health. Persistent financial hardship is correlated with outcomes at age 7. This may be the effect of permanent income but might also be a mother fixed effect. Exploring the links between low parental income and child health, we find indications that the principle determinant of child health is not income related behaviours such as smoking, maternal employment when the child is young, the diet fed to the child, or the nature of the housing of the child. Instead, the biggest determinant of child health appears to be the pre-birth health of the mother, particularly her mental health. Mothers who rated their mental or general health as poor, or who experienced or had strong responses to potentially difficult events during their childhood, have both lower income and children in poorer health.

There are several potential explanations for this link. One explanation might be that, as the data are self-reported, mothers in poorer mental health may be more likely to report their child's health as poor. While the data do not contain doctor reported measures of health, it seems unlikely that reporting error drives all the results. First, the effect of mother reported health is stronger for the more objective measure of health – the count of the number of symptoms. Second, to avoid contemporaneous reporting bias, we confine our analysis to mother's report of their health made during early pregnancy and examine the effect on child health seven years later. A second explanation might be broadly genetic: mothers who are vulnerable to poor health have children who also vulnerable. If this is the link, what is interesting here is we find a link between mental health and child health, rather than between a mother's physical health - as measured by her BMI, own birth weight or whether she was preterm - and her child's health. A third explanation might be that mothers who experience early stress may be less good at producing children's health from a given set of inputs. A fourth might be that mothers in poorer mental health may seek less medical help, or may seek and get less help from families and partners. Our findings suggest that these two last routes need to be further explored to better understand the link between parental income and child health.

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Appendix

Table A1: Prevalence of symptoms of poor child health by age of child

Symptom	Age of child (months)				
	6	18	30	42	81
	Col%	Col %	Col %	Col %	Col %
diarrhoea	28.68	60.74	55.09	44.05	35.38
blood in stools	3.96	3.04	3.3	2.14	0.85
vomiting	31.26	55.51	59.88	54.22	44.74
cough	64.81	83.78	85.2	87.61	77.23
high temperature	39.30	68.08	66.95	63.15	53.06
cold	87.64	95.12	93.08	94.29	87.18
ear ache	10.06	33.26	31.17	30.96	27.96
ear discharge	2.83	6.83	6.34	5.17	5.39
convulsions	0.07	2.33	2.35	1.2	0.51
colic	39.35	8.24	-	-	-
stomach ache	-	-	26.61	34.62	59.51
rash	38.20	45.2	35.97	23.08	18.74
wheezing	21.56	23.55	19.34	15.85	12.22
breathlessness	6.19	7.52	8.32	7.64	6.47
stopped breathing	2.23	1.84	1.55	0.87	0.21
urinary infection	-	-	-	-	3.37
headache	-	-	6.47	15.29	40.19
constipation	-	7.3	7.93	9.88	10.32
asthma	-	-	-	-	12.49
eczema	-	-	-	-	16.03
hay fever	-	-	-	-	6.29
other symptom	0.95	7.3	7.93	9.88	6.41
Observations	11160	11116	10318	10053	8504-

Table A2: The proportion of children by number of symptoms of poor health and age of child (percent)

Number of symptoms in past year	Age of child (months)				
	6[1]	18	30	42	81
0	1.8	0.6	1.96	1.12	2.5
1	8.09	2.23	2.3	2.65	4.44
2	15.45	6.37	6.38	8.57	7.63
3	19.99	12.34	11.31	13.98	11.28
4	18.87	18.11	17.59	17.52	14.08
5	15.02	20.49	19.15	18.68	15.29
6	10.03	18.68	16.98	15.53	13.92
7	6.01	11.62	12	10.8	12.3
8	2.81	5.87	6.91	6.54	8.21
9	1.16	2.31	3.36	3.1	4.77
10	0.54	0.9	1.25	0.96	3.05
11	0.15	0.36	0.59	0.42	1.33
12	0.03	0.07	0.11	0.13	0.79
13	0.02	0.03	0.01	0	0.32
14	0.01	0	0	0	0.07
15	0	0	0.1	0	0.01
16	0	0	0.01	0	0
17	-	-	0	0	0.01
18	-	-	-	-	0
19	-	-	-	-	0
20	-	-	-	-	0
21	-	-	-	-	0
All	100	100	100	100	100
Observations	11,455	11,116	10,318	10,053	8,504

[1] refers to "first few months" rather than "last year"

Table A3: Mother-reported child health by age of child (column percent)

Mother-reported child health for past year		Age of child (months)				
		6[1]	18	30	42	81
Mother's response	**very healthy**	59.56	45.38	48.81	44.66	61.34
	minor problems	37.37	49.65	47.16	51.47	36.82
	sometimes quite ill	2.22	4.27	3.62	3.5	1.71
	mostly unwell	0.85	0.71	0.42	0.37	0.13
	all	11,408	11,014	10,261	9,953	7,778
Derived variable	**poor health[2]**	40.44	54.62	51.19	55.34	38.66
	very poor health[3]	3.07	4.98	4.03	3.87	1.84

[1] refers to "first few months" rather than "past year"
[2] mother's responses: minor problems, sometimes quite ill, mostly unwell
[3] mother's responses: sometimes quite ill, mostly unwell

Table A4: Financial hardship scores by age of child (column percent)

Financial hardship score	Age of child (months)					
	32 weeks gestation	8	21	33	61	85
0	36.6	30.9	32.4	35.4	43.0	49.0
1	14.0	15.3	14.6	13.0	13.0	11.5
2	11.1	10.6	10.3	10.3	11.1	9.9
3	7.0	7.4	7.2	7.4	6.4	7.6
4	6.1	6.8	6.4	6.2	4.9	4.2
5	5.9	7.0	6.2	6.3	6.2	4.9
6	4.2	4.8	4.1	4.0	3.0	3.3
7	3.1	3.1	3.6	3.6	2.7	2.3
8	2.6	3.2	2.6	2.8	1.8	1.5
9	2.3	2.6	2.6	2.5	2.0	1.7
10	2.7	3.0	3.0	2.9	2.0	1.7
11	1.5	1.9	2.1	2.0	1.6	1.0
12	1.2	1.4	1.7	1.5	1.0	0.5
13	0.7	0.7	1.3	0.9	0.6	0.4
14	0.4	0.4	0.8	0.5	0.3	0.2
15	0.9	1.1	1.1	0.8	0.5	0.4
All	100	100	100	100	100	100
5 plus	25.5	29.2	29.1	27.8	21.6	17.8
8 plus	12.3	14.3	15.2	13.9	9.8	7.4
Observations	11,371	10,693	9,714	9,187	8,324	7,596

A financial hardship score of 5 plus is used as the low-income indicator in the main analysis.

Table A5: Sample participation at 81 months as a function of poor child health at six months and low-income at eight months

	Sample participation at 81 months	
	Marginal effect	**Standard error**
Top 40% of symptoms at 6 months	-0.030***	0.009
Low-income at 8 months	-0.066***	0.010
Number of observations	10684	10684
Top 20% of symptoms at 6 months	-0.047***	0.011
Low-income at 8 months	-0.065***	0.010
Number of observations	10684	10684
Top 5% of symptoms at 6 months	-0.096***	0.022
Low-income at 8 months	-0.066***	0.010
Number of observations	10637	10637
Mother-reported poor child health at 6 months	-0.096***	0.022
Low-income at 8 months	-0.067***	0.010
Number of observations	10637	10637
Mother-reported very poor child health at 6 months	-0.012	0.009
Low-income at 8 months	-0.067***	0.010
Number of observations	10637	10637

Table A6: Net family income by age of child (column percent)

Family Income (£ per week)	**Age of Child (months)**		
	33	**47**	**85**
<£100 per week	8.4	7.3	3.8
£100 to £199 per week	17.4	15.2	10.9
£200 to £299 per week	28.5	26.3	18.2
£300 to £399 per week	21.3	22.6	22.6
>£400 per week	24.4	28.6	44.5
All	100	100	100
< £200 per week	25.8	22.5	14.7
Observations	8,380	8,141	6,977

Table A7: Comparison of low-income groups based on financial hardship score and family income (percent)

Family income at 33 months (£ per week)	%	In financial hardship at 33 months		In financial hardship at 85 months	
		No	Yes	No	Yes
<£100 per week	**Row**	21.5	78.5	24.2	75.8
<£100 per week	**Column**	2.5	23.4	1.1	15.9
£100 to £199 per week	**Row**	47.3	52.8	45.6	54.4
£100 to £199 per week	**Column**	11.4	32.6	6.0	32.8
£200 to £299 per week	**Row**	73.4	26.6	75.3	24.7
£200 to £299 per week	**Column**	29.1	27.0	16.7	24.9
£300 to £399 per week	**Row**	84.9	15.1	89.2	10.8
£300 to £399 per week	**Column**	25.2	11.4	24.5	13.5
>£400 per week	**Row**	93.6	6.4	94.8	5.2
>£400 per week	**Column**	31.7	5.6	51.6	12.9
All	**Row**	71.9	28.1	82.0	18.0
All	**Column**	100.0	100.0	100.0	100.0
Observations		6008	2351	5643	1239

Table A8: The timing of poor health and low-income indicators

	Age of Child (months)											
	-1[1]	**6**	**8**	**18**	**21**	**30**	**33**	**42**	**47**	**61**	**81**	**85**
Health indicators												
Symptoms of poor child health		■		■		■		■			■	
Mother-reported child health		■		■		■		■			■	
Low-income indicators												
Financial hardship score	■		■	■	■		■			■		■
Reported family income							■		■			■

[1] Refers to 32 weeks gestation.

Table A8 summarises the child's age at which the health outcomes and low-income measures are available. When analysing contemporaneous associations, we match only low-income and health measures provided they are separated by no more than four months. Thus, the 6, 18, 30 and 81-month health outcomes are matched with the 8, 21, 33 and 85 month incomes respectively.

Table 1: Descriptive statistics of variables used in analysis

Variable[1]	Mean	Standard Deviation
Child Health outcomes		
Top 40% of number of symptoms of poor health		
6 months	0.358	0.479
18 months	0.399	0.490
30 months	0.413	0.492
42 months	0.375	0.484
81 months	0.448	0.497
Top 20% of number of symptoms of poor health		
6 months	0.208	0.406
18 months	0.212	0.409
30 months	0.243	0.430
42 months	0.220	0.414
81 months	0.186	0.389
Top 5% of number of symptoms of poor health		
6 months	0.047	0.212
18 months	0.037	0.188
30 months	0.054	0.227
42 months	0.046	0.210
81 months	0.056	0.230
Mother-reported poor child health		
6 months	0.404	0.491
18 months	0.546	0.498
30 months	0.512	0.500
42 months	0.553	0.497
81 months	0.387	0.487
Mother-reported very poor child health		
6 months	0.031	0.172
18 months	0.050	0.217
30 months	0.040	0.197
42 months	0.039	0.193
81 months	0.018	0.134
Child characteristics		
Birth weight (kg)		
Less than 2.5	0.050	0.219
2.5 – 3	0.142	0.349
3.1-3.9	0.583	0.493
More than 3.9	0.174	0.379
Child's sex		
Female	0.484	0.500
Male	0.516	0.500
Child's ethnicity		
White	0.950	0.219
Non-white	0.050	0.219
Birth order		
First born	0.445	0.497
Second born	0.364	0.481
Third born (or higher)	0.142	0.349
Number of adults in household at 8 weeks gestation		
One	0.053	0.225
Two	0.835	0.371
Three (or more)	0.110	0.312
Mother's age at child's birth		
21 or less	0.101	0.302
22 to 25	0.207	0.404

26 to 35	0.622	0.485
36 (or more)	0.069	0.254
Mother's reported health before pregnancy		
Sometimes, often or always unwell	0.080	0.271
Usually well	0.601	0.490
Always well	0.319	0.466
Mother's mental health at 18 weeks gestation		
CCEI score[2]		
Lowest quartile	0.287	0.452
Second lowest quartile	0.214	0.410
Second highest quartile	0.256	0.437
Highest quartile	0.242	0.429
Disruptions in mother's life to age 17 years		
Life Events Score (LES)	0.303	0.460
Lowest quartile	0.238	0.426
Second lowest quartile	0.224	0.417
Second highest quartile	0.235	0.424
Highest quartile	0.200	0.400
Mother's child health related behaviours		
Mother smokes at		
32 weeks gestation	0.200	0.400
8 months	0.242	0.428
21 months	0.227	0.419
33 months	0.226	0.418
47 months	0.222	0.416
Mother breast fed		
never	0.264	0.441
less than 3 months	0.230	0.421
3-5 months	0.166	0.372
6+ months	0.340	0.474
Dietary type at 33 months		
Junk	0.315	0.465
Healthy	0.251	0.434
Traditional	0.217	0.412
Snack	0.217	0.412
Mother starts work within first 33 months		
Does not	0.362	0.481
Full time, child aged 0-6 months	0.093	0.291
Part time, child aged 0-6 months	0.224	0.417
Child aged 7-9 months	0.091	0.288
Child aged 10-17 months	0.127	0.333
Child aged 18-33 months	0.103	0.304
Mother's birth weight		
Pre-term	0.738	0.261
Lowest decile	0.518	0.222
Birth weight missing	0.492	0.499
Pre-pregnancy BMI (quartile)		
Lowest	0.257	0.437
Second lowest	0.244	0.429
Second highest	0.249	0.432
Highest	0.248	0.432
Housing Conditions		
Ever had serious damp, condensation or mould problems	0.017	0.131
Missing	0.304	0.460

[1] All variables are dummy variables

[2] CCEI score: Crown Crisp Experiential Index

Table 2: The impact of current low-income on current poor child health by age of child (marginal effects)

	Top 40% of symptoms of poor health		Top 20% of symptoms of poor health		Top 5% of symptoms of poor health		Mother-reported poor child health		Mother-reported very poor child health	
Age of child (months)	**Controls**		**Controls**		**Controls**		**Controls**		**Controls**	
	No	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**
8	0.084***	0.079***	0.072***	0.063***	0.026***	0.018***	0.051***	0.045***	0.020***	0.018***
	(0.010)	(0.012)	(0.009)	(0.010)	(0.005)	(0.005)	(0.011)	(0.012)	(0.004)	(0.004)
21	0.048***	0.049***	0.048***	0.044***	0.022***	0.017***	0.037***	0.037***	0.030***	0.020***
	(0.011)	(0.012)	(0.009)	(0.010)	(0.005)	(0.005)	(0.011)	(0.012)	(0.005)	(0.005)
33	0.056***	0.062***	0.050***	0.047***	0.022***	0.018***	0.052***	0.059***	0.021***	0.013***
	(0.012)	(0.013)	(0.010)	(0.011)	(0.006)	(0.006)	(0.012)	(0.013)	(0.005)	(0.005)
81	0.053***	0.053***	0.054***	0.056***	0.033***	0.030***	0.066***	0.062***	0.009*	0.007
	(0.015)	(0.017)	(0.012)	(0.014)	(0.008)	(0.009)	(0.016)	(0.017)	(0.005)	(0.005)

* significant at 10%; ** significant at 5%; *** significant at 1%

Standard errors in parentheses.

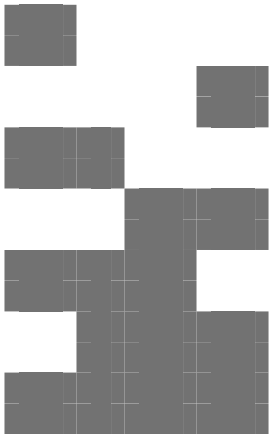
Controls are child fixed characteristics (birth weight, sex, whether white and birth order), number of adults in household at 8 weeks gestation, mother's highest educational qualification at 32 weeks gestation and mother's age at child's birth.

Table 3: The impact of number of times in low-income on poor child health at 81 (marginal effects)

Number of times in low-income	Top 40% of symptoms of poor health	Top 20% of symptoms of poor health	Top 5% of symptoms of poor health	Mother-reported poor child health	Mother-reported very poor child health
1	0.027	0.029*	0.019*	0.021	-0.010**
	(0.019)	(0.016)	(0.010)	(0.020)	(0.004)
2	0.075***	0.033*	0.011	0.008	0.002
	(0.024)	(0.020)	(0.012)	(0.024)	(0.007)
3	0.058**	0.033	0.021	0.069**	-0.005
	(0.027)	(0.023)	(0.015)	(0.028)	(0.006)
4	0.034	0.031	0.012	0.081***	0.016
	(0.030)	(0.025)	(0.016)	(0.030)	(0.011)
5	0.032	0.057**	0.063***	0.018	0.011
	(0.032)	(0.028)	(0.021)	(0.033)	(0.011)
6	0.134***	0.121***	0.073***	0.084**	0.029*
	(0.035)	(0.033)	(0.025)	(0.037)	(0.015)
1 to 2	0.045***	0.030**	0.016*	0.016	-0.005
	(0.016)	(0.013)	(0.008)	(0.017)	(0.004)
3 to 6	0.059***	0.052***	0.035***	0.063***	0.010*
	(0.018)	(0.015)	(0.010)	(0.018)	(0.005)
Observations	5653	5653	5653	5259	5259

* significant at 10%; ** significant at 5%; *** significant at 1%
Standard errors in parentheses.
Controls are child fixed characteristics (birth weight, sex, whether white and birth order), number of adults in household at 8 weeks gestation, mother's highest educational qualification at 32 weeks gestation and mother's age at child's birth.

Table 4: Selected low-income sequences on poor child health at 81 months (marginal effects)

Experience of low-income at points shaded below	Top 40% of symptoms of poor health	Top 20% of symptoms of poor health	Top 5% of symptoms of poor health	Mother-reported poor child health	Mother-reported very poor child health
-1 [1] 8 21 33					
	0.030	0.006	0.013	-0.051	-0.011**
	(0.037)	(0.029)	(0.019)	(0.036)	(0.005)
	0.012	-0.009	0.016	0.004	-0.012***
	(0.032)	(0.024)	(0.017)	(0.032)	(0.004)
	0.092**	0.070*	0.039	0.079*	0.008
	(0.043)	(0.038)	(0.026)	(0.045)	(0.013)
	0.003	-0.039	-0.016	0.003	-0.010
	(0.039)	(0.028)	(0.016)	(0.040)	(0.006)
	0.088**	0.046	0.036	0.121***	0.031
	(0.044)	(0.038)	(0.026)	(0.046)	(0.019)
	0.071**	0.030	0.024	0.079**	-0.001
	(0.035)	(0.029)	(0.019)	(0.036)	(0.009)
	0.074***	0.077***	0.052***	0.063***	0.019**
	(0.023)	(0.020)	(0.014)	(0.024)	(0.009)
Other	0.034*	0.033**	0.008	0.016	0.002
Observations	6467	6467	6467	5985	5985

* significant at 10%; ** significant at 5%; *** significant at 1%

Standard errors in parentheses.

Controls are child fixed characteristics (birth weight, sex, whether white and birth order), number of adults in household at 8 weeks gestation, mother's highest educational qualification at 32 weeks gestation and mother's age at child's birth.

[1] Refers to 32 weeks gestation.

Table 5: Ordered probits of the number of times in low-income between 32 weeks gestation and 85 months

Mother health and mother child health related behaviours	Number of times in low-income (maximum=6)	
	Coefficient	Standard error
Mother's self-reported health (omitted category: always well)		
Mother sometimes/often/always unwell before pregnancy	0.357***	(0.076)
Mother usually well before pregnancy	0.142***	(0.037)
CCEI score[1] (omitted category: lowest quartile)		
Mother in second lowest quartile	0.158***	(0.048)
Mother in second highest quartile	0.402***	(0.046)
Mother in highest quartile	0.701***	(0.049)
Life event score (omitted category: lowest quartile)		
Mother in second lowest quartile of childhood life event score	0.054	(0.044)
Mother in second highest quartile of childhood life event score	0.179***	(0.045)
Mother in highest quartile of childhood life event score	0.345***	(0.046)
Mother's birth weight		
Pre-term	0.029	(0.027)
Lowest decile of birth weight	-0.028	(0.026)
Birth weight missing	0.004	(0.012)
Pre-pregnancy BMI (quartile)		
Second lowest	-0.014	(0.016)
Second highest	-0.007	(0.016)
Highest	-0.006	(0.017)
Duration breast fed (omitted category: never)		
Less than 3 months	-0.021	(0.052)
3 to 5 months	-0.019	(0.056)
More than 5 months	-0.077	(0.049)
Dietary type (omitted category: healthy)		
Junk	0.138***	(0.053)
Traditional	-0.077	(0.055)
Snack	-0.131**	(0.053)
Missing	-0.005	(0.057)
Time mother starts work after birth (omitted category: not before 33 months)		
Full time when child aged less than 6 months	-0.128**	(0.065)
Part time when child aged less than 6 months	-0.040	(0.046)
Work when child aged 7 to 9 months	-0.089	(0.064)
Work when child aged 10 to 17 months	0.077	(0.056)
Work when child aged 18 to 33 months	0.140**	(0.059)
Number of times observed smoking (omitted category: never)		
1 to 3	0.352***	(0.051)
4	0.478***	(0.060)
Missing	0.387***	(0.080)
Housing Conditions		
Ever had serious damp, condensation or mould problems	0.964***	0.119
Missing	-0.061	0.052

* significant at 10%; ** significant at 5%; *** significant at 1%

Controls are child fixed characteristics (birth weight, sex, whether white and birth order), number of adults in household at 8 weeks gestation, mother's highest educational qualification at 32 weeks gestation and mother's age at child's birth.

[1] CCEI score: Crown Crisp Experiential Index

Table 6: The impact of current low-income on current poor child health by age of child (marginal effects from low-income regressors)

Age of child (months)	Top 40% of symptoms of poor health	Top 20%pf symptoms of poor health	Top 5% of symptoms of poor health	Mother-reported poor child health	Mother-reported very poor child health
8	0.025*	0.027**	0.002	0.009	0.009*
	(0.014)	(0.012)	(0.004)	(0.015)	(0.005)
21	0.009	0.015	0.007	-0.004	0.003
	(0.015)	(0.012)	(0.005)	(0.015)	(0.006)
33	0.023	0.015	0.009	0.017	0.007
	(0.015)	(0.015)	(0.006)	(0.016)	(0.005)
81	0.022	0.031*	0.004	0.001	-0.002
	(0.020)	(0.016)	(0.009)	(0.020)	(0.004)

* significant at 10%; ** significant at 5%; *** significant at 1%
Standard errors in parentheses.
Background controls are child fixed characteristics (birth weight, sex, whether white and birth order), number of adults in household at 8 weeks gestation, mother's highest educational qualification at 32 weeks gestation, mother's work status during first 33 months.

Table 7: The impact of number of times in low-income on poor child health at 81 months controlling for maternal health and health production behaviours singly (marginal effects)

	Standard Controls Only	**Standard Controls Plus**				
		Mother's self-assessed health until present pregnancy	CCEI[1] score at 32 weeks gestation	Life Event Score	Mother's birth weight	Pre-pregnancy BMI (quartile)
In low-income 1 to 2 times	0.042**	0.039**	0.028	0.037**	0.042**	0.014
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.021)
In low-income 3 to 6 times	0.066***	0.056***	0.035*	0.054***	0.065***	-0.028
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.021)
	Standard Controls Only	**Standard Controls Plus**				
		Time mother starts work after birth	Number of times observed smoking	Duration breast fed	Dietary type	Housing Conditions
In low-income 1 to 2 times	0.042**	0.043**	0.023	0.043**	0.041**	0.042**
	(0.018)	(0.018)	(0.017)	(0.018)	(0.018)	(0.018)
In low-income 3 to 6 times	0.066***	0.065***	0.065***	0.067***	0.066***	0.065***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)

Number of observations for health outcomes relating to symptoms of poor health is 4848 and for outcomes relating to mother assessed child health is 4528.

* significant at 10%; ** significant at 5%; *** significant at 1%

Standard errors in parentheses.

Controls are child fixed characteristics (birth weight, sex, whether white and birth order), number of adults in household at 8 weeks gestation, mother's highest educational qualification at 32 weeks gestation and mother's age at child's birth.

[1] CCEI score: Crown Crisp Experiential Index

Table 8: The importance of low income compared to other observable characteristics on poor child health at age 81 months (marginal effects)

	Top 40% of number of symptoms of poor health	Top 20% of number of symptoms of poor health	Top 5% of number of symptoms of poor health	Mother-reported poor child health	Mother-reported very poor child health
Number of times in low-income					
1 to 2	0.029	0.024*	0.015*	0.002	-0.006*
	(0.019)	(0.015)	(0.009)	(0.019)	(0.003)
3 to 6	0.035*	0.030*	0.019*	-0.002	0.001
	(0.021)	(0.017)	(0.010)	(0.021)	(0.004)
Birth weight (kg)					
<2.5	-0.016	-0.016	-0.006	0.086**	-0.006
	(0.042)	(0.042)	(0.017)	(0.044)	(0.006)
≥2.5-<3.9	-0.002	0.002	-0.002	0.001	0.003
	(0.023)	(0.023)	(0.010)	(0.023)	(0.005)
≥3.9	-0.004	-0.004	-0.006	-0.018	-0.007**
	(0.020)	(0.020)	(0.008)	(0.020)	(0.003)
Fixed child characteristics					
Female	0.051***	0.051***	0.007	0.011	-0.003
	(0.015)	(0.015)	(0.007)	(0.015)	(0.003)
Non-white	0.053	0.053	0.029	0.049	-0.00
	(0.043)	(0.043)	(0.023)	(0.044)	(0.008)
Second born	-0.046***	-0.046***	-0.002	0.021	-0.001
	(0.017)	(0.017)	(0.007)	(0.018)	(0.004)
Third born	-0.063***	-0.028*	-0.011	0.005	0.004
	(0.023)	(0.017)	(0.009)	(0.024)	(0.006)
Number of adults in household at 8 weeks gestation					
2	0.019	0.002	0.002	0.026	0.005
	(0.045)	(0.033)	(0.018)	(0.044)	(0.007)
3	0.014	-0.011	-0.005	0.092	0.009
	(0.054)	(0.039)	(0.021)	(0.056)	(0.018)
Mother's age at child birth					
21 or less	-0.081	-0.008	-0.023	-0.127***	0.003
	(0.048)	(0.035)	(0.014)	(0.043)	(0.011)
22-25	-0.017	-0.017	-0.013	-0.022	0.001
	(0.023)	(0.017)	(0.009)	(0.023)	(0.005)
36 or more	-0.027	0.000	0.005	0.008	-0.006
	(0.027)	(0.021)	(0.013)	(0.028)	(0.004)
Mother's highest education at 32 weeks gestation					
CSE/none	-0.024	-0.003	0.001	0.017	0.004
	(0.026)	(0.020)	(0.011)	(0.027)	(0.006)
A-Level or higher	-0.017	-0.013	-0.006	-0.010	0.001
	(0.018)	(0.013)	(0.008)	(0.018)	(0.004)
Mother's self assessed health until present pregnancy					
Sometimes/often/always unwell	0.117***	0.115***	0.040**	0.239***	0.014
	(0.036)	(0.032)	(0.020)	(0.037)	(0.011)
Usually well	0.070***	0.021*	0.014*	0.110***	0.002
	(0.016)	(0.013)	(0.007)	(0.016)	(0.003)
F-test: chi^2	22.32	15.86	6.52	64.44	2.83
probability	0.00001	0.0004	0.04	$1.015e^{-14}$	0.24
CCEI score at 18 weeks gestation					
Second lowest quartile	0.028	0.026	0.021*	0.001	-0.000
	(0.021)	(0.017)	(0.011)	(0.021)	(0.005)
Second highest quartile	0.082***	0.074***	0.020*	0.074***	0.004
	(0.021)	(0.018)	(0.011)	(0.022)	(0.005)
Highest quartile	0.117***	0.063**	0.039***	0.062***	0.010
	(0.023)	(0.035)	(0.013)	(0.023)	(0.007)

F-test: chi^2	31.21	22.38	11.25	11.70	4.45
probability	$7.677e^{-7}$	0.00005	0.01	0.01	0.22
Childhood life event score					
Second lowest quartile	0.050**	0.035**	0.006	0.045*	0.003
	(0.020)	(0.017)	(0.010)	(0.024)	(0.005)
Second highest quartile	0.080***	0.082***	0.029**	0.058**	0.004
	(0.021)	(0.018)	(0.012)	(0.026)	(0.005)
Highest quartile	0.089***	0.087***	0.055***	0.033	0.013*
	(0.022)	(0.019)	(0.013)	(0.023)	(0.007)
F-test: chi^2	21.34	32.43	29.08	14.48	6.09
probability	0.00009	$4.247e^{-7}$	$2.155e^{-6}$	0.002	0.11
Mother's birth weight					
Pre-term	0.058*	0.020	0.004	0.053	-0.009**
	(0.034)	(0.027)	(0.015)	(0.034)	(0.004)
Lowest decile of birth weight	-0.096***	-0.035	0.003	-0.029	-0.0000
	(0.035)	(0.025)	(0.016)	(0.036)	(0.008)
Birth weight missing	-0.016	0.001	-0.001	0.006	0.007*
F-test: chi^2	0.27	1.17	3.17	0.70	0.47
probability	0.87	0.56	0.20	0.71	0.79
Pre-pregnancy BMI (quartile)					
Second lowest	0.015	-0.015	-0.001	0.031	-0.005
	(0.021)	(0.016)	(0.009)	(0.021)	(0.003)
Second highest	-0.031	-0.009	0.010	0.014	-0.009***
	(0.021)	(0.016)	(0.010)	(0.021)	(0.003)
Highest	0.001	-0.011	0.005	0.004	-0.002
	(0.022)	(0.016)	(0.010)	(0.022)	(0.004)
F-test: chi^2	0.27	1.17	3.17	0.70	0.47
probability	0.87	0.56	0.20	0.71	0.79
Duration breast fed (months)					
Less than 3	0.016	0.005	0.010	0.045*	-0.002
	(0.024)	(0.018)	(0.011)	(0.024)	(0.004)
3-5	0.000	-0.004	-0.006	0.058**	-0.002
	(0.026)	(0.019)	(0.011)	(0.026)	(0.005)
6 or more	0.034	0.018	0.006	0.033	-0.005
	(0.023)	(0.018)	(0.010)	(0.023)	(0.004)
F-test: chi^2	3.45	2.08	2.71	5.58	1.45
probability	0.33	0.56	0.44	0.13	0.69
Dietary type					
Junk	0.077***	0.036*	0.015	0.009	0.001
	(0.024)	(0.020)	(0.012)	(0.025)	(0.005)
Traditional	0.062**	0.032	0.012	0.024	0.024
	(0.024)	(0.020)	(0.012)	(0.025)	(0.025)
Snack	0.060***	0.024	0.000	0.011	0.011
	(0.023)	(0.019)	(0.010)	(0.023)	(0.023)
Missing	0.042	0.039*	0.009	0.038	0.038
	(0.025)	(0.021)	(0.012)	(0.026)	(0.026)
F-test: chi^2	12.23	5.18	2.95	2.70	12.58
probability	0.02	0.27	0.57	0.61	0.01
Time mother starts work after birth					
Full-time work, child aged 0-6 months	-0.044	-0.036*	-0.014	-0.038	-0.038
	(0.028)	(0.020)	(0.011)	(0.028)	(0.028)
Part-time work, child aged 0-6 months	-0.031	-0.004	-0.007	-0.018	-0.018
	(0.020)	(0.015)	(0.008)	(0.020)	(0.020)
Child aged 7-9 months	-0.009	0.001	0.002	0.044	0.044
	(0.027)	(0.021)	(0.012)	(0.028)	(0.028)
Child aged 10-17 months	-0.018	-0.035**	-0.006	0.014	0.014
	(0.025)	(0.018)	(0.010)	(0.025)	(0.025)
Child aged 18-33 months	-0.043	0.009	-0.011	-0.035	-0.035

		(0.027)	(0.021)	(0.010)	(0.027)	(0.027)
F-test:	chi^2	4.96	7.24	2.62	9.42	2.46
	probability	0.42	0.20	0.76	0.09	0.78
Number of times observed smoking						
1 to 3		-0.028	-0.025	-0.015*	-0.004	-0.009***
		(0.024)	(0.017)	(0.009)	(0.024)	(0.003)
4		-0.062**	-0.008	-0.011	0.011	-0.002
		(0.027)	(0.020)	(0.010)	(0.028)	(0.005)
Missing		-0.074**	-0.001	-0.011	-0.020	-0.001
		(0.036)	(0.028)	(0.014)	(0.037)	(0.007)
F-test:	chi^2	8.70	2.05	3.07	0.49	3.88
	probability	0.03	0.56	0.38	0.92	0.27
Poor Housing Conditions						
Ever had serious damp, condensation or mould problems		-0.024	0.047	-0.007	0.019	0.005
		(0.058)	(0.046)	(0.021)	(0.058)	(0.013)
Missing		-0.008	0.001	0.018	-0.017	-0.002
		(0.023)	(0.018)	(0.011)	(0.023)	(0.004)
F-test:	chi^2	0.27	1.17	3.17	0.70	0.47
	probability	0.87	0.56	0.20	0.71	0.79
Observations		4556	4556	4556	4251	4251

* significant at 10%; ** significant at 5%; *** significant at 1%

Standard errors in parentheses.

Sample consists of all children with non-missing values for all health outcomes, background controls and mother-related characteristics and all controls.

Controls are child fixed characteristics (birth weight, sex, whether white and birth order), number of adults in household at 8 weeks gestation, mother's highest educational qualification at 32 weeks gestation and mother's age at child's birth.

[1] CCEI score: Crown Crisp Experiential Index