AN INVESTIGATION INTO REGIONAL DIFFERENCES IN CHILD HEALTH AND COGNITIVE FUNCTION

REPORT FOR THE ECONOMIC RESEARCH UNIT, WELSH ASSEMBLY GOVERNMENT

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1. Introduction.

Relative to their counterparts in the rest of the UK, working age adults in Wales are disadvantaged across a range of social and economic indicators (see, for example, O'Leary *et al.* 2005 for an examination of employment and economic activity). Importantly, this disadvantage is not confined to cohorts directly affected by the decline in heavy industry in the 1980s and, in fact, is actually evident among the youngest working age individuals (aged 16-24).

In terms of personal characteristics, two key measures are consistently identified as important determinants of economic disparities (see, for example, O'Leary *et al.* 2005); namely education and health. Moreover, there is an increasing recognition that differences in educational and health outcomes in adulthood stem from differences in early childhood. For example, Feinstein (2003) uses data from the British Cohort Study (BCS) and finds that composite measures of cognitive development at 22 months and 42 months are both correlated with formal educational qualifications at age 26. Similarly, in terms of health, Case, Fertig and Paxson (2005) using data from the National Child Development Study (NCDS), find that, even after controlling for a range of parental characteristics, poor health in childhood is negatively correlated with educational attainment, health, employment and social status in adulthood.

Improving the health and development of young children thus appears to be one way of improving the outcomes for future generations in Wales. However, relatively little evidence exists on if and how childhood health and development outcomes differ across the UK. Examination of these differences across countries within the UK has been facilitated by the development of the Millennium Cohort Study (MCS) which traces the lives of children born in the year 2000. Unlike previous cohort studies, such as NCDS and the BCS, one of the main aims of the MCS is to provide robust information for each of the four countries in the UK. We are therefore able to ask, are children born in Wales during the Millennium already disadvantaged relative to their counterparts in England, Scotland and Northern Ireland?

While the MCS data has the advantage of being able to focus on a contemporary cohort of children (and thus consider a future generation of adults in Wales), this is also a limitation. At the time of writing, the latest available data covers the cohort members when aged 5. As such, the focus of this study is constrained to look at regional differences in early childhood indicators and not their relationship with outcomes in later life.[1] However, there is an increasing recognition of the importance of early childhood indicators, for example, Cunha and Heckman (2007) note "persistent ability gaps across children from various socioeconomic groups open up at early ages before children enter school" (page 1).

[1] An interesting question is does correlation between child and adult indicators differ in Wales? However, this type of analysis has been limited in previous cohort studies since there was not a boost to the sample for Wales.

Advantage (or disadvantage) in childhood can be generated through alternative mechanisms. Firstly, it may be that parents (and families) in Wales have different characteristics (for example, health, income, employment) and/or behaviours (for example, smoking, alcohol consumption) to those elsewhere in the UK. This could potentially generate an intergenerational transmission mechanism whereby disadvantaged adults reduce the opportunities available to the next generation, so that the child's economic outcomes are correlated with the outcomes of their parents. Secondly, it may be that features of the social and economic (but also physical) environment in Wales (that surround the family) advantage or disadvantage its children (a 'neighbourhood' effect or even an 'all Wales' effect). Thirdly, it may be that institutions in Wales (e.g. schools) and other health or education related policies which differ between parts of the UK contribute to any differences in outcomes observed. The Welsh Assembly Government sponsored boost to the MCS sample in Wales provides the first opportunity to undertake a comprehensive analysis of child development, parental characteristics and behaviour in Wales and thus to attempt to isolate and distinguish between these mechanisms to enhance our understanding of how and why child outcomes vary.[2]

An additional reason for focusing on regional differences in early childhood outcomes is that differences in early years policy interventions exist between countries. Indeed, the Welsh Assembly Government has recognised the importance of this type of intervention, as illustrated in *Wales: A Vibrant Economy* which states "early action is crucial here, since the pattern of low educational attainment and low skills has its origin in children's early years, and the evidence is that the older a child is, the harder it becomes to help them raise their attainment" (page 10). Over time, as the children of the Millennium Cohort age, these data will become increasingly important in providing evidence from which this area of policy is evaluated.[3] This study will establish if and how early child outcomes differ between countries. Further, by considering the influence of parental income, maternal education and employment and parenting behaviour on child outcomes, it should provide evidence to inform a range of important policy debates such as should mothers be encouraged to work or stay at home during the child's early years? Further, the examination of the relationship between child and parent outcomes will provide evidence on intergenerational transmission mechanisms, of which an understanding is essential if Wales is to ensure "all our children and future generations enjoy better prospects in life, and are not landed with a legacy of problems bequeathed by us" (*Wales: A Better Country,* page 4).

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[2] The first economic analysis to specifically utilise the enhanced Welsh data was by Joshi and Hawkes (2005) who focus on characteristics of mothers, particularly age at child birth. Consistent with the argument that there may be regional differences in maternal characteristics, they find teenage mothers are overrepresented in Wales compared to the rest of the UK and that motherhood over the age of 30 is relatively less prevalent.

[3] An obvious example could be an evaluation of the impact of the primary school free breakfast initiative in Wales.

This research is also able to consider intra-regional differences within Wales and focuses particularly on the influence of local area deprivation (in addition to low family income) on child outcomes. In this respect, the evidence will be important for the Welsh Assembly Government strategy on child poverty and inequality, *A Fair Future for our Children*, which states “No-one, especially children and young people, should be disadvantaged or prevented from achieving their full potential because of where they live or their family circumstances” (page 1).

This report will utilise the information available in sweeps 1-3 (from birth to when the child is age 5) of the MCS, to explore the following research questions:

- Do children born in the Millennium in Wales have different health outcomes at birth to those born elsewhere in the UK?
- How do cross country differences in health and cognitive development change as the child ages (until age 5)?
- What determines these cross country differences in child health and child development?
- What intra-regional differences exist in child health and cognitive development in Wales? What determines this intra-regional variation?

The remainder of this report will be structured as follows: a brief review of the key elements of the existing literature will be discussed in Section 2. Section 3 describes the MCS and explains the nature of the child health and development measures employed here. Section 4 explains the statistical methodology used in the analysis. Section 5 presents the descriptive statistics and the results of the multivariate analysis. Section 6 concludes.

2. What Determines Child Health and Development?

As noted above, economic interest in outcomes during childhood has increased as a result of a series of studies which demonstrate the importance of childhood outcomes for economic outcomes in later life. For example, Feinstein (2003) uses data from the BCS to examine a 1970 birth cohort in Britain. He finds that development at 22 months and 42 months, which is measured using a composite index of intellectual, emotional and personal development, are both correlated with formal educational qualifications at age 26. Further, he shows social class is important for child development as early as 22 months and it becomes increasingly important as the child ages. In terms of childhood health, Case *et al*. (2005) find, using data from the NCDS and, thus, a 1958 cohort in Great Britain, that, even after controlling for a range of parental characteristics, poor health in childhood is negatively correlated with educational attainment, health, employment and social status at age 42. They therefore argue that child health is one mechanism which contributes to the intergenerational transmission of socio-economic status, since children born in low income families are more likely to have adverse health outcomes in childhood.

Recent contributions to the US literature have provided a comprehensive examination of the empirical evidence and more formal theoretical underpinnings for the formation of skills over the life-cycle (see Cunha *et al*., 2006 and Cunha and Heckman, 2007). Indeed, Cunha and Heckman (2007) argue that there is now consistent evidence that "…ability matters. A large number of empirical studies document that cognitive ability is a powerful determinant of wages, schooling, participation in crime and success in many aspects of social and economic life." (page 2). They also recognise the value of cognitive and non-cognitive skills, stating "noncognitive abilities (perseverance, motivation, time preference, risk aversion, self-esteem, selfcontrol, preference for leisure) have direct effects on wages (controlling for schooling), schooling, teenage pregnancy, smoking, crime, performance on achievement tests and many other aspects of social and economic life" (Cunha and Heckman, 2007, page 2). In summarising the evidence, Heckman (2008) and Cunha *et al*. (2006) show that differentials along socio-economic groupings develop at an early age (before age 6) and tend to persist. Understanding and accounting for this divergence in childhood has, thus, become key in understanding a range of well established adult economic disparities, for example, between ethnic groups in the US (see for example, Carneiro *et al*. 2005).

If gaps in early childhood ability are important predictors of future disparities, then the natural question is what determines these childhood disparities and it is this to which we next turn. The economics literature on child development, behaviour and health share many similarities. Indeed, the same issues have been at the forefront of the recent literature, the presence of and possible alternative explanations of an income or socioeconomic gradient in child outcomes and the impact of maternal employment (and therefore different forms of child care) on these outcomes during childhood.

Household Income/Family Background

The economic literature on child health has grown rapidly since a study by Case *et al*. (2002) who use US data to demonstrate the positive relationship between household income and child health, which increases with the age of the child, leading to a widening of the income-child health differential.[4] They demonstrate the robustness of the finding to introducing controls for health at birth, parental health, genetic and non-genetic parents and behaviour of the parents. A comparison study in England, by Currie *et al*. (2007), similarly finds evidence of a positive relationship of income on child general health using data from the Health Survey for England (HSE), although the relationship is of a smaller magnitude than found in the US and is not found to increase with the age of the child. In a similar manner to Case *et al*. (2002), the relationship is found to be robust to the inclusion of a range of additional controls such as measures of child nutrition and parental exercise. However, unlike the Case *et al*. (2002) study, the relationship cannot be found when parent reported measures of child health are replaced with more objective measures.

Subsequent studies have focused on examining the robustness of this child health/family income relationship and, particularly, on whether unobservables which are correlated with income contribute to the observed relationship. This is clearly crucial for policy development. Doyle, Harmon and Walker (2005) investigate two potential biases in the relationship between child health and income, namely measurement error and endogeneity. Measurement error is caused by using grouped income data and potentially leads to a downward bias in the effect of income on child health. In contrast, the endogeneity between income and child health (caused by common unobservables) would have an upward bias on the estimate of the impact of family income. They use data from the HSE and attempt to control for these effects using an instrumental variable approach and find no significant effect of family income or parental education on child health, suggesting the income gradient identified in the earlier literature may reflect unobserved factors. Lindeboom *et al*. (2006) similarly question whether the positive relationship between parental education and child health represents a causal relationship. Using data from the NCDS, they find that instrumenting parental education with an increase in minimum school leaving age in 1947 removes the positive association between parental education and child health which is measured from birth until age 16.[5]

Propper *et al*. (2004) reinvestigate the child health/family income gradient but use observations on children aged under 7 from the Avon Longitudinal Study of Parents and Children (ALSPAC). They examine the influence of behaviour of the mother (e.g. breast feeding) and maternal health (prior to the birth of

[4] Currie and Stabile (2003) also find evidence of the family income child health gradient in Canada. They find that it results from children in low income families having more health shocks rather than health shocks having more adverse consequences for these children.

[5] This is in contrast to evidence from Currie and Moretti (2003) who, when accounting for the endogeneity of mothers education, still find a positive effect of attending college on infant health measures including birthweight.

the child) on the child health/family income gradient. For example, it may be that inadequate controls for these features, which are likely to be correlated with household income, explain the income-child health gradient observed in previous studies. Indeed, after controlling for these factors they find no influence of household income (as measured by parental reported financial hardship or net family income) on either parental reported or more objective measures of child health. Instead, they argue maternal health is the mechanism through which income affects child health.

Propper and Rigg (2007) also use data from ALSPAC but investigate the role of the parental socio-economic status on child behaviour which is measured (at age 7) using the Strengths and Difficulties Questionnaire. They find evidence of a positive relationship between family socio-economic status and child behaviour, which is still observed after controlling for the quality of the home environment, maternal mental health and child nutrition.

The literature on child development has close links with the more developed literature on more formal educational attainment in later childhood, where there has been considerable interest in the influence of parental education and family income (see, for example, Chevalier, 2004 and Chevalier *et al*., 2005). For example, Carneiro *et al*. (2007) use US data on the children from the National Longitudinal Study of Youth (NLSY) 1979 to examine the role of maternal education on cognitive development and behaviour at a variety of ages. They account for the potential endogeneity of maternal education using IV strategy and find a strong influence of maternal education on child test scores (at age 7) measured using the Peabody Individual Achievement Tests (PIAT), which is greater than that implied by the OLS estimates. However, they also find evidence of a positive influence of mother's cognitive ability over and above the effect of her education. Maternal education is also found to reduce the incidence of child behavioural problems. Interestingly, the effect of maternal education on test scores diminishes as the children age (aged 12-14), but the impact on behaviour is still evident.

Studies continue to consider a range of additional influences on child development. For example, Dustmann and Trentini (2008) use MCS data to examine the impact of pre-school attendance on test scores among ethnic minority groups in the UK. They find evidence of significant differences in test scores between minority groups at age 3, but that attendance at pre-school (reception class) mitigates some of this disadvantage by age 5. Sanz-de-Galdeano and Vuri (2007) use US data from the National Education Longitudinal Study to trace the impact of parental divorce on cognitive outcomes of children aged 13 in 1988. There is evidence that divorce has a negative impact on test scores in a cross section; however, this is found to reflect inferior test scores among children from divorced families *before* the divorce actually takes place. As such, they find no evidence to support a causal impact of divorce on test scores when accounting for differences in the characteristics of families and unobserved family characteristics associated with divorce.

Maternal Employment

As Verropoulou and Joshi (2009) note, the employment rate among mothers of successive cohorts between 1958 (NCDS) and 2000 (MCS) has increased dramatically. About fifty percent of mothers of the 1958 cohort returned to paid work by the time their child was 7, whereas about fifty percent of mothers of the Millennium Cohort returned to work by the time their child was 9 months old. As a consequence of these dramatic changes, understanding the impact of maternal employment on child development and health has become increasingly important.[6]

Gregg *et al*. (2005) focus on the influence of maternal employment on child development using the ALSPAC, which was collected in Avon during the early 1990s and the analysis focuses on children aged between 4 and 7. Consistent with evidence in the US (see Gregg *et al*., 2005 for a review) they find evidence of a (small) negative impact of full time maternal employment during the first 18 months of a child's life on cognitive development when measured using an ALSPAC literacy test. The relationship is only found to be significant for more educated mothers and, interestingly, when the mother uses informal (rather than formal) childcare such as care from relatives. Verropoulou and Joshi (2009) use information on the children (aged 4-17) who are born to members of the British 1958 cohort using data from the National Child Development Study (NCDS). After controlling for family circumstances, mothers' education and mothers' own childhood cognitive development, they find a negative relationship between maternal employment (when the child is aged under 12 months) and child outcomes only exists for a single outcome (reading). They find no evidence of a negative relationship on mathematics scores or measures of child behaviour. Interestingly, however, their analysis finds a positive relationship between the cognitive score of the mother (measured during childhood) and the child.

The examination of maternal employment has extended to child health. Using US data, Berger *et al*., (2005) find a negative impact of early maternal employment (during the first 12 weeks) on child health as measured by indicators such as health checkups, breastfeeding and immunisations. Von Hinke Kessler Scholder (2007) uses UK data from the NCDS to examine the relationship between maternal employment (when the child is aged 7) and childhood obesity (at age 16). Consistent with the US literature (see for example, Anderson *et al*., 2003) she finds a positive relationship between maternal employment and the probability of their child being overweight (which is measured using Body Mass Index (BMI) values) but, as with analysis of childhood development, the relationship is only evident for full-time maternal employment. However, in contrast to the findings in the US (see, for example, Ruhm, 2008) the relationship is more pronounced among families from lower social classes. Hawkins *et al*. (2008a) confirm the positive relationship between maternal employment and child obesity but, in contrast,

[6] The impact of maternal employment on the educational outcomes of children later in life has also been considered (see, for example, Ermisch and Francesconi, 2000).

find it is only significant among households in the highest income band (annual income of £33,000 or more).

Early Years Policy Interventions

In examining evidence on early interventions for disadvantaged children (including the Perry Preschool and the Abecedarian programmes) Heckman (2008) argues there are “substantial positive effects of early environmental enrichment on a range of cognitive and non-cognitive skills” (pages 19-20). Further, he argues that raising the ability in early years will also increase the returns to future schooling and adult learning. This is a direct result of what Cunha and Heckman (2007) call *self productivity*, that childhood abilities augment future skills and *dynamic complementarity*, that the productivity enhancement of investing in new skills is higher for those with more skills. Waldfogel and Washbrook (2008) provide a review of the evidence on early years policy in the UK and US and argue priority should be given to three areas. The first is policies which develop parenting; they highlight the *Nurse-Family Partnership* (established in the US, but recently piloted in the UK) where low income families are given medical advice as a successful example. The second is to improve established schemes such as (in the UK) *Sure Start* which provides services in areas such as health, education and childcare to deprived families. The third and final priority area is to improve the quality of (pre-school) nursery education and link it more directly into primary schools.

Regional Analysis

Despite the developments in this literature over the last few years, the nature of the data, which predominately relates to England or the UK as a whole, has largely precluded an examination of regional differences, particularly in relation to Wales. The availability of the MCS has started to change this and Joshi and Hawkes (2005) illustrate the value of the data for Wales when examining the characteristics of mothers of the Millennium Cohort, particularly age at first birth. One example of a study on child characteristics is Hawkins *et al*. (2008b) who focus on regional differences in childhood obesity at age 3. They find evidence that children in Wales and Northern Ireland are more likely to be overweight even after controlling for their personal and family characteristics, suggesting there is a country specific childhood obesity effect. Similarly, Dex (2008a) considers differences between the outcomes of Millennium Cohort members (and the characteristics of their families) at MCS2 in Scotland and the rest of the UK. The significant differences, namely, that children in Scotland are found to have superior cognitive development, but are more likely to be living in poverty and are less likely to be breastfed are further examined using multivariate analysis in Dex (2008b). She finds that children in Scotland have significantly higher performance on the British Ability Scale naming vocabulary subtest, even after controlling for their own characteristics and the characteristics if their family. In contrast, differences in the Bracken school readiness test were explained by differences in the characteristics of the cohort across countries.

Investigation into differences in outcomes at a finer spatial level has also been relatively limited. Indeed, as Propper *et al*. (2004) note "The impact of school and neighbourhood on children's health remains to be investigated" (page 23). The main exception to this is studies that control for area level deprivation. For example, Currie *et al*. (2007) find no significant effect of local deprivation (measured by the IMD) on child health after controlling for a range of personal and household characteristics.

3. The Millennium Cohort Study (MCS).

3.1. Introduction.

Data from three sweeps of the MCS (referred to as MCS1-MCS3) are used in this analysis. MCS1 data was collected when the children in the Millennium Cohort were aged about 9 months; the children are aged about 3 at MCS2 and aged about 5 at MCS3. A further sweep has been undertaken since then but the data are not yet available.[7] Therefore the analysis traces the Millennium Cohort from birth until entry to full time schooling. A total of 19,244 families (2,760 in Wales) have taken part in the study at some point during the 3 sweeps. However, information about these families is not necessarily available at each sweep. Indeed, information is actually only available on 13,234 families at all three sweeps (2,002 in Wales). This is because a group of new families were introduced in sweep 2 and there is attrition of families between sweeps in the survey.

The MCS provides detailed information about, amongst other things, the characteristics and behaviour of their parents, child health and development, childcare, housing and the local area. Full details of the data, including questionnaires, are available from the Centre for Longitudinal Studies (CLS).[8] Due to the presence of twins and triplets in the MCS families there is potentially more than one cohort member in each family. This analysis is restricted to the first child for each MCS family and, thus, parental information from each sweep is specific to each member of the sample (i.e. it is only used once). Controls are, however, included for those individuals who are members of multiple birth MCS families. After this restriction, there are a total of 49,388 child observations (from 19,244 families) from sweeps 1-3, of which 7,202 observations are from children who were resident in Wales when they entered the sample.

The sample for the MCS was drawn from all live births during the year starting from the 1st September 2000.[9] The sample contains a disproportionate number of children from areas of high poverty in Wales, Scotland and Northern Ireland and in areas with a high concentration of ethnic minorities in England. As such, the data need to be weighted if they are to be representative of each country. Country specific (or UK wide) weights have been applied throughout this analysis. The issue of non-random non-response between waves has also been investigated by the CLS and an additional set of wave specific non-response weights has been designed. However, since Plewis (2007) notes that (until sweep 3) the bias generated by non-response is small relative to the bias created from the sample design, the sweep specific non-response weights are not applied. All analysis is undertaken using Stata's *svy* command.

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[7] From these sweeps, data are used from the parent interview (MCS1-MCS3), child assessment data (MCS2-MCS3), child measurement (MCS2) and geographically linked data (MCS1-MCS2). Information which was not collected consistently across countries, such as information about older siblings and about schooling, is not utilised in the analysis.

[8] See http://www.cls.ioe.ac.uk/studies.asp?section=000100020001

[9] In Scotland and Northern Ireland the start date was slightly later, 23rd November 2000.

In MCS1 (age 9 months) all information is provided by parents, or, more specifically, the main carer (typically the mother) and their partner (typically the father) (which in some cases was provided by proxy). At MCS2 and MCS3 (age 3 and 5 respectively) the information provided by the parent interview is supplemented with child measurements and cognitive assessment obtained directly (by the interviewer) from cohort member. Two things are worth noting here, first the main carer is not always the child's mother and, secondly, the main carer is not necessarily the same person in different sweeps. Given information is provided by the main carer about their own personal characteristics, we constrain the sample to include only responses where the main carer is the natural mother at all sweeps. This aids interpretation as the focus is now exclusively on the influence of maternal characteristics. Following this restriction the remaining sample is 47,464 (7,044 in Wales) or 96% of all main respondent interviews.[10] This restriction also enables relevant information to be transferred more easily across sweeps where it relates to the household, child or the same main carer. Although paternal characteristics are also likely to be important in the development of the child, this additional examination is beyond the scope of the current study. We do, however, control for household characteristics. No controls are included to capture the influence of the extended family or formal childcare. This is also left for future investigation.

3.2 Measures of Child Health and Development

Due to the differences in the age of the Millennium Child at the time when the data are collected, the measures of child health and development vary between sweeps. This is necessary to collect the most appropriate measures at each stage of development; however, it limits the consistency of the information across time and prevents (accurately) tracing how the extent of regional differences differ over the lifecycle. A range of measures of child health and development are collected in the MCS and, therefore, key indicators are selected for analysis at each sweep, together with the measures that are available at all sweeps.[11]

3.2.1 Child Health

In the first sweep information is collected on birthweight (in Kg) which is an objective measure of child health that has previously been shown to be an important determinant of adult outcomes (see, for example, Currie and Hyson, 1999 and Black *et al*., 2007). An indicator of low birth weight is defined using the World Health Organization definition of less than 2.5 kg. Information is also collected on three parental reported measures of child health. Firstly, an indicator whether the child has been involved in an accident for which he/she

[10] The number of children who are not living with their genetic parents (particularly their mother) is small. As such, there is insufficient information to explore differences between genetic and non-genetic parents in detail.

[11] Examples of child health indicators available but not utilised in this report include problems with vision and hearing, asthma and wheezing, infections such as chickenpox and immunisations.

was taken to a doctor or hospital.[12] Secondly, a measure of the number of other health problems (i.e. excluding accidents or injuries) for which the child has been admitted to a hospital ward.[13] Thirdly, an indicator of (non-accident) health problems which have required medical attention (including GP, NHS direct).[14]

In the second sweep information is collected again about the number of accidents for which the child was taken to a doctor or a hospital (as in sweep 1) and the number of non-accident hospital admissions (but in this case, since MCS1). However, additional indicators are collected in sweep 2, including a parental reported measure of the presence of long-term medically diagnosed health problems.[15]

In the third sweep information is similarly collected about accidents/injuries which required medical attention (although in sweep 3 parents are asked about *additional* accidents since sweep 2) and non-accident hospital admissions (similarly the question asks for *additional* admissions since sweep 2). Further, information is also collected on the parental reported measure of long-term health problems introduced in sweep 2 (see above). In addition to this, parents are asked to report their assessment of the general health of the child (ranked excellent to poor).

In both the second and third sweep, trained interviewers weigh and measure the children in the MCS. This information is used to calculate BMI values which, when compared to age and gender adjusted critical values, can be used to define ‘normal weight’, ‘overweight’ and ‘obese’ children. In addition, in sweep 3, waist circumference measures were taken as an additional

[12] At MCS1 the main carer was asked. ‘Most babies have accidents at some time. Has ^Jack ever had an accident or injury for which ^he has been taken to the doctor, health centre, or hospital?’. At MCS2 the same question was asked ‘Most children have accidents at some time. Has ^Jack ever had an accident or injury for which ^he has been taken to the doctor, health centre, or hospital?’. However, at MCS3 the question changed to ‘Most children have accidents at some time. Since we last interviewed you when [^Cohort child's name] was [^age of cohort child], has [^he/she] had an accident or injury for which [^he/she] has been taken to the doctor, health centre, or hospital?’

[13] The precise nature of the question differs between MCS1 and MCS2. At MCS1, they are asked ‘Apart from any accidents or injuries, has’ ^Jack ever been admitted to a hospital ward because of an illness or health problem?’. In MCS2 they are asked ‘Since we saw you last, has ^ Jack been admitted to hospital because of an illness or health problem apart from any hospital admissions you have already told me about?’ (The interviewer is told to exclude admission for injury, surgery or other treatment for eyes or ears which main respondent has already reported). At MCS3 they are asked ‘Since we last interviewed you when [^Cohort child's name] was [^age of cohort child], has [^he/she] been admitted to hospital because of an illness or health problem apart from any hospital admissions you have already told me about?’ The same instructions applied to interviewers.

[14] The precise question is ‘We would like to know about any health problems for which ^Jack has been taken to the GP, Health Centre or Health visitor, or to Casualty, or you have called NHS direct. How many separate health problems, if any, has ^Jack had, not counting any accidents or injuries?’

[15] Does ^Jack have long-term conditions that have been diagnosed by a health professional? By long-term I mean anything that ^Jack has had for at least 3 months or is expected to continue for at least the next 3 months.

measure of body fat. Waist circumference and waist-height ratio have recently been found to be a more accurate predictor of health in later life (see, for example, Savva *et al*. 2000). A waist to height ratio of 0.5 is used to identify abdominal obesity (see, Garnett, *et al*. 2008).

3.2.2 Child Development and Behaviour

Across the sweeps the MCS collects information on a series of established measures of cognitive development. For more details of these measures see Hansen (2008). At the first sweep child development is assessed using parental reports to questions on child activity and behaviour which are part of the Denver Development Screening Test. The information collected in this test covers three areas, namely, the child's gross and fine motor skills and communicative gestures. Motor skills are assessed using parental responses to questions about activities like sitting, walking and hand-eye coordination, whereas communicative gestures would include indicators such as the child waves bye-bye when someone leaves.

In sweep 2 there are two main cognitive assessments, namely the British Ability Scales (BAS) naming vocabulary test and the Bracken School Readiness Assessment. In short, the BAS assesses verbal communication and picture recognition, whereas the Bracken assessment tests concepts such as colours, letters and numbers. Whilst it is possible to examine performance across the elements of the latter assessment, a composite measure is analysed here. Since the children may differ (slightly) in the age at which their test is administered, the scores from both tests are age adjusted to remove differences in outcomes as a result of differences in development by age. For the BAS test, age adjusted T scores have a mean of 50 and standard deviation of 10 and a value higher than 50 indicates a superior performance relative to the average of the age group. For the Bracken School Readiness Assessment the normed scores are ranked, so relative development can be classed from 'very advanced' to 'very delayed'.

In sweep 3 the BAS naming vocabulary test is readministered and supplemented with the BAS picture similarity test and the BAS pattern construction test. The picture similarity test is designed to test pictorial reasoning and the pattern construction test is designed to test spatial awareness. Age adjusted T scores are provided for all three measures. The Bracken School Readiness Assessment is not re-administered.[16]

As Propper and Rigg (2007) discuss, emotional and behavioural problems in childhood have also been linked with adverse outcomes in later life, such as adult antisocial behaviour and labour market disadvantage which are partly a consequence of poor educational attainment. In both sweeps 2 and 3 information is collected on emotional and behavioural problems as part of the Strength and Difficulties Questionnaire (SDQ). This is administered to the

[16] There are various external/environmental factors which may influence the value of test score obtained (such as noise disruption in the household). No attempt is made to examine these factors here, although information is available in the MCS2 for future investigation.

main carer and contains 25 questions on the child's emotional reactions, conduct, activity, peer problems and social interaction. A composite score is created by aggregating across responses from 4 of the domains in the SDQ (excluding social interaction).[17] The maximum overall score is 40 and a score above 17 is used to indicate abnormal behaviour (which is roughly equivalent to 10% of the sample, see Goodman, 1997).

Although we focus on each indicator separately, there is a strong correlation between different measures of development and also between the measures of development and behaviour. For example, the correlation between BAS and Bracken scores of cognitive development at MCS2 is 0.58 and the correlation between the total strengths and difficulties score and BAS (MCS2 and MCS3) is -0.30.[18]

[17] The total SD score is only available where there are valid responses to all 20 variables which make up the total score.

[18] Within the subtests of the BAS score there is a correlation of 0.36 between naming vocabulary and picture similarity, 0.37 between pattern construction and naming vocabulary and 0.37 between pattern construction and picture similarity.

4. Methodology

For those indicators where the descriptive statistics identify significant country variation the source of variation is explored through multivariate analysis. With this type of analysis it is possible to examine the correlation between child outcomes and parental and household characteristics and behaviour. It is thus possible to identify the role differences in the characteristics of children and their parents have in explaining regional differences in child outcomes. It is also interesting to examine what, if any, country specific differences exist after controlling for these characteristics. This country specific effect could reflect wider cultural or policy specific features for which we have no controls in our models. Additional specifications of the models also consider the influence of the characteristics of the neighbourhood in more detail and intra-regional differences within Wales.

Regardless of the particular measure of child health or development or the specific sweep (s) to which the data refer, the basic model can be represented as follows:

$$Y_{it} = \alpha + X_{it}\beta + Z_{pt}\varphi + W_{ht}\gamma + R_{it}\delta + \varepsilon_{it} \qquad (1)$$

Y_{it} denotes the (health/development/behaviour) outcome of interest for cohort member i at sweep t (t=MCS1,MCS2, MCS3). For indicators that are sweep specific, t will be the same for all observations, that is, the data will be a single cross section, whereas for measures which are consistently available across sweeps there may be multiple observations on a cohort member, creating panel data.

Potentially important determinants of these outcomes can be classified into groupings on the basis of the existing literature.[19] Variables within X_{it} refer to the personal characteristics of the Millennium Cohort child and include gender, age in days, ethnicity (defined broadly as white and non-white), birth order and being part of a twin or triplet birth. It is also possible to control for prior indicators of health, for example, birth weight.

Variables included in Z_{pt} relate to the characteristics and behaviour of the main carer of the child, such as, age of mother at birth, whether the mother is a lone parent, the highest qualification held by the mother, maternal employment and indicators of maternal health (including depression and diabetes) and maternal obesity.[20] Indicators of maternal behaviour could include controls for lifestyle (smoking, alcohol consumption, recreational drug use (sweep 3 only) and physical activity) and parenting such as breastfeeding, child diet (sweep 3 only), presence or absence of regular

[19] Full details of all the included variables together with variable means are included in the appendix. The precise variables included within each model depend on the particular indicator of health or development under investigation.

[20] Obesity is measured using BMI values. An individual is classified as underweight if BMI is less than 18.5, is normal weight if BMI lies between 18.5 and 25, is overweight if BMI lies between 25 and 30 and is obese if BMI is greater than 30.

bedtimes (sweep 2 and 3), whether the child eats breakfast (sweep 3) and if he/she has help with reading, writing or numbers (sweep 2 and sweep 3).

Variables which relate to the household in which the cohort member is situated are included in W_{ht}. Potential indicators include the number of adults in the household, a measure of household income/poverty and housing conditions such as tenure, presence of damp and access to a garden.

The final group of indicators (R_{it}) are a set of country dummy variables, which denote country of current residence and include Wales. The country of residence may differ from the country of birth due to migration. However, only 3% of Millennium Cohort Children who were born in Wales are resident in UK countries outside Wales by age 5 and, as such, the results are robust to including controls for country of residence or country of birth.

The nature of the dependent variable determines the precise statistical model estimated. For example, for continuous indicators, estimation is by ordinary least squares (OLS), whereas for binary indicators such as obesity, probit models are used and for ranked variables such general health an ordered probit model is most appropriate. For indicators which are collected consistently across sweeps there are potentially multiple observations on the same Millennium Cohort Child. Initially the models described above are estimated on the pooled data.[21] However, as the previous literature highlights, different parental and family influences can become more or less important depending on the age of the child. In pooling the data we constrain the influence to be constant across different ages of the child. As such, the models are also estimated separately at different ages.

Pooling the data across countries in this way constrains the coefficients on parental and family background to be the same across countries. The main alternative, that would not impose this restriction, is to estimate the equations separately by country and perform a decomposition of the gap between Wales and the rest of the UK. Using a method developed by Blinder (1973) and Oaxaca (1973), it is possible to separate the total gap into a characteristics effect (that part explained by differences in child or family characteristics) and an unexplained component (which would reflect differences in the response to characteristics in Wales).

One issue raised in the existing literature is the potential difference in child development by gender. The basic model specification allows gender to have a differential effect on child development but does not allow the influence of parental or household characteristics to vary by gender. The models are also estimated separately by gender to investigate if there are gender differences in the relationship between personal and parental characteristics, country and child development.

[21]Given the panel nature of the data it is typical to control for unobserved individual heterogeneity using a fixed effects specification. However, as Propper *et al.* (2004) discuss, this may be less appropriate for the analysis of child development since, by definition, children are changing over time.

Intra-regional differences and neighbourhood characteristics

The locality in which a child and its family are situated is a potentially important determinant of health and development. Local characteristics such as the physical and social (cultural) environment, access to services and deprivation may all be important. Restricted access data on disaggregate (local) areas of residence were made available for this project, but are only currently available for MCS1 and MCS2. For these years it is possible to examine more detailed intra-regional differences and map additional data relating to the characteristics of the locality and its residents into the MCS data. Data is mapped from the ONS neighbourhood statistics database into the MCS at a disaggregated spatial level, the output and lower super output area level (mean population size 1500 people).[22] All the indicators are taken from the 2001 Census and therefore relate to characteristics around the time of birth (and are only available for areas within England and Wales). Local area characteristics include the measures of health of the resident population (more specifically, the percentage of people over 16 with a limiting long-term illness), measures of socioeconomic status (approximate social grade), qualifications and economic activity.[23] An indicator for the urban or rural nature of the area is also included.

Given the focus of the analysis on MCS1-MCS3, it is unfortunate area information is only available until MCS2. Rather than eliminate observations from MCS3 by looking at the characteristics of the area at the time of interview, we focus on the characteristics of the area at MCS1 on outcomes at MCS1, MCS2 and MCS3.[24]

It is also possible to use the finer spatial information to examine intra-regional differences in outcomes within Wales. Alternative specifications of model (1) are estimated where the sample is constrained to Wales and country dummies are replaced by an indicator of area deprivation (again defined on the basis of area of residence at MCS1). It is also possible to use the overall index value from the WIMD to identify relative deprivation by including dummy variables for lowest to highest deprivation in terms of deciles (only available in MCS1 and MCS2).

[22] Data are available at http://www.neighbourhood.statistics.gov.uk/dissemination/. More information about lower super output areas is also available from this source.
[23] Unfortunately, information on relative area deprivation is collected differently in the Index of Multiple Deprivation (IMD) for England and the Welsh Index of Multiple Deprivation (WIMD). As such, this information can only be used for analysis within each country and not for comparisons between countries.
[24] The narrow definition of the output area means the local area of residence at MCS1 may differ considerably in future sweeps. For example, in MCS2 only 66% are in the same output area as at time of MCS1.

5. Results

5.1 Descriptive Statistics

5.1.1 Cross Country Differences

Parents of the Millennium Cohort (at MCS1)

Although there is extensive evidence relating to the differences in the characteristics and outcomes of the working age population between Wales and other parts of the UK, it is worth briefly considering if these features are evident among the parents of the Millennium Cohort Children. We focus on key indicators including lone parent status, mother's education, health, employment status and family income, all of which potentially could affect the outcomes of their child. Table 5.1 presents the mean values for these variables by country and '*','**' and '***' are used to denote the difference from Wales is statistically significant at the 10%, 5% and 1% level respectively.

Consistent with the analysis of Joshi and Hawkes (2005), the Millennium Cohort children are significantly more likely to be in a single parent family in Wales than in other parts of the UK. Further, mothers of the Millennium Cohort are (on average) younger in Wales. The higher concentration of teenage mothers is matched by a lower concentration of mothers aged over 30. Despite this, there are relatively few other significant differences in maternal characteristics between countries in the UK in terms of health and employment (53% are employed in Wales when the child is aged 9 months[25]). This is surprising given the high rates of disability and inactivity found among the working age population in Wales (see for example, Jones *et al*. 2006 and Blackaby *et al*. 2003). Mothers in Wales are slightly less qualified than their counterparts in the rest of the UK, although this fails to reach statistical significance at conventional levels. Unsurprisingly (nominal) household income is about £3,000 lower in Wales than England, although adjusting for regional differences in prices will narrow this gap slightly. Consistent with this, children in Wales are more likely to be living in a household in poverty (defined as less than 60% of the median UK household income). This is also evident after adjusting for the size of the household to proxy the needs of the family using equivalised income. In contrast, the proportion of mothers reporting financial difficulties (not reported) is actually significantly lower in Wales than England, which may be a result of differences in expectations.

There is also some evidence that parental behaviour differs in Wales. Mothers of the Millennium Cohort are more likely to smoke in Wales (at 34%) than in England (28%) or Scotland (29%). The percentage of mothers that drink alcohol frequently is not significantly different to England or Scotland, but all these countries have a greater prevalence of frequent drinking amongst mothers than in Northern Ireland.

[25] Not all of these will have actually returned to work.

Table 5.1 Parental characteristics at MCS1

	England	Wales	Scotland	Northern Ireland
Lone parent	0.134***	0.178	0.145**	0.169
Mother age at birth less than 20	0.100***	0.132	0.115	0.100***
Mother age at birth between 20 and 30	0.477	0.488	0.461	0.472
Mother age at birth greater than 30	0.424*	0.380	0.425	0.429
Maternal employment (during pregnancy)	0.503 (0.678)	0.528 (0.674)	0.558 (0.709)	0.575** (0.701)
Paternal employment	0.912**	0.891	0.899	0.896
Maternal health problems	0.214	0.216	0.202	0.202
Maternal underweight (before pregnancy)	0.038 (0.054)	0.044 (0.058)	0.030*** (0.051)	0.027*** (0.040**)
Maternal normal weight (before pregnancy)	0.582 (0.662)	0.560 (0.649)	0.612*** (0.681*)	0.568 (0.674)
Maternal overweight (before pregnancy)	0.250 (0.196)	0.250 (0.204)	0.244 (0.192)	0.290*** (0.207)
Maternal obesity (before pregnancy)	0.131 (0.089)	0.146 (0.089)	0.115*** (0.076)	0.116*** (0.079)
Maternal highest qualification degree or higher education	0.281	0.260	0.302	0.288
Maternal highest qualification A level or equivalent	0.092	0.087	0.182***	0.093
Maternal highest qualification O level or equivalent	0.351	0.366	0.319**	0.344
Maternal highest qualification other qualifications	0.136	0.123	0.060***	0.104*
Maternal highest qualification no qualifications	0.141*	0.164	0.137	0.170
Average household income[26]	24,503***	21,345	23,372	21,597
Average equivalised household Income	17,896***	15,624	17,120	15,441
Poverty	0.274***	0.341	0.303*	0.345
Poverty (equivalised income)	0.241***	0.300	0.265*	0.308
Mother ever had doctor diagnosed depression	0.233***	0.268	0.271	0.273
Mother smoke	0.276***	0.336	0.292**	0.332
Mother drinks alcohol (3-4 times a week or more frequent)	0.166	0.145	0.127	0.058***

Notes to table: Data are weighted by weight1. Sample is restricted to a single cohort member per family where the natural mother is the main carer at all productive responses. Country refers to country at MCS1.

[26] Responses to questions on household income are banded but midpoint of band has been used to calculate the average. Equivalised income adjusts for the size of the household to standardise income for a 2 person household with no children. Following previous analysis of the MCS (see Hansen and Joshi, 2007), the main carer is assigned a weight of 0.61, a partner 0.39 and any children in the household 0.23.

Childhood health and development is also likely to be determined by parenting behaviour and parent-child activities during their childhood. Table 5.2 presents the mean values of these indicators at MCS3 by country. Relative to children in England, children in Wales are significantly less likely to eat breakfast everyday at age 5. This is despite a greater proportion of children in Wales attending a pre-school breakfast club (8%), which is likely to be a consequence of the free primary school breakfast initiative in Wales.[27]

There are few significant differences across countries in terms of hours spent watching TV, with nearly two thirds watching between 1 and 3 hours. With the exception of Northern Ireland, just over half of the children eat 3 or more pieces of fruit a day. Children in Wales are, however, significantly less likely than those in England to have regular bedtimes on weekdays during term time.

Parents are more likely to report that they have undertaken some physical activity (e.g. sport) with their child in Wales than in England or Scotland. The vast majority of children in Wales are reported to have some help with reading, writing and numbers and they are more likely to have had help than those in Northern Ireland, although children in Wales are significantly less likely to get help with reading than those in England.[28]

Table 5.2 Parenting and child activities at MCS3

	England	Wales	Scotland	Northern Ireland
Breakfast everyday	0.931**	0.916	0.927	0.911
Breakfast club	0.051***	0.084	0.069	0.025***
Watches TV less than 1 hour	0.215	0.221	0.230	0.226
Watches TV 1-3 hours	0.642	0.633	0.632	0.660
Watches TV more than 3 hours	0.143	0.146	0.138	0.114**
Fruit (3 pieces a day)	0.551	0.536	0.535	0.432***
Regular bedtime in term time	0.910**	0.892	0.909	0.898
Plays physical activity with mother more than once a week	0.595***	0.656	0.613**	0.646
Someone at home helps with reading	0.989***	0.975	0.967	0.935***
Someone at home helps with writing	0.919	0.909	0.909	0.867***
Someone at home helps with numbers	0.944	0.939	0.905***	0.873***

Notes: See notes to Table 5.1.

Millennium Cohort Child Health

As noted above, few of the indicators of child health are collected consistently across the sweeps and, therefore, the descriptive statistics are presented by sweep (in Tables 5.3-5.5 for sweep 1-3 respectively). Where possible (i.e. for indicators which are collected consistently across time) attention is paid to

[27] It has been rolled out gradually across Wales from September 2004 and these data relate to interviews which commenced in January 2006.
[28] The intensity of help with reading is also lower in Wales, with a lower proportion of those who had help reporting they read to the child *every day* in Wales.

whether cross-country differences narrow or widen over the lifecycle. A similar approach is applied for indicators of child development and behaviour, which are presented in Tables 5.9-5.11.

Table 5.3 Health of the Millennium Cohort members at MCS1

	England	Wales	Scotland	Northern Ireland
Health problem during pregnancy	0.400	0.398	0.395	0.296***
Problems with labour	0.340	0.356	0.330	0.289***
Problems with child at birth or during first week	0.249	0.251	0.292**	0.215***
Average weight at birth (Kg)	3.359	3.368	3.416***	3.451***
Low birth weight[29]	0.068	0.066	0.058	0.055
Any accident	0.081	0.090	0.078	0.062***
Accident (mean number)	0.086	0.095	0.080	0.065***
Any illness	0.790	0.787	0.717***	0.731**
Illness (mean number)	1.743	1.714	1.485**	1.442**
Any hospital admission (non-accident)	0.137***	0.177	0.127***	0.160
Hospital admission (non-accident) (mean number)	0.191*	0.224	0.161***	0.225

Notes: See notes to Table 5.1.

With the exception of Northern Ireland there are relatively few significant differences across countries in early child health (by age 9 months). The average birth weight of children in Wales is significantly below that in Scotland and Northern Ireland. However, there are no significant differences in the percentage classified as of low birth weight, which is frequently identified as a determinant of outcomes in later life (see, for example, Currie and Hyson, 1999 and Black *et al*., 2007). Where there are significant differences, health outcomes tend to be better in Northern Ireland than elsewhere in the UK, for example, using measures of health problems during pregnancy, at birth or in the first week of the child's life. Children in Wales are slightly more likely to have had an accident which required medical attention, although the difference between England and Wales is not significant at conventional levels. The same conclusion holds if, instead, the mean number of accidents is examined. The percentage of children in Wales who have been admitted to hospital for a non-accident health problem (18%) is significantly higher than in England (14%) or Scotland (13%). There is also a higher incidence of non-accident medical conditions for which parents sought wider medical advice (including GP, NHS direct) in Wales relative to Scotland or Northern Ireland, but the rate is similar to that in England.

[29] Defined using The World Health Organisation definition of below 2.5kg.

Table 5.4 Health of the Millennium Cohort members at MCS2

	England	Wales	Scotland	Northern Ireland
Long term health problem	0.161	0.150	0.151	0.128
Limiting illness	0.030	0.032	0.027	0.025
Any accident	0.352***	0.389	0.367	0.352**
Accident (mean number)	0.475***	0.553	0.504	0.449***
Hospital admission (since MCS1) (non-accident)	0.174***	0.234	0.160***	0.192**
Any hospital admission (non-accident)	0.263***	0.346	0.239***	0.296***
Hospital admission (non-accident) (mean number)	0.455***	0.581	0.420***	0.505*
BMI- normal (%)	0.775***	0.725	0.753	0.726
BMI- overweight (%)	0.175***	0.217	0.187**	0.207
BMI- obese (%)	0.050	0.058	0.060	0.067

Notes: See notes to Table 5.1.

At age 3 parental reports of long term illness (and limiting illness) are fairly similar across countries (see Table 5.4). In Wales, 15% of children are reported to have a long-term health problem, whilst 3% have a long-term health problem which limits their normal activities. Consistent with the evidence at MCS1, children in Wales are more likely to have had an accident than those in most other parts of the UK; however, at MCS2, the gap is significant when compared to England or Northern Ireland. Between 9 months and 3 years the proportion of children in Wales that have had an accident for which medical attention was sought has risen from 9% to 39%. The percentage of children admitted to hospital for (non-accident) medical attention is also significantly higher in Wales than the rest of the UK at 35% and a greater percentage of children have been admitted to hospital since MCS1 in Wales. Also of concern, but consistent with recent evidence from Hawkins *et al*. (2008b), children in Wales are more likely to be overweight relative to those resident in England or Scotland. Only 73% of children in Wales and Northern Ireland are classed as ‘normal’ weight compared to 75% of children in Scotland and 78% in England.

At age 5 no significant cross country differences in health have emerged in parental reported long-term health problems or limiting health problems, although the percentage affected as the child ages has increased in all countries (see Table 5.5). Mothers in England are less likely than those in Wales to report their child health is ‘excellent’ but are more likely to report ‘good’ or ‘very good’ health. There are no significant differences in the proportion of children reported as having fair or poor health across countries.

About 53% of children in Wales have experienced an accident by MCS2 which required medical attention compared to 49% in England, 50% in Scotland and only 45% in Northern Ireland. Similarly, the mean number of accidents is significantly higher in Wales.[30] The number of children who have had a non-accident related hospital admission (at 41%) also remains significantly higher in Wales than in the rest of the UK.[31] Children in Wales also remain more likely to be overweight than in Scotland or England. Consistent with the greater prevalence of being overweight in Wales, children are also more likely to have a ‘high’ waist to height ratio (over 50%) relative to elsewhere. However, more positively, the percentage classed as being overweight in Wales has declined from 22% to 18% between ages 3 and 5.

Table 5.5 Health of the Millennium Cohort members at MCS3

	England	Wales	Scotland	Northern Ireland
Long term health problem	0.196	0.197	0.186	0.207
Limiting illness	0.057	0.065	0.057	0.073
Maternal reported child general health- excellent	0.517***	0.585	0.585	0.560
Maternal reported child general health- very good	0.315***	0.280	0.290	0.297
Maternal reported child general health- good	0.128***	0.098	0.093	0.103
Maternal reported child general health- fair or poor	0.039	0.037	0.032	0.041
Any accident	0.485***	0.534	0.502*	0.445***
Accident (since MCS2)	0.268***	0.313	0.275**	0.229***
Accident (mean number)	0.811***	0.954	0.844**	0.698***
Hospital admission (since MCS2) (non-accident)	0.116***	0.151	0.126**	0.130
Any hospital admission (non-accident)	0.321***	0.406	0.304***	0.358***
Hospital admission (non-accident) (mean number)	0.587***	0.775	0.610*	0.722
BMI- normal	0.797***	0.763	0.797***	0.753
BMI- overweight	0.152***	0.181	0.148***	0.179
BMI- obese	0.051	0.056	0.054	0.068
Waist measure (average)	0.487*	0.489	0.486**	0.492*
Waist/height ratio > 50%	0.292***	0.332	0.292**	0.374**

Notes: See notes to Table 5.1.

Regional Comparisons

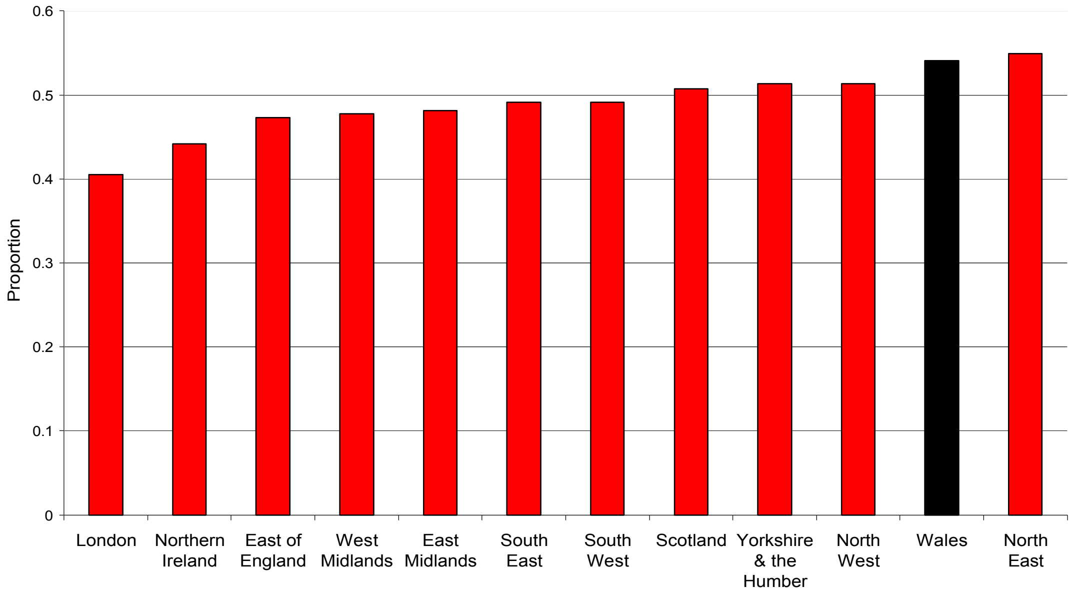
Given the higher incidence of accidents, non-accident hospital admission and obesity in Wales, it is interesting to consider regional differences and changes as the cohort age. Figure 5.1 presents the proportion of children who have had an accident which required medical attention by age 5 by government

[30] An analysis of the type of the first or most severe accident reveals a higher concentration of being *banged on the head/ injury to head without being knocked out* in Wales. This is also the most common type of accident reported.

[31] An analysis of the reason for the first or main hospital admission reveals a higher concentration of admissions for breathing type problems (including *chest infection or pneumonia and wheezing or asthma)* in Wales. These are also the most common reasons for hospital admission.

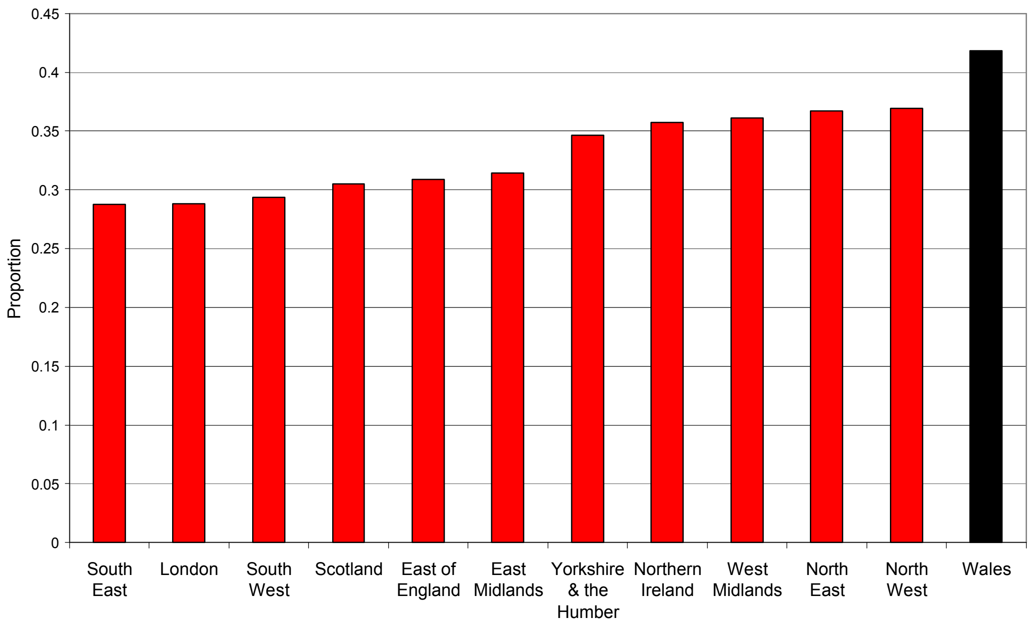
office region. Figures 5.2 and 5.3 show a similar regional breakdown for non-accident hospital admissions and the proportion classed as overweight or obese respectively.

Figure 5.1. Proportion of children reported to have an accident which required medical attention by age 5, by region.



Notes to figure: Data are weighted by weight2. Sample is restricted to a single cohort member per family where the natural mother is the main carer at all productive responses. Region refers to region of residence at MCS3.

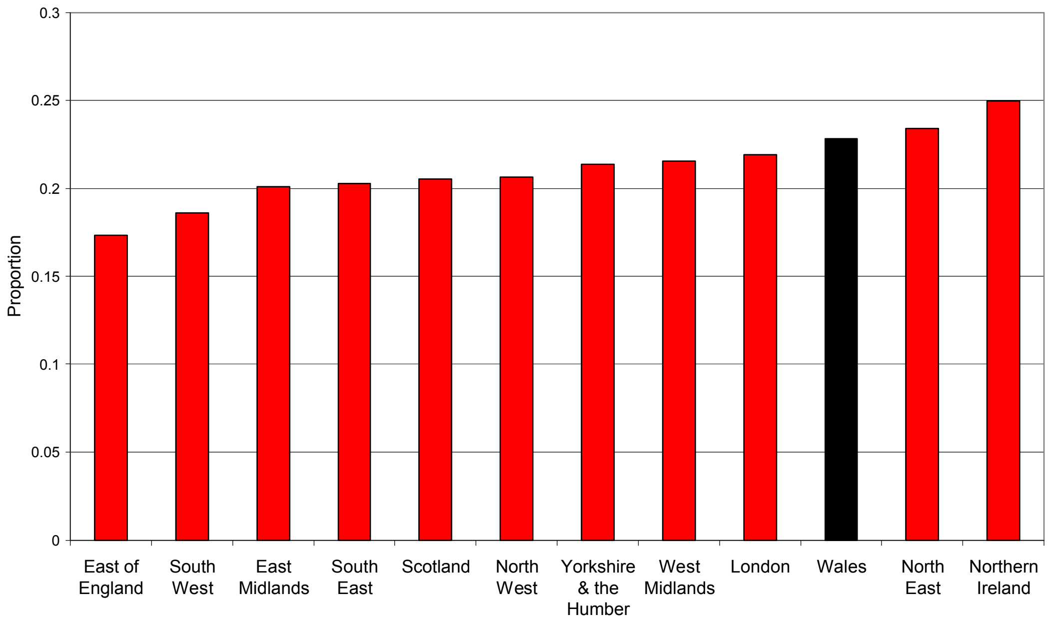
Figure 5.1. Proportion of children admitted to hospital for a non-accident health problem by age 5, by region.



Notes to figure: See notes to figure 5.1.

The prevalence of accidents among children in Wales is towards the upper end of the regional distribution and similar to other regions in the North of England. In terms of the proportion of children who have had non-accident hospital admissions, Wales appears to lie considerably above all other regions in the UK. However, again it is the Northern regions, and, in this case, the West Midlands that also have a relatively high proportion of children affected. The percentage of children classed as overweight or obese at age 5 in Wales is again towards the top of the regional distribution and is similar to the North East of England. The highest prevalence of childhood obesity is in Northern Ireland, where nearly a quarter of children are overweight or obese. What is evident in all these graphics is that these measures of child health, even at age 5, vary by region. For example, while nearly 25% of children in Northern Ireland are above ‘normal’ weight the corresponding figure in the East of England is 17%.

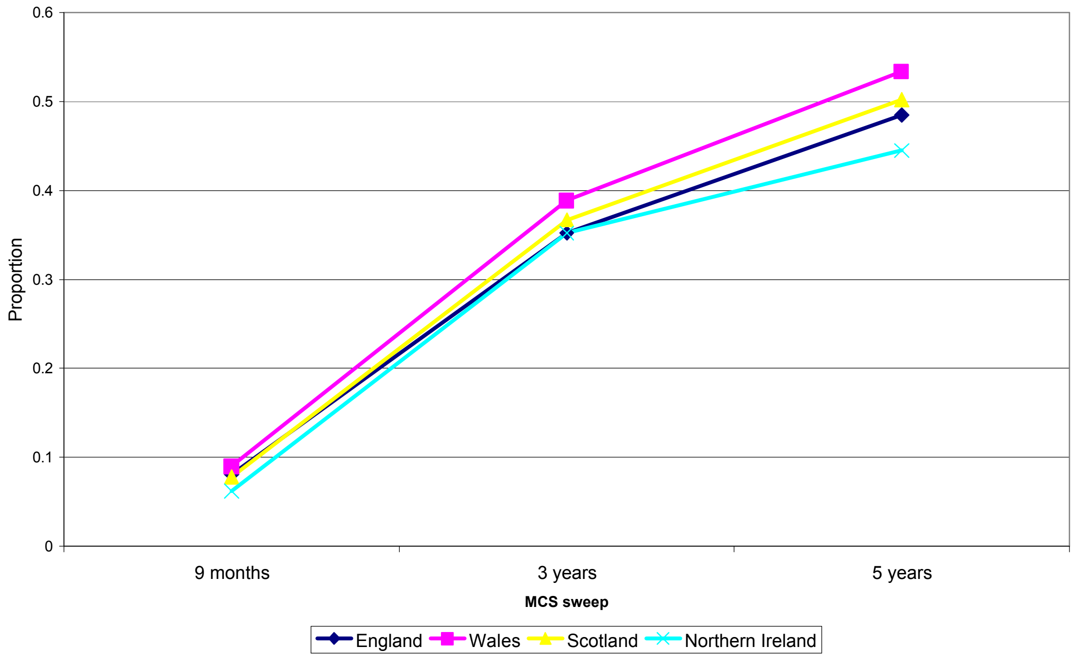
Figure 5.3. Proportion of children who are overweight or obese at age 5, by region.



Notes to figure: See notes to figure 5.1.

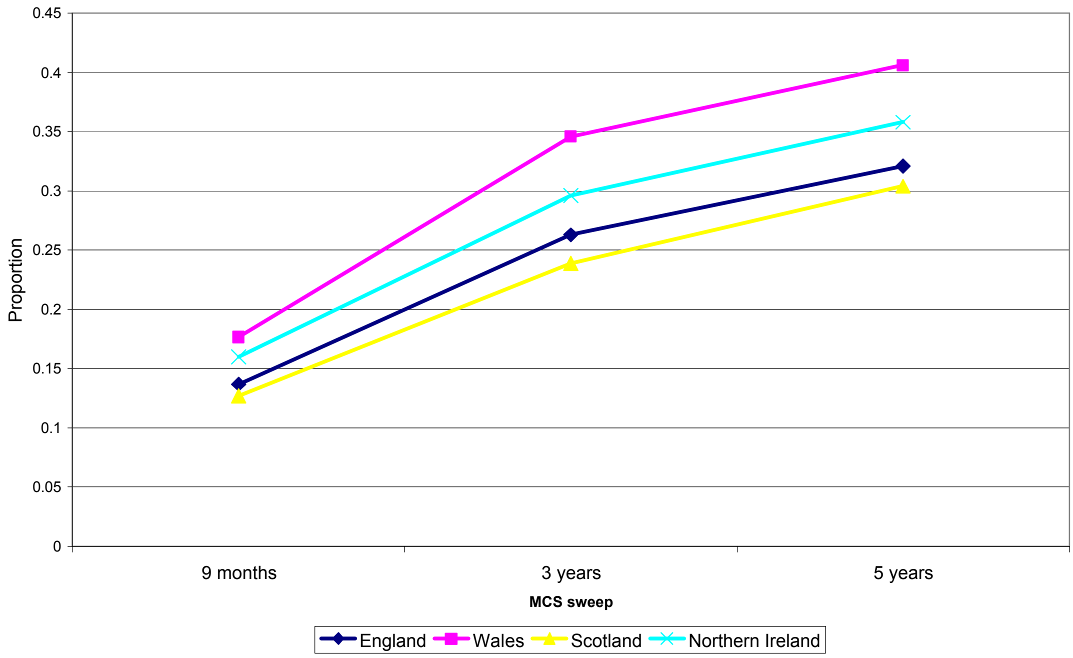
Since information on accidents, and non-accident hospital admissions, is collected throughout the 3 sweeps, Figures 5.4 and 5.5 focus on changes in these variables over time. Unsurprisingly, as the child ages, the proportion who have had an accident requiring medical attention or a non-accident hospital admission increases. Importantly, however, Figures 5.4 and 5.5 both show that the rate of increase is faster in Wales. As such, by age 5, the disadvantage is more pronounced than at 9 months due to a cumulative effect over time. In contrast, Figure 5.6, which shows the proportion classed as overweight or obese, identifies a decline in the probability of being overweight between the ages of 3 and 5. The decline in Wales is larger than in England leading to a narrowing of the overall gap by age 5. However, the prevalence of overweight children in Wales (and Northern Ireland) at age 5 remains significantly higher than England or Scotland and clearly warrants future monitoring.

Figure 5.4. The probability of having had an accident which required medical attention MCS1-MCS3.



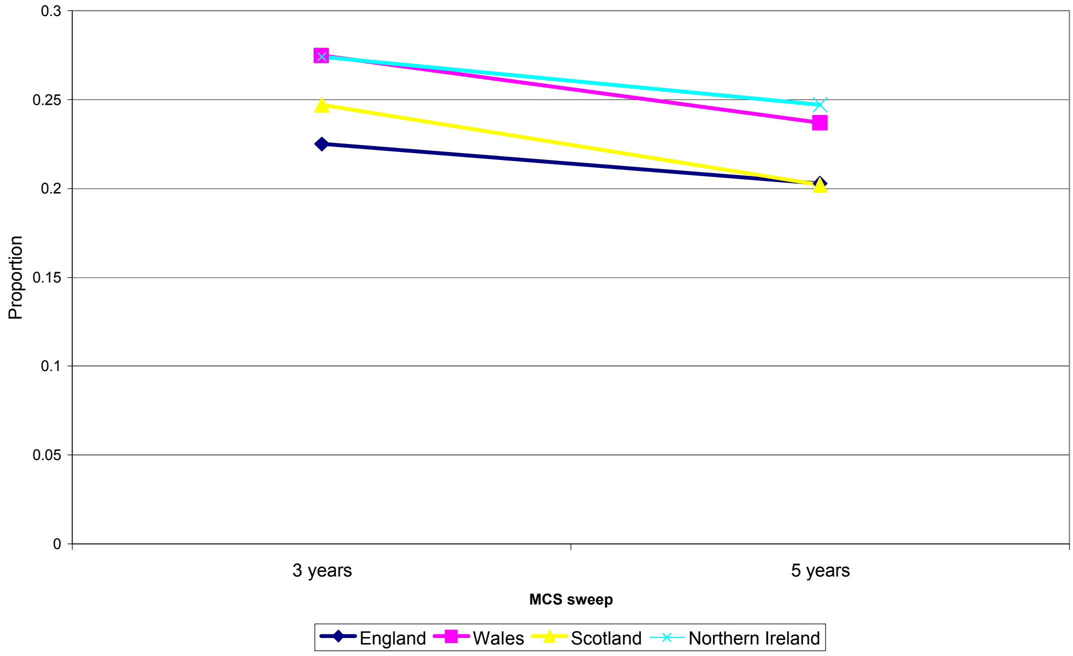
Notes to figure: See notes to table 5.1.

Figure 5.5. The probability of having had a non-accident hospital admission MCS1-MCS3.



Notes to figure: See notes to table 5.1.

Figure 5.6. The probability of being overweight or obese MCS2-MCS3.



Notes to figure: See notes to table 5.1.

Transitions

Observing the same children over time in a cohort study of this type also enables us to investigate how experiences at one stage of development affect future outcomes. Table 5.6 displays cross tabulations of obesity at age 3 and age 5 for the entire UK sample. A child classed as being of normal weight at age 3 has a 91% probability of being a normal weight at age 5. This probability falls to 46% if the child was overweight at age 3 and 20% if the child was obese at age 3. Nearly half of children who are obese at age 3 remain so at age 5 and the corresponding figure for being overweight is 45%. Clearly, therefore, there is persistence in obesity, but it is certainly not the case that a child will remain obese throughout his/her early years; obesity in childhood can be a temporary phenomenon, particularly if a child is 'overweight' rather than obese.

Table 5.6. Obesity at age 3 and age 5, UK.

	Age 5		
Age 3	Normal	Overweight	Obese
Normal	8363 (0.91)	743 (0.08)	132 (0.01)
Overweight	999 (0.46)	954 (0.45)	240 (0.10)
Obese	148 (0.20)	223 (0.33)	309 (0.47)

Notes to table: See notes to table 5.1. Figures refer to (unweighted) cell counts whereas figures in parenthesis refer to weighted row frequencies. Probabilities may not sum to 1 due to rounding.

Table 5.7. Accidents requiring medical attention at age 9 months, 3 years and 5 years, UK.

	Age 3	
Age 9 months	No accident	Accident
No accident	8,661 (0.66)	4,518 (0.34)
Accident	941 (0.84)	180 (0.16)
Age 3	Age 5	
No accident	6,673 (0.78)	1,834 (0.22)
Accident	2,590 (0.63)	1,584 (0.37)

Notes to table: See notes to table 5.6.

The correlation between accidents over the lifecycle is less strong, which may be expected given their nature. Indeed, having an accident before the age of 9 months does not increase a child's probability of having an accident between 9 months and age 3. However, having an accident between 9 months and 3 increases the probability of an accident between 3 and 5 years of age from 22% to 37%. This is consistent with some children being more at risk of accidents due to their personal or household characteristics.

Table 5.8. Hospital admission at age 9 months, 3 years and 5 years, UK.

	Age 3	
Age 9 months	No hospital admission	Hospital admission
No hospital admission	10,332 (0.85)	1,934 (0.15)
Hospital admission	1,367 (0.69)	667 (0.32)
Age 3	Age 5	
No hospital admission	9,795 (0.91)	975 (0.09)
Hospital admission	1,814 (0.77)	592 (0.23)

Notes to table: See notes to table 5.6.

There is a positive correlation between having been admitted to hospital earlier in childhood and admission in the most recent period. For example, the probability of hospital admission between MCS1-MCS2 for a child who had not been admitted to hospital prior to MCS1 was 15%, whereas for a child who had already been admitted to hospital the corresponding figure is more than double at 32%. This is to be expected given the ongoing treatment of certain long-standing medical conditions.

Millennium Cohort Child Development and Behaviour

At sweep 1 development is measured by a series of questions from the Denver Development Screening Test. The proportions of children who undertake the activity (according to their mother) often (rather than occasionally or never) are reported in Table 5.9 below.

Table 5.9. Development of the Millennium Cohort members at MCS1

	England	Wales	Scotland	Northern Ireland
'He smiles when you smile at him'	0.995***	0.998	0.996	0.998
'He can sit up without being supported'	0.961	0.957	0.959	0.951
'He can stand up while holding onto something such as furniture'	0.712	0.715	0.685**	0.627***
'He puts his hands together'	0.843	0.858	0.845	0.851
'He grabs objects using the whole hand'	0.994	0.995	0.992	0.993
'He can pick up a small object using forefinger and thumb only'	0.895	0.879	0.899	0.899*
'He passes a toy back and forth from one hand to another'	0.952	0.956	0.955	0.964
'He can walk a few steps on his own'	0.052	0.060	0.052	0.047
'He reaches out and gives you a toy or some other object that he is holding'	0.589***	0.661	0.609***	0.634
'He waves bye-bye on his own when someone leaves'	0.366***	0.433	0.413	0.476**
'He extends his arms to show he wants to be picked up'	0.810***	0.858	0.831**	0.870
'He nods his head for yes'	0.076*	0.094	0.056***	0.075*
'If you put *Jack* down on the floor, can he move about from one place to another?'	0.927	0.929	0.911**	0.911**

Notes to table: See notes to table 5.1.

Where significant differences exist between countries (which largely relate to communicative gestures) parents in Wales virtually always report their children are more developed. For example, 66% of children in Wales are reported to often reach out and give their parents a toy or some other object that he/she is holding compared to 63% in Northern Ireland, 61% in Scotland and 59% in England. Similarly, 86% of children in Wales are reported to often extend their arms to show they want to be picked up, compared to 81% in England and 83% in Scotland. Of course, these figures do not adjust for differences in age or gender composition between countries and this may be particularly important at this very early stage of development.

Table 5.10 Development of the Millennium Cohort members at MCS2

	England	Wales	Scotland	Northern Ireland
BAS naming vocabulary test score	74.483	75.378	78.665***	77.338**
BAS naming vocabulary t score	50.278	50.547	52.862***	51.682*
Bracken school readiness assessment score	105.392	104.555	107.572***	102.422*
Bracken – advanced	0.278	0.240	0.316**	0.216
Bracken - average	0.608**	0.651	0.594**	0.627
Bracken - delayed	0.114	0.109	0.090	0.157***
Strength and difficulties questionnaire (average)	8.813**	8.440	8.260	8.182
Strength and difficulties questionnaire identifies behavioural problems	0.074*	0.062	0.056	0.072

Notes to table: See notes to table 5.1.

At age 3 more formal cognitive assessments are undertaken, the results of which are reported in Table 5.10. The BAS assesses vocabulary by requiring the child to name the items shown in pictures. Ability adjusted scores are not adjusted for differences in age and, therefore, age adjusted T scores are constructed which are relative to a standardisation sample (i.e. children of the same age) and have a mean value of 50 and a standard deviation of 10. Average BAS naming vocabulary scores (and age adjusted T scores) indicate that children in Scotland and Northern Ireland perform significantly better than those in Wales. Relative to children in Scotland, children in Wales are more than 2 months behind in terms of development (consistent with Dex, 2008a).[32] Children in Scotland also perform significantly better than those in Wales on the Bracken School Readiness score which assesses knowledge of colours, letters, shapes and numbers. An alternative interpretation is given by examining the distribution of these scores and classifying children as ‘advanced’, ‘average’ or ‘delayed’ relative to the group mean. Using this measure, a greater proportion of children are classed as ‘average’ in Wales than elsewhere. There is a significantly higher concentration of children who are assessed as ‘advanced’ in Scotland and ‘delayed’ in Northern Ireland. In terms of behaviour (rather than development) it is actually children in England who have a greater probability of experiencing behavioural difficulties, as indicated by a significantly higher mean value in the strengths and difficulties questionnaire and a greater proportion with abnormally high scores. Using this measure, about 6% of children in Wales are identified as having abnormal behaviour at age 3.

[32] Hansen (2008) *The Millennium Cohort Study First, Second and Third Surveys: A Guide to the Datasets* provides approximate equivalents between test scores and months of development.

Table 5.11 Development of the Millennium Cohort members at MCS3

	England	Wales	Scotland	Northern Ireland
BAS naming vocabulary	109.243	108.962	111.555***	110.371
BAS naming vocabulary t score	55.336***	54.272	56.658***	56.045***
BAS picture similarity	82.038**	82.925	81.728**	85.213***
BAS picture similarity t score	55.615	55.668	54.860*	58.648***
BAS pattern construction	88.404***	90.390	87.118**	88.210**
BAS pattern construction t score	51.080	50.937	49.771	51.691
Strength and difficulties questionnaire (average)	6.706	6.726	6.349*	6.221**
Strength and difficulties questionnaire identifies behavioural problems	0.040	0.041	0.032	0.031

Notes to table: See notes to table 5.1.

Table 5.11 shows that, at age 5, children in Scotland still demonstrate higher average BAS naming vocabulary. After adjusting for differences in age, the T scores indicate that children in Wales are significantly behind all other UK countries. Both additional (non-verbal) BAS tests picture similarity, which is an indicator of problem solving skills and pattern construction, which measures spatial ability, show average scores are significantly higher in Wales than in England or Scotland and the difference corresponds to children being (on average) one month ahead. Pattern construction T scores are insignificant, indicating the difference in the score identified above is probably the result of differences in the average age of the sample between countries. There is also no significant difference between England and Wales when picture similarity T scores are used. In terms of behaviour, children in England no longer have more evidence of behavioural problems than those in Wales, although there is now evidence that children in Scotland and Northern Ireland have a lower total score. Between age 3 and age 5 there is a consistent decline in the proportion that have abnormal behavioural scores in all UK countries.

Summary

The descriptive analysis highlights three measures of child health where persistent and significant differences exist between Wales and the rest of the UK countries. Relative to their counterparts in the rest of the UK, Welsh children are significantly more likely to have sought medical care for accidents and non-accident health problems. Welsh children are also more likely to be overweight or obese. These areas of potential concern warrant further investigation to identify the role differences in parental characteristics and behaviour play in explaining the cross country variation in the outcomes of the child.

There is less consistent evidence of significant differences in development between Wales and the rest of the UK. There is, however, some evidence to suggest that differences in BAS naming vocabulary score by age 5, with T score values indicating that children in Wales have fallen behind their counterparts in the rest of the UK.

5.1.2 Intra-regional Differences

Disparities within regions (intra-regional) are often more dramatic than differences between regions (inter-regional). Therefore, the same health and development indicators are analysed within Wales. The MCS splits observations within Wales as from the 'advantaged' or 'disadvantaged' area. The disadvantaged area comprises of wards which fall into the poorest quarter of wards as measured by the Child Poverty Index for England and Wales. The advantaged area contains all wards not included in the disadvantaged area. Over two-thirds of the original sample in Wales (measured at MCS1) was from the disadvantaged area; further details of the geographical distribution of the sample in Wales are provided by Joshi and Hawkes (2005). In a similar manner to Table 5.1, Table 5.12 presents the mean values for parental characteristics for each area within Wales and '*','**' and '***' are used to denote statistical significance from the advantaged area in Wales at the 10%, 5% and 1% level respectively.

Unsurprisingly, given the well-established correlation between many of these individual outcomes and economic deprivation, there are significant differences in parental characteristics between the 'advantaged' and 'disadvantaged' areas in Wales.[33] Millennium Cohort Children from disadvantaged areas are more likely to live in a lone parent family, have a mother under 20, a mother with low or no qualifications, parents that are not working and on average their household income is significantly lower.[34] A household in the disadvantaged area has, on average, about £8,800 lower income than the advantaged area (measured in 2001 values). Children from the disadvantaged area are also more likely to have a mother who smokes, but are less likely to have a mother that drinks alcohol frequently. Interestingly, there are no significant differences in maternal obesity before pregnancy between areas, although, after pregnancy, obesity is more prevalent in the disadvantaged areas (with 17% of mothers being obese compared to 13% in the advantaged area). Two things are worth noting; firstly, what is clear from a comparison between Tables 5.1 and 5.12 is that the variation in parental characteristics between the more and less deprived areas is far greater than between Wales and other UK countries. Secondly, children in the disadvantaged area face a multitude of potential sources of disadvantage, since highly educated mothers are more likely to be part of two parent households, have higher family income, delay childbirth and have better health.

The difference in parental characteristics identified above may be expected to influence their parenting activities, and, by age 5, there are significant differences in child activities, such as eating habits, watching television and bedtimes (see Table 5.13). In the advantaged area children are more likely to

[33] The Child Poverty index indicates the percentage of children who are in low income families (defined as those receiving means tested benefits).

[34] We use the term *from* the advantage or disadvantaged area throughout, more specifically, the children were resident in the area at the time they entered the sample (at MCS1 or 9 months old). They were therefore not necessarily born in the area and are not necessarily resident in that area at subsequent interviews.

eat breakfast but this is not a consequence in differential attendance at pre school breakfast clubs, consistent with the Welsh Assembly Government free breakfast initiative being open to all children regardless of family income. In the advantaged area 12% of children watch more than 3 hours of television per day whereas the corresponding figure in the disadvantage area is 18%. There are no significant differences in parental reported physical activity or support with reading, writing or numbers, although these latter measures give no indication of the intensity with which the activity is carried out. However, further investigation reveals that the differences in intensity are also quite modest; 50% of the children who had some help reading had help everyday in the advantaged area compared to 45% in the disadvantaged area.[35]

Table 5.12 Parental Characteristics within Wales at MCS1

	Wales advantaged	**Wales disadvantaged**
Lone parent	0.107	0.260***
Mother age at birth less than 20	0.073	0.202***
Mother age at birth between 20 and 30	0.453	0.529***
Mother age at birth greater than 30	0.474	0.270***
Maternal employment (during pregnancy)	0.619 (0.762)	0.422*** (0.570***)
Paternal employment	0.928	0.837***
Maternal health problems	0.203	0.230
Maternal underweight (before pregnancy)	0.046 (0.059)	0.041 (0.056)
Maternal normal weight (before pregnancy)	0.579 (0.659)	0.537* (0.638)
Maternal overweight (before pregnancy)	0.247 (0.199)	0.253 (0.211)
Maternal obesity (before pregnancy)	0.128 (0.083)	0.169** (0.095)
Maternal highest qualification degree or equivalent	0.339	0.166***
Maternal highest qualification A level or equivalent	0.108	0.063***
Maternal highest qualification O level or equivalent	0.360	0.373
Maternal highest qualification other qualifications	0.100	0.150***
Maternal highest qualification no qualifications	0.093	0.248***
Average household income	25,433	16,603***
Average equivalised household income	18,467	12,326***
Poverty	0.231	0.471***
Poverty (equivalised income)	0.196	0.421***
Mother ever had doctor diagnosed depression	0.242	0.298**
Mother smoke	0.259	0.427***
Mother drink (3-4 times a week or more)	0.199	0.080***

Notes to table: Data are weighted by weight1. Sample is restricted to a single cohort member per family and families where the natural mother is the main carer at all productive responses. Area relates to area at MCS1 (and is not necessarily area of current residence).

[35] For writing and numbers a greater percentage of those who had some help had it *every day* in the disadvantaged area compared to the advantage area. It is of course possible that differences in the quality of help exist between areas.

Table 5.13. Parenting and child activities within Wales at MCS3

	Wales advantaged	Wales disadvantaged
Breakfast everyday	0.933	0.896***
Breakfast club	0.081	0.087
TV less than 1 hour	0.252	0.183***
TV 1-3 hours	0.630	0.637
TV more than 3 hours	0.118	0.180***
Fruit (3 pieces a day)	0.573	0.491***
Regular bedtime	0.907	0.869**
Plays physical activity with mother more than once a week	0.662	0.648
Someone at home helps with reading	0.979	0.971
Someone at home helps with writing	0.906	0.912
Someone at home helps with numbers	0.940	0.937

Notes to table: See notes to table 5.12.

Child Health

Given the differences in parental characteristics noted above, it is interesting to examine if there are any significant differences in child outcomes by 9 months. Table 5.14 shows that there are few significant differences in maternal health either during pregnancy or at birth. The sole exception is proportion of mothers reporting health problems during labour, which is actually lower in the disadvantaged area.[36] While children from the advantaged area are heavier on average, there is no significant difference in the proportion with low birth weight, which is more typically used as an indicator of future health. By 9 months some significant differences emerge and, in each case, the children from the disadvantaged area have inferior health outcomes. For example, while 11% of children in the disadvantaged area have had medical treatment for an accident, the corresponding figure for children from the more advantaged area is 8%. For non-accident hospital admissions a similar pattern emerges, with 20% of children from the disadvantaged area being admitted compared to 16% of children from the advantaged area.

[36] This could potentially reflect the lower average age of mothers at birth in the disadvantaged area.

Table 5.14. Health of the Millennium Cohort members within Wales at MCS1

	Wales advantaged	Wales disadvantaged
Problems during pregnancy	0.395	0.399
Problems with labour	0.373	0.337*
Problems with child at birth or during first week	0.249	0.252
Average weight at birth	3.403	3.326***
Low birthweight	0.068	0.064
Any accident	0.075	0.107***
Accident (mean number)	0.080	0.112***
Any illness	0.796	0.775
Illness (mean number)	1.715	1.713
Any hospital admission (non-accident)	0.157	0.200**
Hospital admission (non-accident) (mean number)	0.194	0.259**

Notes to table: See notes to table 5.12.

At age 3, parents in the disadvantaged area are more likely to report their child has a long-term health problem. Consistent with this, non-accident hospital admissions remain more prevalent in the disadvantaged area with 38% of children in the disadvantaged area having being admitted to hospital by age 3. In contrast to the figures reported at 9 months of age, the prevalence of accidents is not significantly different between the advantaged and disadvantaged area by age 3. A greater proportion of children in the disadvantage area are classed as ‘normal’ weight at 74% compared to 71% in the advantaged area consistent with deprivation not being the main driver of the relatively high rates of obesity in Wales. This is not the case in England or Scotland where children in the disadvantaged area are less likely to be of ‘normal’ weight.

Table 5.15. Health of the Millennium Cohort members within Wales at MCS2

	Wales advantaged	Wales disadvantaged
Long term health problem	0.133	0.170**
Limiting illness	0.030	0.034
Any accident	0.388	0.390
Accident (mean number)	0.544	0.562
Any hospital admission (since MCS1) (non-accident)	0.219	0.253
Any hospital admission (non-accident)	0.322	0.376***
Hospital admission (non-accident) (mean number)	0.530	0.642*
BMI- normal	0.709	0.744
BMI- overweight	0.237	0.194**
BMI- obese	0.054	0.063

Notes to table: See notes to table 5.12.

As Table 5.16 shows, at age 5, the probability of having a non-accident hospital admission remains higher amongst children from the disadvantaged area. In contrast, the probability of an accident and of obesity is unrelated to the areas as defined by their economic advantage, which is consistent with the high prevalence in Wales (relative to the rest of the UK) being driven by something other than area deprivation. Consistent with the previous literature, which shows a family-income gradient in parental reported general health, this measure shows significant variation across areas, with parents in more advantaged areas being more likely to report their child is in excellent health (63% compared to 53%) but less likely to report fair or poor health (2% compared to 5%). Long-term health problems and limiting long-term health problems, while more prevalent in the disadvantaged area, are not significantly different from the more advantaged area.

Table 5.16. Health of the Millennium Cohort members within Wales at MCS3

	Wales advantaged	Wales disadvantaged
Long term health problem	0.182	0.214
Limiting illness	0.058	0.074
Maternal reported child general health-excellent	0.626	0.534***
Maternal reported child general health-very good	0.267	0.297*
Maternal reported child general health-good	0.084	0.115**
Maternal reported child general health-fair or poor	0.023	0.054***
Any accident (%)	0.525	0.546
Any accident (since MCS2)	0.305	0.323
Accident (mean number)	0.939	0.973
Any hospital admission (since MCS2) (non-accident)	0.132	0.174*
Any hospital admission	0.386	0.431*
Hospital admission (mean number)	0.666	0.908***
BMI- normal	0.766	0.759
BMI- overweight	0.180	0.181
BMI- obese	0.054	0.059
Waist measure (average)	0.488	0.491
Waist/height ratio > 50% (%)	0.321	0.346

Notes to table: See notes to table 5.12.

Child Development

The following tables (5.17-5.19) present indicators of child development at MCS1, MCS2 and MCS3 for the advantaged and disadvantaged areas in Wales. At 9 months only two indicators exhibit significant variation between the advantaged and disadvantaged area in Wales (see Table 5.17). They are parental reports of the child being able to walk a couple of steps on his/her own and when the child extends his/her arms to show he/she wants to be picked up. In both cases parents in the disadvantaged area report their children are relatively well-developed. For example, 5% of children in the advantaged area are reported to walk unaided compared to 8% in the disadvantaged area.[37]

Table 5.17 Development of the Millennium Cohort members within Wales at MCS1

	Wales advantaged	Wales disadvantaged
'He smiles when you smile at him'	0.999	0.998
'He can sit up without being supported'	0.960	0.954
'He can stand up while holding onto something such as furniture'	0.699	0.734
'He puts his hands together'	0.847	0.871
'He grabs objects using the whole hand'	0.994	0.995
'He can pick up a small object using forefinger and thumb only'	0.875	0.884
'He passes a toy back and forth from one hand to another'	0.955	0.957
'He can walk a few steps on his own'	0.046	0.078***
'He reaches out and gives you a toy or some other object that he is holding'	0.647	0.676
'He waves bye-bye on his own when someone leaves'	0.415	0.453
'He extends his arms to show he wants to be picked up'	0.832	0.888***
'He nods his head for yes'	0.102	0.084
'If you put *Jack* down on the floor, can he move about from one place to another?'	0.924	0.937

Notes to table: See notes to table 5.12.

By age 3 more formal tests can be administered, the results of which are presented in Table 5.18.[38] The BAS naming vocabulary scores are higher on average for children from the advantaged area and indicate that these children are about 2.5 months more developed. The Bracken scores are also

[37] This and many of the outcomes which follow are reported by the mother. Since the characteristics of mothers differ considerably between more and less deprived areas it is possible that their subjective reporting also differs and this may contribute to the differences in outcomes identified.

[38] While these tests are undertaken by trained interviewers and do not rely on parental reports, the environment in which the child takes the test may differ between more and less deprived areas. No controls have been included for the environment in which the test was taken and thus this may contribute to the difference in outcomes observed.

higher in the more advantaged area (but not significantly so). Consistent with this, a higher proportion of children in the disadvantaged area are ‘delayed’ using this test, at 12% compared to 10% in the advantaged area, but again this does not reach significance at conventional levels. In terms of behaviour, the strengths and difficulties questionnaire indicates that children have, on average, a higher score (indicating more behavioural problems) in the disadvantaged area. The magnitude of the difference at age 3 is considerable; while nearly 10% of children in the disadvantaged area are classed as having abnormal behaviour, the corresponding figure in the advantaged area is 3%.

Table 5.18. Development of the Millennium Cohort members within Wales at MCS2

	Wales advantaged	Wales disadvantaged
BAS naming vocabulary test	76.813	73.632**
BAS naming vocabulary t score	51.455	49.445**
Bracken School Readiness Assessment score	105.503	103.414
Bracken - advanced	0.258	0.218
Bracken - average	0.646	0.658
Bracken - delayed	0.097	0.124
Strength and difficulties questionnaire (average)	7.548	9.556***
Strength and difficulties questionnaire identifies behavioural problems	0.034	0.095***

Notes to table: See notes to table 5.12.

By age 5, the differences in development by area are evident across all measures (see Table 5.19) consistent with previous UK evidence which shows that, as children age, there is increasing polarisation by socio-economic group in the child’s early years (Feinstein, 2003). In every case, regardless of which precise element of cognitive function or behaviour the test is designed to measure, Millennium Cohort children from the disadvantaged area of Wales have inferior development to those who entered the sample outside this area. The same pattern is evident across measures designed to test vocabulary, spatial awareness, problem solving and behavioural problems. On average, a child from the disadvantaged area is nearly 5 months less developed in terms of naming vocabulary, 3 months less developed in terms of picture similarity and just over 1 month less developed on pattern construction. Although the proportion identified as having behavioural problems has declined as the cohort has aged, children from the disadvantaged area remain more than twice as likely to have abnormal behaviour than those sampled from outside this area. Understanding the causes of these widening differentials in development is clearly essential in attempting to narrow inequality in outcomes over the lifecycle.

Table 5.19. Development of the Millennium Cohort members within Wales at MCS3

	Wales advantaged	Wales disadvantaged
BAS naming vocabulary score	110.826	106.686***
BAS naming vocabulary t score	55.795	52.412***
BAS picture similarity score	83.737	81.936***
BAS picture similarity t score	56.550	54.596***
BAS pattern construction score	91.272	89.314*
BAS pattern construction t score	51.624	50.098*
Strength and difficulties questionnaire (average)	6.158	7.448***
Strength and difficulties questionnaire identifies behavioural problems	0.026	0.061***

Notes to table: See notes to table 5.12.

Summary

The health indicators which show significant variation across countries, such as accidents and obesity, exhibit more limited variation within Wales. This would suggest that the inferior outcomes observed in Wales are not driven by income/deprivation differences and are not the result of a problem concentrated in disadvantaged parts of Wales. Instead, the evidence suggests these health issues are an ‘all Wales’ phenomenon. As such, it may be that cross country differences are difficult to explain in terms of parental characteristics and behaviour. This is the issue to which we now turn using multivariate analysis in Section 5.2.

Child development indicators vary dramatically within Wales and the difference between children from the advantaged and disadvantaged area in Wales widen over the lifecycle (at least until age 5). Indeed, by age 5, children from the disadvantaged area are less developed on a range of indicators of cognitive development and behaviour and, thus, are already likely to face multiple sources of disadvantage in future life.

5.2 Multivariate Analysis

5.2.1 Cross Country Analysis

Three indicators of child health in Wales were consistently different from other countries in the UK, namely the number of accidents for which medical attention was required, the number of hospital admissions for non-accident health problems and obesity as measured by age and gender adjusted BMI values. In terms of development, there is some evidence, using T scores on the naming vocabulary subtest of the BAS, that cognitive development is slightly delayed in Wales by age 5. This section examines if these cross country differences are explained by the characteristics of the children and their families or if these differences exist after controlling for characteristics which are important determinants of child health and development. The presence of a residual country specific effect would suggest there is an effect of living in Wales on the outcome of interest. The explanations for this must, therefore, lie with country specific cultural differences or country specific policy and institutions.

Data from three sweeps is pooled across time (t=1,2,3) and a binary variable is created for any accident or hospital admission by the time of interview modelled using a probit model.[39] Childhood obesity is collected in sweep 2 and 3 and a probit model is estimated on the binary indicator which indicates normal weight and above normal weight (overweight and obese). Information on the BAS naming vocabulary subtest is available in sweep 2 and sweep 3. For ease of interpretation, the dependent variable is the ability adjusted score and the models are estimated by OLS.[40]

Tables 5.20 and 5.21 display the coefficient estimates based on the specification described in section 4. In each case, estimates are presented based on an equation which pools observations across age groups and then separately for children at a particular age. For the pooled model, a specification which controls for only characteristics of the child is compared to a more comprehensive specification which includes characteristics of the mother, household income and other household and parenting characteristics. It is only the latter, more comprehensive specifications which are presented for the age specific models.

Accidents

Table 5.20 presents the multivariate model where the dependent variable is having an accident which required medical attention at some point before the interview date. Being resident in Wales is significant across both specifications of the pooled model and the magnitude of the effect is reduced

[39] Information on accidents and hospital admissions is available in each of the three sweeps, for more details about definitions see Section 4. Regressions relate to any accident or hospital admission by the time of interview. This analysis, therefore, clearly ignores potentially important information on the *number* of admissions or accidents.

[40] The corresponding models on the BAS T-score are available in the appendix. The key results are not sensitive to the choice of dependent variable.

only slightly by controlling for child and family characteristics. The marginal effects indicate that living in Wales increases probability of an accident by over 2 percentage points.

In terms of child characteristics, being male or white significantly increase the probability of an accident during childhood. Children with young mothers have a higher probability of an accident (relative to those with mothers aged over 30) but maternal education has a counterintuitive role with more education increasing the probability of an accident. It may be the case that more educated mothers are more likely to seek medical advice after any given accident. Having a mother who has a long-term illness or who has been diagnosed with depression increases the risk of the child having had an accident.

The final three columns present a breakdown by age. The effect of being resident in Wales is only significant at age 5 and appears to reflect a cumulative (negative) effect over time.

Table 5.20 Multivariate analysis of the probability of having an accident which required medical attention.

	Pooled		9 months	3 years	5 years
Constant	-2.287***	-2.135***	-0.595	-4.848**	2.636
	(51.09)	(20.89)	(0.14)	(2.31)	(0.55)
Wales	**0.086*** **	**0.080*** **	**0.023**	**0.062**	**0.137*** **
	(3.02)	**(2.78)**	**(0.56)**	**(1.64)**	**(3.39)**
Scotland	0.004	0.007	-0.055	-0.008	0.064
	(0.12)	(0.25)	(1.03)	(0.23)	(1.59)
Northern Ireland	-0.093***	-0.048	-0.144***	0.017	-0.063
	(3.04)	(1.62)	(2.82)	(0.41)	(1.57)
Age	0.191***	0.194***	-0.926	0.622*	-0.323
	(35.05)	(32.76)	(0.33)	(1.86)	(0.64)
Age squared	-0.005***	-0.005***	0.218	-0.022*	0.009
	(23.17)	(21.12)	(0.48)	(1.67)	(0.65)
Male	0.181***	0.183***	0.032	0.213***	0.249***
	(8.66)	(8.78)	(0.91)	(7.80)	(9.63)
White	0.255***	0.193***	0.105*	0.235***	0.210***
	(7.74)	(5.27)	(1.82)	(4.99)	(5.09)
Firstborn	0.062***	-0.014	0.090**	-0.038	-0.049
	(3.27)	(0.62)	(2.31)	(1.31)	(1.57)
Lone parent		0.009	-0.037	-0.012	0.075*
		(0.25)	(0.66)	(0.23)	(1.68)
Mother <20 at birth		0.261***	0.234***	0.284***	0.263***
		(6.54)	(3.95)	(5.28)	(5.33)
Mother <30 at birth		0.106***	0.070*	0.114***	0.116***
		(4.44)	(1.66)	(3.66)	(3.81)
Mother degree		0.056	0.265***	-0.032	0.004
		(1.37)	(4.04)	(0.61)	(0.08)
Mother A level		0.048	0.317***	-0.072	-0.012
		(0.99)	(4.79)	(1.13)	(0.19)
Mother O level		0.073**	0.187***	0.004	0.065
		(2.21)	(3.18)	(0.10)	(1.42)
Mother other qualification		0.056	0.239***	-0.041	0.025
		(1.36)	(3.51)	(0.78)	(0.43)
Mother employed		-0.041**	-0.060*	-0.043	-0.029
		(2.03)	(1.66)	(1.26)	(0.95)
Household poverty		-0.002	0.069	0.013	-0.064
		(0.08)	(1.40)	(0.31)	(1.51)
Low birth weight		-0.080**	-0.057	-0.125**	-0.046
		(2.03)	(0.85)	(2.42)	(0.91)
Multiple birth		-0.180*	-0.399**	-0.181	-0.109
		(1.69)	(2.23)	(1.30)	(0.79)
Garden		-0.011	-0.072	0.053	0.012
		(0.31)	(1.42)	(0.85)	(0.20)
Mother smokes		0.031	0.005	0.016	0.059*
		(1.35)	(0.13)	(0.52)	(1.88)
Log of number in household		-0.163***	-0.265***	-0.132**	-0.065
		(3.48)	(3.90)	(2.14)	(0.97)
Mother long-term ill		0.076***	0.055	0.091***	0.071**
		(3.61)	(1.46)	(2.98)	(2.23)
Mother diagnosed depression		0.117***	0.119***	0.128***	0.105***
		(5.32)	(3.37)	(4.12)	(3.42)
Observations	46215	40395	16335	12177	11883

Notes to table: Data are weighted by weight2. Sample is restricted to a single cohort member per family where the natural mother is the main carer at all productive responses. Country refers to country of residence at time of interview. Sample refers to unweighted number of observations. Coefficients on age and age squared have been multiplied by 100.

Hospital Admission

The probability of have being admitted to hospital for a non-accident health problem is significantly higher for children resident in Wales, even after controlling for their personal and family characteristics (see Table 5.21). The country specific effect raises the probability of hospital admission in the pooled model by nearly 7 percentage points relative to England (the omitted group) and is considerably greater than the effect of living in Northern Ireland (3 percentage points).

In terms of characteristics, males are also more likely to be admitted for a non-accident health problem and it is also more likely if they have a young mother (relative to the over 30 years group). The educational attainment of the mother is also important; having a degree reduces the probability of hospital admission relative to a child whose mother has no qualifications, by 4 percentage points. As may be expected, having a low birth weight is strongly positively correlated with hospital admission, increasing the risk of hospital admission by 12 percentage points. This is likely to reflect a higher probability of admission immediately after childbirth and also the subsequent effect of low birth weight on health (further analysis reveals low birth weight is a significant determinant of hospital admissions between 9 months and 3 years). Consistent with the analysis of accidents, having a mother with long-term health problem or who has been diagnosed with depression are also positively correlated with child admission to hospital. The importance of maternal health is consistent with the evidence from Propper *et al*. (2004) but, unlike them, we do not find that introducing these controls removes the direct effect of family income. In fact, it is maternal education and maternal age at birth that appear to remove the positive effect of household poverty.

The final three columns present estimates for age specific equations. Even at age 9 months there is evidence of a Welsh specific effect and this remains significant as the child ages.

Table 5.21 Multivariate analysis of the probability of having a non-accident hospital admission.

	Pooled		9 months	3 years	5 years
Constant	-1.482***	-1.527***	-2.973	-3.440	7.151
	(29.70)	(16.67)	(0.95)	(1.57)	(1.55)
Wales	**0.218*** **	**0.208*** **	**0.133*** **	**0.234*** **	**0.248*** **
	(6.73)	**(6.11)**	**(3.36)**	**(5.76)**	**(5.78)**
Scotland	-0.066*	-0.052	-0.039	-0.079*	-0.045
	(1.85)	(1.38)	(0.91)	(1.78)	(1.03)
Northern Ireland	0.095***	0.108***	0.068	0.096**	0.148***
	(2.68)	(2.98)	(1.54)	(2.16)	(3.21)
Age	0.083***	0.087***	0.835	0.410	-0.817*
	(22.19)	(21.11)	(0.41)	(1.16)	(1.68)
Age squared	-0.002***	-0.002***	-0.106	-0.014	0.022*
	(13.53)	(12.75)	(0.31)	(1.01)	(1.69)
Male	0.153***	0.159***	0.126***	0.156***	0.192***
	(7.28)	(7.23)	(4.54)	(5.83)	(8.08)
White	0.049	0.035	0.083	0.021	0.003
	(1.05)	(0.70)	(1.41)	(0.38)	(0.05)
Firstborn	0.065***	0.025	-0.023	0.038	0.056*
	(2.80)	(0.91)	(0.65)	(1.12)	(1.81)
Lone parent		0.039	0.056	-0.009	0.016
		(1.08)	(1.17)	(0.18)	(0.33)
Mother <20 at birth		0.149***	0.162***	0.113*	0.159***
		(3.31)	(3.20)	(1.94)	(2.86)
Mother <30 at birth		0.087***	0.071**	0.083***	0.102***
		(3.04)	(2.07)	(2.60)	(3.11)
Mother degree		-0.130***	-0.131**	-0.105*	-0.135***
		(2.91)	(2.21)	(1.89)	(2.61)
Mother A level		-0.119**	-0.157**	-0.074	-0.118*
		(2.19)	(2.28)	(1.19)	(1.80)
Mother O level		-0.016	-0.040	0.007	0.000
		(0.42)	(0.84)	(0.14)	(0.00)
Mother other qualification		-0.029	-0.068	-0.009	0.001
		(0.67)	(1.34)	(0.18)	(0.02)
Mother employed		0.000	-0.014	-0.010	0.020
		(0.00)	(0.46)	(0.31)	(0.65)
Household poverty		0.014	0.074*	0.016	-0.033
		(0.59)	(1.92)	(0.39)	(0.88)
Low birth weight		0.408***	0.435***	0.416***	0.374***
		(8.23)	(7.98)	(6.94)	(6.16)
Multiple birth		-0.041	-0.101	0.005	-0.034
		(0.37)	(0.78)	(0.03)	(0.28)
Garden		0.000	-0.011	-0.017	0.025
		(0.01)	(0.24)	(0.29)	(0.39)
Mother smokes		0.065**	0.050	0.087**	0.058
		(2.20)	(1.25)	(2.38)	(1.59)
Log of number in household		-0.042	0.100*	-0.159**	-0.122*
		(0.93)	(1.70)	(2.41)	(1.81)
Mother long-term ill		0.111***	0.079**	0.111***	0.142***
		(4.50)	(2.32)	(3.03)	(4.25)
Mother diagnosed depression		0.122***	0.114***	0.119***	0.132***
		(4.26)	(3.21)	(3.71)	(3.98)
Observations	46221	40403	16336	12177	11890

Notes to table: See notes to table 5.20.

Obesity

Table 5.22 presents the estimates from the probit model where the dependent variable is being overweight or obese. The estimates from the pooled model are presented in columns 1-3 and the final two columns contain age specific estimates at age 3 and 5 respectively. The controls for country of current residence confirm that children in Wales and Northern Ireland have a significantly higher probability of being overweight or obese relative to those in England. Being resident in Wales increases the probability of a child being overweight or obese by over 3 percentage points. As the controls for personal, parental and parenting characteristics are included across the specifications, there is little change in the country specific effect on obesity. This confirms it is not differences in the composition of the population between countries that is driving the higher rate of obesity in Wales.

In terms of child characteristics, males are less likely to be obese, but there is no consistent significant influence of age, ethnicity or birth order. In terms of parental characteristics, children with a mother qualified to 'A level' standard (but, surprisingly, not above this level) are less likely to be overweight. However, having a mother aged between 20 and 30 reduces the risk of childhood obesity relative to the omitted group of mothers aged over 30. Having a mother who is in employment at the time of interview has no significant effect on the probability of obesity. There is also no influence of family income. Parenting behaviour in the early years is, however, important; children with no (or short durations of) breastfeeding are more likely to be obese, as are children who are fed solid foods within 3 months of birth. Importantly, relative to children in England, those resident in Wales are less likely to have been breastfed and are more likely to have been fed solid foods early in childhood, both of which contribute to the problem of obesity in Wales.

As may be expected, weight at birth is important, with those of low birth weight less likely to be obese consistent with the positive correlation of weight across the lifecycle. There is also evidence of strong positive correlation of obesity between mother and child. Having an obese mother (measured before pregnancy) increases the probability of the child being overweight by 16 percentage points. This may reflect genetic influences or common features of diet and physical activity for mother and child. Recent evidence from Perez-Pastor *et al*. (2009) suggests there is a strong link between mother's obesity and obesity of female children, whereas paternal obesity has a strong influence when the child is male. As such, they argue it is a consequence of common lifestyle rather than a genetic influence. Having a mother who has been diagnosed with diabetes increases the risk of obesity, consistent with recent research in the US (Hillier *et al*. 2007). Other maternal long-term illness has a smaller negative effect.

The final two columns consider children at age 3 separately from those at age 5 which enables additional controls to be included in the specifications. The results confirm Figure 5.6, in that it is at age 3 where the difference between England and Wales is more pronounced. Indeed, at age 5, once a range of personal and family characteristics have been controlled for, the country of residence is no longer significant. While none of the additional controls for diet or activity has an influence at age 3, they are important by age 5. For example, having breakfast everyday reduces the probability of childhood obesity by 4 percentage points. There is also some evidence that at age 5 a sedentary lifestyle (watching more than 3 hours television per day) is positively associated with obesity. However, the consumption of fruit has no significant effect on obesity, but these measures may reflect appetite more generally as well as the composition of the child's diet.

Table 5.22 Multivariate analysis of the probability of being overweight or obese.

	Pooled			3 years	5 years
Constant	-0.985***	-0.925**	-0.807*	-3.124	-1.836
	(2.65)	(2.12)	(1.74)	(1.18)	(0.36)
Wales	**0.132*** **	**0.111*** **	**0.113*** **	**0.166*** **	**0.055**
	(4.37)	**(3.50)**	**(3.51)**	**(3.75)**	**(1.33)**
Scotland	0.041	0.049	0.049	0.067	0.023
	(1.11)	(1.22)	(1.20)	(1.32)	(0.49)
Northern Ireland	0.156***	0.130***	0.157***	0.142***	0.173***
	(4.89)	(3.55)	(4.08)	(3.01)	(3.39)
Age	0.047	0.061	0.031	0.364	0.154
	(0.92)	(1.04)	(0.51)	(0.87)	(0.29)
Age squared	-0.002	-0.002	-0.001	-0.015	-0.004
	(1.13)	(1.21)	(0.67)	(0.87)	(0.32)
Male	-0.081***	-0.097***	-0.093***	-0.026	-0.157***
	(3.31)	(3.60)	(3.31)	(0.79)	(4.83)
White	-0.015	-0.084*	-0.063	0.018	-0.154***
	(0.35)	(1.84)	(1.44)	(0.34)	(2.76)
Firstborn	-0.005	0.002	0.032	0.031	0.038
	(0.20)	(0.06)	(1.05)	(0.83)	(0.98)
Lone parent		-0.018	-0.009	0.020	-0.041
		(0.42)	(0.19)	(0.33)	(0.72)
Mother <20 at birth		-0.153***	-0.077	-0.077	-0.071
		(2.83)	(1.42)	(1.17)	(1.09)
Mother <30 at birth		-0.082***	-0.083***	-0.071**	-0.094***
		(2.99)	(3.13)	(2.11)	(2.97)
Mother degree		-0.054	-0.052	-0.013	-0.106*
		(1.10)	(1.01)	(0.21)	(1.66)
Mother A level		-0.109*	-0.123**	-0.099	-0.151**
		(1.91)	(2.01)	(1.38)	(2.03)
Mother O level		-0.021	-0.038	-0.053	-0.027
		(0.51)	(0.83)	(0.92)	(0.47)
Mother other qualification		0.027	0.010	-0.003	0.027
		(0.50)	(0.19)	(0.04)	(0.41)
Mother employed		0.050*	0.037	0.032	0.041
		(1.70)	(1.23)	(0.84)	(1.03)
Household poverty		0.003	-0.006	-0.005	0.002
		(0.09)	(0.15)	(0.11)	(0.05)
Low birth weight		-0.333***	-0.316***	-0.299***	-0.341***
		(5.29)	(4.95)	(3.76)	(4.57)
Multiple birth		-0.221*	-0.245*	-0.333**	-0.157
		(1.75)	(1.86)	(1.98)	(1.17)
Garden		-0.095*	-0.102*	-0.147**	-0.058
		(1.89)	(1.82)	(2.29)	(0.78)
Mother smokes		0.119***	0.134***	0.110***	0.164***
		(3.90)	(4.24)	(2.78)	(4.25)
Log of number in household		-0.085	-0.095	-0.020	-0.149**
		(1.57)	(1.60)	(0.26)	(2.06)
Solid foods 3 months		0.185***	0.165***	0.148***	0.182***
		(6.49)	(5.50)	(4.10)	(5.13)
Not breast fed		0.143***	0.108**	0.108**	0.126**
		(3.39)	(2.45)	(2.07)	(2.24)
Breastfed <1 month		0.128**	0.104*	0.090	0.136**
		(2.26)	(1.85)	(1.44)	(1.99)
Breastfed 1-3 months		0.102**	0.079	0.051	0.118*

		(2.04)	(1.52)	(0.91)	(1.78)
Breastfed 3-6 months		0.078	0.090*	0.098*	0.090
		(1.63)	(1.86)	(1.69)	(1.52)
Breastfed 6-9 months		0.073	0.088	0.056	0.126*
		(1.29)	(1.56)	(0.83)	(1.77)
Mother underweight			-0.260***	-0.279***	-0.240***
			(3.47)	(3.34)	(2.78)
Mother overweight			0.330***	0.283***	0.377***
			(10.75)	(8.02)	(10.09)
Mother obese			0.546***	0.438***	0.656***
			(12.97)	(8.30)	(13.78)
Mother long-term ill			-0.081***	-0.093**	-0.072**
			(2.92)	(2.39)	(1.98)
Mother diabetes			0.279***	0.261**	0.306***
			(2.95)	(2.27)	(2.76)
Fruit- 1 portion					-0.005
					(0.06)
Fruit- 2 portions					0.016
					(0.19)
Fruit- 3 or more					0.084
					(1.13)
TV > 3 hours (3)					0.066*
					(1.68)
Breakfast daily					-0.206***
					(3.44)
Physical activity (3)					0.029
					(0.83)
Physical activity at school					0.051
					(1.46)
Physical activity (2)				0.037	
				(0.88)	
Fruit and vegetables				0.074	
				(0.79)	
TV > 3 hours (2)				-0.004	
				(0.09)	
Observations	27086	23052	21944	10745	11187

Notes to table: See notes to table 5.20.

BAS Naming Vocabulary Subtest

Table 5.23 shows the coefficients from the multivariate model where the dependent variable is the ability adjusted score naming vocabulary BAS subtest.[41] The pooled model indicates that children in Wales perform worse than those in England and including the parental and family controls in column 2 only reduces the effect slightly.

In terms of child characteristics, being male reduces total BAS score consistent with previous evidence of the relative development differences by gender (see, for example, Hansen and Joshi, 2007). However, the influence of gender appears to diminish as the children age, suggesting males develop faster between the ages of 3 and 5. Being white is associated with a considerably higher BAS score and may reflect differences in the language

[41] The results are qualitatively similar if, instead, age adjusted T scores are used (see Table A.2).

ability for those where English may not be the only language spoken at home. Interestingly, the effect of ethnicity also appears to narrow slightly at age 5, consistent with Dustmann and Trentini (2008) who argue child attendance at nursery reduces the ethnic test score gap. There is also a positive effect of being first born.

Children with lone parents, those with young mothers (relative to the over 30 group) and those with mothers with no formal qualifications have lower scores. There is a strong positive correlation between the educational attainment of the mother and the cognitive development of the child, consistent with intergenerational transmission. Having a mother with degree level qualifications increases a child test score by about 10 points relative to a child whose mother has no qualifications. This effect is equivalent to being about 6 months more developed at age 3 and 12 months more developed at age 5. Maternal employment also has a small positive effect. This may reflect unobservables correlated with maternal employment such as motivation. However, there is no evidence to suggest reverse causation, that is, that the mothers of better developed children choose to work, since similar results are observed if the measure is replaced with employment at 9 months.

Consistent with the change to a child development rather than health based indicator, maternal health is less important than for previous measures, although there is still some evidence that having a mother with a long-term illness is detrimental to cognitive development. For the first time we see a significant effect of household poverty, which reduces BAS score 3 points (this is equivalent of just less than 3 months at both 3 years and 5 years), consistent development being more sensitive to deprivation than the measures of child health considered above. Low birth weight also has a negative influence at age 3.

The age specific models (in columns 3 and 4) show that, after controlling for characteristics, there is no significant difference in the BAS score between England and Wales at age 3, but a gap of over 2 points (equivalent to 2.5 months) has developed by age 5. This is clearly a concerning trend and one that can be monitored with future sweeps of the data. It is also important to note that the advantage displayed by children from Scotland at age 3 (see Dex, 2008b) has been removed by age 5. We also control for parental reported support with reading, writing and numbers. There is a large and significant effect of support with reading at both age 3 and age 5. While this may reflect a wider parental interest in the development of their child, the significance of reading and of writing/alphabet (though to a lesser extent) but not numbers is consistent with the nature of the outcome being assessed. Having a regular bedtime is also positively associated with BAS score.

Table 5.23 Multivariate analysis of BAS naming vocabulary subtest ability adjusted score.

	Pooled		3 years	5 years
Constant	-20.583***	-23.314***	-32.845	-1.548
	(4.54)	(5.32)	(1.12)	(0.03)
Wales	**-1.621*** **	**-1.317*** **	**0.147**	**-2.152*** **
	(2.95)	**(3.06)**	**(0.23)**	**(5.00)**
Scotland	1.239**	0.921**	2.020***	0.560
	(2.51)	(2.18)	(3.21)	(1.01)
Northern Ireland	0.978	1.141*	2.147***	0.966
	(1.36)	(1.76)	(3.58)	(0.97)
Age	9.147***	10.334***	11.405**	7.473
	(14.92)	(17.99)	(2.47)	(1.31)
Age squared	-0.153***	-0.189***	-0.276	-0.127
	(7.71)	(10.21)	(1.51)	(0.85)
Male	-2.533***	-2.487***	-3.915***	-0.816***
	(9.41)	(9.49)	(13.23)	(2.66)
White	12.215***	9.169***	9.267***	8.097***
	(12.61)	(13.41)	(11.24)	(10.91)
Firstborn	3.136***	2.294***	2.380***	2.080***
	(10.41)	(7.14)	(5.98)	(6.07)
Lone parent		-3.045***	-2.528***	-2.953***
		(7.63)	(4.17)	(6.16)
Mother <20 at birth		-4.034***	-3.288***	-4.356***
		(7.68)	(4.92)	(7.91)
Mother <30 at birth		-1.365***	-1.139***	-1.508***
		(4.78)	(3.26)	(4.52)
Mother degree		9.693***	7.037***	9.940***
		(17.16)	(10.44)	(14.66)
Mother A level		6.781***	5.641***	5.827***
		(11.21)	(8.41)	(7.84)
Mother O level		5.152***	4.121***	4.922***
		(9.61)	(6.74)	(8.34)
Mother other qualification		2.432***	1.439*	2.942***
		(3.92)	(1.93)	(4.33)
Mother employed		0.563*	0.629*	0.694*
		(1.96)	(1.72)	(1.81)
Household poverty		-3.066***	-3.451***	-2.290***
		(8.83)	(7.45)	(4.71)
Low birth weight		-1.894***	-3.051***	-0.574
		(3.62)	(4.50)	(0.90)
Multiple birth		-0.803	-0.868	-0.699
		(0.69)	(0.59)	(0.56)
Garden		1.354**	1.637**	0.676
		(2.00)	(2.08)	(0.85)
Mother smokes		-0.068	0.367	0.209
		(0.24)	(0.99)	(0.64)
Log of number in household		-5.622***	-4.932***	-5.010***
		(9.76)	(6.59)	(7.24)
Mother long-term ill		-0.755***	-1.042***	-0.520
		(2.75)	(2.79)	(1.43)
Mother diagnosed depression		-0.089	0.322	-0.330
		(0.29)	(0.83)	(1.01)
Support reading				6.060***
				(3.51)
Support writing				1.194**

				(2.02)
Support numbers				0.455
				(0.61)
Regular term bedtime				2.595***
				(4.64)
Daily support reading			6.822***	
			(8.17)	
Weekly support reading			4.009***	
			(4.82)	
Library			1.756***	
			(5.41)	
Support Alphabet			1.172***	
			(2.59)	
Support numbers			0.248	
			(0.23)	
Regular bedtime			1.591***	
			(3.48)	
Observations	27332	23321	11581	11588
R-squared	0.58	0.63	0.21	0.19

Notes to table: See notes to table 5.20.

Neighbourhood effects

The models presented in Tables 5.20-5.23 do not control for the influence of the locality or neighbourhood on child outcomes. Due to restrictions in the availability of local area data, these models are re-estimated on a sample based on observations from England and Wales. In addition to the personal and parental controls included in the above specifications, controls are included for the social grouping of the local area at the time of birth using information from the 2001 Census.[42] The full results are included in the appendix (Table A.4) and since the influences of the personal and parental controls have been discussed above, we focus on the neighbourhood characteristics and their influence on the country specific effect.

For all four variables examined above, namely accidents, non-accident hospital admissions, obesity and BAS naming vocabulary scores, the country specific influence remains significant after controlling for the social composition of the population at birth and the urban/rural nature of the area. As such, local area deprivation/neighbourhood effects do not appear to explain the 'Wales effect'. In terms of the three health indicators, the influence of the area characteristics is modest or absent, suggesting it is the characteristics of the family rather than the neighbourhood which are important. For the development (BAS) indicator, a concentration in the social groupings associated with higher levels of education and earnings, namely *higher and intermediate managerial, administrative and professional* and *supervisory, clerical, junior managerial, administrative and professional*, have a positive influence of the BAS score over and above the influence of maternal education and household income, suggesting some positive community effect prior to formal schooling. This may reflect a social network

[42] Various other local characteristics were also tested, but, given the strong correlation between the measures, it was decided to control for social grade and urban/rural area.

or peer effect and/ or capture the nature of the local environment surrounding the child.

Gender

Additional specifications of the pooled models are also estimated for each gender separately since parental characteristics may influence child outcomes differentially by gender. For each of the health and development outcomes above, the full specification is presented in the appendix (Table A.5) for male and female children respectively. Since many of the influences are qualitatively similar across genders, the discussion focuses on gender differences in the country specific effect. Some interesting results emerge. After controlling for characteristics, living in Wales only significantly increases the risk of an accident for females, suggesting it is particularly the high accidents rate for females in Wales that is driving the overall results. For hospital admissions, living in Wales has a similar positive effect for both genders, confirming it may be a policy or cultural effect. Being resident in Wales increases the risk of being overweight for both male and female children, although the marginal effect for females (4 percentage points) is considerably greater than that for males (2 percentage points). Living in Wales reduces BAS naming vocabulary scores by about 1 point for both males and females.

5.2.2 Intra-regional Analysis

The intra-regional analysis restricts the sample to children born and resident in Wales and examines the influence of deprivation in the local area at time of entry into the sample (MCS1). The descriptive statistics suggest intra-regional differences exist among a greater number of health, and particularly development outcomes. We consider two measures of health where intra-regional differences were identified, namely hospital admissions (which were also considered above) but also parental reported general health (MCS3 only). We also consider measures of development and behaviour using scores on the subsets of the BAS and the strengths and difficulties questionnaire respectively.

Table 5.24 presents the results for hospital admissions, since many of the influences are qualitatively similar to the UK specification and the focus of the discussion is on intra-regional differences. The raw figures suggest that children from the advantaged area were less likely to have a non-accident hospital admission than in the disadvantaged area. However, this effect is completely removed by controlling for child and family characteristics, which suggests that it is differences in the characteristics of the individuals who live in the areas that is driving the results. The same conclusion holds if the regressions are run separately at each age group. Therefore, being from the disadvantaged area within Wales does not increase a child's risk of an accident. The difference in the raw figures purely reflects a composition effect which is consistent with the more dramatic differences in maternal characteristics and behaviour identified between these areas.

When the dependent variable is maternal reports of child general health (Table 5.25), child and family characteristics also reduce the effect of deprivation in the area of birth. However, even after controlling for child and family characteristics, being from a deprived area has a residual negative effect on general health. For example, being from the disadvantaged area reduces probability of being in excellent general health by 4 percentage points. This influence of the neighbourhood deprivation is in contrast to the findings of Currie *et al*. (2007). Consistent with other measures, general health is also negatively associated with being male, but being white has the opposite effect. Having a mother educated to degree level or in employment has a positive effect on their reports of child general health but consistent with much of the evidence so far, their ill-health has a negative influence. For example, having a mother with a long-term health problem reduces the probability of their child being in excellent health by 8 percentage points. Consistent with Propper *et al*. (2004), there is no significant evidence of an influence of household poverty.

Table 5.24. Multivariate analysis of intra-regional differences in non-accident hospital admissions.

	Pooled	9 months	3 years	5 years
Constant	-1.685***	15.887**	0.779	10.523
	(7.21)	(2.18)	(0.17)	(0.88)
Disadvantaged area	0.001	0.048	-0.019	-0.030
	(0.02)	(0.67)	(0.28)	(0.37)
Age	0.107***	-11.568**	-0.215	-1.216
	(12.20)	(2.40)	(0.29)	(0.98)
Age squared	-0.003***	1.921**	0.007	0.032
	(8.18)	(2.41)	(0.24)	(1.01)
Male	0.174***	0.156**	0.147**	0.228***
	(2.67)	(2.04)	(2.27)	(3.11)
White	0.151	0.065	0.206	0.224
	(1.27)	(0.51)	(1.07)	(1.52)
Firstborn	0.013	0.108	-0.027	-0.037
	(0.21)	(1.35)	(0.38)	(0.45)
Lone parent	0.048	0.044	0.015	0.025
	(0.82)	(0.63)	(0.18)	(0.24)
Mother <20 at birth	0.363***	0.309***	0.370***	0.413***
	(4.37)	(2.86)	(3.19)	(4.32)
Mother <30 at birth	0.141**	0.114	0.161**	0.150**
	(2.33)	(1.37)	(2.16)	(2.48)
Mother degree	-0.076	-0.071	0.037	-0.188*
	(0.85)	(0.61)	(0.29)	(1.91)
Mother A level	-0.076	-0.179	0.112	-0.198
	(0.70)	(1.32)	(0.89)	(1.41)
Mother O level	-0.033	-0.034	0.032	-0.094
	(0.51)	(0.38)	(0.37)	(1.33)
Mother other qualification	-0.125	-0.186	-0.036	-0.150
	(1.33)	(1.51)	(0.37)	(1.50)
Mother employed	-0.130***	0.017	-0.252***	-0.146*
	(2.72)	(0.30)	(3.27)	(1.82)
Household poverty	0.003	0.221***	-0.062	-0.140
	(0.05)	(2.95)	(0.64)	(1.54)
Low birth weight	0.355***	0.504***	0.284**	0.199
	(3.45)	(5.23)	(2.25)	(1.34)
Multiple birth	0.098	-0.054	0.140	0.357
	(0.35)	(0.17)	(0.42)	(1.05)
Garden	-0.069	-0.229	-0.004	0.314*
	(0.51)	(1.46)	(0.02)	(1.73)
Mother smoke	0.085	0.095	0.100	0.073
	(1.60)	(1.30)	(1.47)	(1.10)
Log of number in household	0.096	0.201	-0.029	0.093
	(1.09)	(1.51)	(0.21)	(0.66)
Mother long-term ill	0.183***	0.133*	0.234***	0.178**
	(3.70)	(1.88)	(3.27)	(2.38)
Mother depression	0.147**	0.144**	0.119*	0.179**
	(2.33)	(2.13)	(1.69)	(2.14)
Observations	6207	2558	1855	1794

Notes to table: Data are weighted by weight1. Sample is restricted to a single cohort member per family where the natural mother is the main carer at all productive responses. The sample is also restricted to children born and resident in Wales at the time of interview. Disadvantaged area refers to area at MCS1. Sample refers to unweighted number of observations.

Table 5.25. Multivariate analysis of intra-regional differences in child general health.

	General Health at Age 5	
Disadvantaged area	-0.257***	-0.109*
	(4.59)	(1.70)
Age	1.382*	1.546**
	(1.96)	(2.13)
Age squared	-0.036*	-0.040**
	(1.98)	(2.14)
Male	-0.182***	-0.166**
	(2.97)	(2.65)
White	0.299**	0.384**
	(2.03)	(2.41)
Firstborn	-0.116**	-0.153***
	(2.41)	(2.76)
Lone parent		0.051
		(0.64)
Mother <20 at birth		-0.010
		(0.11)
Mother <30 at birth		-0.133**
		(2.20)
Mother degree		0.310***
		(3.91)
Mother A level		0.101
		(0.96)
Mother O level		0.062
		(0.74)
Mother other qualification		0.033
		(0.40)
Mother employed		0.206***
		(2.69)
Household poverty		-0.096
		(1.08)
Low birth weight		-0.102
		(0.82)
Multiple birth		0.102
		(0.27)
Garden		-0.088
		(0.54)
Mother smoke		-0.037
		(0.51)
Log of number in household		-0.050
		(0.33)
Mother long-term ill		-0.200***
		(2.80)
Mother depression		-0.243***
		(4.50)
Cut point 1	11.573*	13.154*
	(1.68)	(1.82)
Cut point 2	12.262*	13.894*
	(1.78)	(1.92)
Cut point 3	13.169*	14.854**
	(1.91)	(2.05)
Observations	2052	1795

Notes to table: Data are weighted by weight1. Sample is restricted to a single cohort member per family where the natural mother is the main carer at all productive responses. The sample is also restricted to children born and resident in Wales at the time of interview. Disadvantaged area refers to area at MCS1. Sample refers to unweighted number of observations. Estimation by ordered probit model.

Table 5.26 presents the corresponding results for measures of development which exhibit significant variation across areas. The first three columns relate to the naming vocabulary subtest of the BAS, whereas the final two columns relate to pattern construction and picture similarity respectively.[43] The unadjusted gap in raw BAS naming vocabulary score between the advantaged and disadvantaged area is nearly 3.5 points; however, after controlling for characteristics, the gap narrows to about 1 point and is no longer significant. As with the analysis of child health, the gap in the raw score is largely explained by the adverse characteristics that the children and their families from the disadvantaged area possess. There is, however, a residual negative effect of being from the disadvantaged area at age 5, which is equivalent to being more than two months less developed. At this age, area deprivation appears to be of similar importance to poverty within the household. The influence of the level of deprivation in the local area, at age 5, may suggest either there is a cumulative effect of being from a deprived area or that the characteristics of the neighbourhood become increasingly important as the child begins formal schooling.[44]

Given the influence of language identified in Hansen and Joshi (2007) and Hansen and Joshi (2008), an additional control, for children in households where Welsh is spoken, is included in this specification. There is a negative correlation between living in a household where Welsh is spoken and BAS naming vocabulary test scores (despite the test being offered in Welsh). Indeed, when using this particular measure of vocabulary, children in households where Welsh is spoken are found to be 6 months less developed at age 5. Further analysis (not reported) indicates that the effect is larger for households who mainly or solely speak Welsh relative to dual language Welsh-English households. It is also worth noting that the penalty associated with living in a household where Welsh is spoken is not as large as other dual language households, which is consistent with the evidence presented by Hansen and Joshi (2008).[45] [46]

The final two columns of the table consider the other two elements of the BAS score, namely pattern construction and picture similarity and both relate to the children when aged 5. In both cases the significant differences that were evident in the raw figures are removed by the inclusion of personal characteristics, suggesting that deprivation in the area of birth is not a significant determinant of problem solving skills or spatial awareness. The significant determinants of BAS pattern and picture scores are similar to the BAS naming vocabulary in that males perform significantly worse than females and that the education of the mother is particularly important.

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[43] Scores from the three different tests cannot be directly compared.

[44] Since we control only for area deprivation at birth, this would only hold if there is limited mobility between the disadvantaged and advantaged areas.

[45] Since children in rural areas are more likely to live in a household where Welsh is spoken it may be that our control for Welsh language is in part capturing the influence of living in a rural area. However, including a control for the urban/rural nature of the area of residence in this model does not affect the influence of living in a Welsh speaking household. The urban/rural nature of the area does not have a significant effect on BAS scores.

[46] The influence of Welsh speaking households (which are not controlled for in the cross country analysis) may explain some of the influence of living in Wales identified in Section 5.2.1. Sensitivity analysis finds the effect of living in Wales is reduced but it remains negative and significant even after controlling for living in a dual language household.

Table 5.26. Multivariate analysis of intra-regional differences in cognitive ability scores.

	BAS				
	Naming Vocabulary			Pattern construction	Picture similarity
	Pooled	3 years	5 years	5 years	5 years
Constant	-7.394	-101.088**	-28.386	33.830	-44.982
	(0.85)	(2.05)	(0.29)	(0.24)	(0.51)
Disadvantaged area	**-0.915**	**0.020**	**-1.915*** **	**-0.026**	**-0.845**
	(1.32)	**(0.02)**	**(2.91)**	**(0.02)**	**(1.19)**
Age	9.392***	23.731***	10.558	2.617	11.326
	(8.73)	(3.08)	(1.05)	(0.18)	(1.25)
Age squared	-0.167***	-0.760**	-0.203	0.007	-0.256
	(4.85)	(2.51)	(0.79)	(0.02)	(1.11)
Male	-2.346***	-4.302***	0.277	-1.940***	-1.084**
	(3.67)	(6.25)	(0.38)	(2.69)	(2.27)
White	3.498**	3.013	2.859	3.418	2.118
	(2.03)	(1.27)	(1.45)	(1.58)	(1.58)
Firstborn	2.844***	2.354***	2.942***	0.920	1.621**
	(5.17)	(3.36)	(4.32)	(0.93)	(2.57)
Lone parent	-3.043***	-3.172***	-2.541***	-2.384*	0.214
	(5.01)	(3.05)	(3.70)	(1.83)	(0.24)
Mother <20 at birth	-3.419***	-3.330***	-3.302***	-1.156	-1.195
	(3.13)	(2.67)	(2.73)	(0.72)	(1.41)
Mother <30 at birth	-0.530	-0.392	-0.657	-0.237	-0.735
	(0.87)	(0.51)	(0.86)	(0.25)	(1.49)
Mother degree	6.312***	4.996***	5.074***	4.616***	3.619***
	(6.53)	(4.65)	(4.51)	(2.89)	(3.30)
Mother A level	5.418***	4.476***	4.212**	4.721***	2.570**
	(3.60)	(2.73)	(2.53)	(2.78)	(2.08)
Mother O level	2.937***	2.094**	2.301***	2.968*	1.891**
	(4.29)	(2.22)	(2.90)	(1.98)	(2.02)
Mother other qualification	1.277	0.775	0.721	2.500	1.241
	(1.30)	(0.59)	(0.63)	(1.31)	(1.23)
Mother employed	0.242	0.557	-0.199	1.458	0.286
	(0.41)	(0.61)	(0.38)	(1.30)	(0.39)
Household poverty	-2.700***	-2.802***	-2.006**	-0.522	-0.935
	(3.86)	(3.28)	(2.44)	(0.35)	(1.09)
Low birth weight	-0.539	-0.249	-0.782	-2.608	-0.308
	(0.41)	(0.13)	(0.60)	(1.10)	(0.25)
Multiple birth	-4.374	-2.440	-6.968**	-0.114	-2.023
	(1.50)	(0.69)	(2.04)	(0.03)	(1.12)
Garden	0.067	-1.299	0.959	3.070	2.324
	(0.06)	(0.90)	(0.62)	(1.16)	(1.20)
Mother smoke	-0.552	-0.123	-0.355	-2.779***	-1.009
	(0.84)	(0.14)	(0.49)	(3.01)	(1.64)
Log of number in household	-5.235***	-4.373***	-4.908***	-2.893	-0.626
	(4.48)	(2.84)	(3.81)	(1.31)	(0.52)
Mother long-term ill	0.544	0.342	1.112	-0.576	0.093
	(0.80)	(0.30)	(1.57)	(0.61)	(0.15)
Mother depression	-0.104	0.253	-0.421	-1.232	0.288
	(0.15)	(0.28)	(0.59)	(1.12)	(0.53)
Welsh speaking	-3.369***	-1.273	-5.035***	-1.119	1.331*
	(3.24)	(0.84)	(5.52)	(1.40)	(1.79)
Daily support reading		6.812***			
		(4.51)			

Weekly support reading		3.991**			
		(2.60)			
Library		1.305			
		(1.55)			
Support alphabet		2.452***			
		(2.94)			
Support numbers		0.530			
		(0.24)			
Regular bedtime		0.954			
		(0.95)			
Support reading			11.172***		
			(5.09)		
Support writing			-0.155		
			(0.13)		
Support numbers			-1.830		
			(1.37)		
Regular term bedtime			2.385**		
			(2.27)		
Observations	3557	1792	1763	1762	1767
R-squared	0.63	0.19	0.16	0.07	0.06

Notes to table: See notes to table 5.24.

Table 5.27 presents coefficients from a probit model where the dependent variable indicates abnormal child behaviour. In the pooled model, even after controlling for child and parental characteristics, the influence of area level deprivation is significant, raising the probability of behavioural problems by 1.5 percentage points.[47] However, characteristics of the child and family do explain the majority of the 5 percentage point raw difference. In contrast to the results using the BAS naming vocabulary scores, by age 5, area level deprivation has no significant influence on behaviour. This is surprising, given child behaviour may also be expected to be influenced by his/her peer group, which may become increasingly important as the child ages. However, this is consistent with the reduced significance of household financial resources, as measured by household poverty, at age 5.

In terms of characteristics, males are significantly more likely to have behavioural problems than females, although, consistent with the results from the BAS score, there is evidence that males catch up by age 5. In terms of parental characteristics, maternal education appears to be most important, a child with a mother who has at least A level qualifications is nearly 3 percentage points less likely to have behavioural problems. Maternal employment is also negatively associated with abnormal behaviour, although this may reflect unobservables correlated with employment, such as motivation, or the presence of formal routines within the household. This result, clearly, does not support the argument that maternal employment has a detrimental impact on child development.[48]

[47] When this model is estimated separately by gender (results are not reported), it is interesting to note that it is particularly the behaviour of female children that is sensitive to area deprivation.
[48] The results are not sensitive if the control for maternal employment at the time of interview is replaced with employment at MCS1.

Table 5.27. Multivariate analysis of intra-regional differences in child behavioural problems.

	Pooled	3 years	5 years
Constant	-5.052***	5.952	4.447
	(3.05)	(0.74)	(0.25)
Disadvantaged area	0.246***	0.294**	0.209
	(2.87)	(2.35)	(1.55)
Age	0.461**	-1.324	-0.552
	(2.10)	(1.07)	(0.30)
Age squared	-0.016**	0.059	0.012
	(2.20)	(1.20)	(0.25)
Male	0.226**	0.288**	0.164
	(2.49)	(2.04)	(1.33)
White	0.180	-0.158	-
	(0.73)	(0.65)	-
Firstborn	0.053	-0.030	0.148
	(0.60)	(0.21)	(1.47)
Lone parent	0.188	0.082	0.301*
	(1.40)	(0.51)	(1.79)
Mother <20 at birth	0.220	0.285	0.113
	(1.66)	(1.25)	(0.62)
Mother <30 at birth	0.032	-0.030	0.081
	(0.31)	(0.20)	(0.47)
Mother degree	-0.503***	-0.444**	-0.561**
	(3.19)	(2.12)	(2.12)
Mother A level	-0.659***	-1.194***	-0.442
	(2.87)	(3.27)	(1.56)
Mother O level	-0.354***	-0.275**	-0.449**
	(3.11)	(2.09)	(2.42)
Mother other qualification	-0.098	-0.146	-0.043
	(0.63)	(0.86)	(0.21)
Mother employed	-0.456***	-0.398***	-0.523***
	(4.65)	(3.04)	(2.93)
Household poverty	0.123	0.269**	-0.044
	(1.15)	(2.21)	(0.27)
Low birth weight	0.237	0.439**	-0.005
	(1.46)	(2.21)	(0.02)
Multiple birth	-0.465	-	0.124
	(1.26)	-	(0.31)
Garden	-0.240	0.093	-0.692*
	(0.63)	(0.25)	(1.86)
Mother smoke	0.115	0.097	0.169
	(1.15)	(0.84)	(1.11)
Log of number in household	0.149	-0.142	0.508**
	(1.08)	(0.66)	(2.30)
Mother long-term ill	0.242***	0.199	0.303***
	(2.87)	(1.37)	(2.83)
Mother depression	0.111	0.127	0.077
	(1.26)	(0.99)	(0.65)
Observations	2731	1276	1455

Notes to table: See notes to Table 5.24.

Neighbourhood effects

The influence of neighbourhood effects are also briefly considered at the intra-regional level (full results are not reported). The simple control for advantage/disadvantage in the local area is replaced with two alternative measures of local area deprivation, namely the representation of socio-economic groups in the local population and relative values of the Welsh Index of Multiple Deprivation. Consistent with the previous analysis, these features of the local area have no influence over the measures of child health. There is some evidence that local area characteristics are important for the naming vocabulary subtest of the BAS, with a concentration in the highest social group (*higher and intermediate managerial, administrative and professional*) or lower levels of deprivation being associated with higher scores. However, local area characteristics play a more important role in child behaviour, with higher concentrations in 1) *higher and intermediate managerial, administrative and professional* and 3) *skilled manual*, or lower levels of deprivation reducing the probability of a child exhibiting behavioural problems.

Summary

The effects of living in Wales on child health remain significant after introducing a wide range of controls for parental and child characteristics. This is unsurprising since the characteristics of children and parents show relatively limited variation across countries. The high prevalence of obesity, accidents and non-accident hospital admissions in Wales (relative to other countries) is not a result of differences in the composition of the population. A child with similar personal characteristics and family background would be more likely to be obese, have an accident which required medical attention and be admitted to hospital for a non-accident health problem if they were resident in Wales.

In contrast, differences in the characteristics of children and their families are important in explaining the difference in health and development outcomes between children from in the more and less deprived areas in Wales. For both indicators of health, namely hospital admissions and maternal reported child general health, the influence of area deprivation diminishes once we control for child and parental characteristics. In terms of hospital admissions, improving the characteristics of children and their family environment will remove any difference between those from an area classified as relatively deprived. In terms of development, the influence of area deprivation is moderated by controlling for the characteristics of the child and family. Pattern and picture BAS subtest scores show no independent relationship with area deprivation, while BAS naming vocabulary scores are negatively associated with area deprivation. Consistent with this, the BAS measure is more closely linked to financial resources of the household. Area level deprivation also has an important influence on child behaviour, at least at age 3.

6. Summary and Conclusions

There is a growing consensus that differences in cognitive ability which stem from early childhood determine a range of socio-economic outcomes in later life (see, for example, Cunha and Heckman, 2007). Adult outcomes have also been found to be adversely affected by poor health in childhood (see, for example, Case *et al*. 2005). As such, identifying and understanding the reasons for differences in child health and development between Wales and the rest of the UK may be important in understanding cross country disparities in a future generation of adults.

This study investigates child health and development in Wales using the Millennium Cohort Study which traces the lives of children born in the UK in 2000/1. One of its key aims is to provide sufficient data from which robust evidence on all 4 UK countries can be developed. We utilise this element of the data and focus on identifying and explaining differences in child health and cognitive development between Wales and the rest of the UK. This report uses information from the first three sweeps of the MCS and thus provides information about development in early childhood, that is, when the cohort is between 9 months and 5 years old.

Child Health

Overall, cross country differences in child health by age 5 are relatively modest, with most indicators suggesting there is no significant difference between Wales and other countries of the UK. There are, however, a number of exceptions:

- Children in Wales are significantly more likely to be overweight or obese compared to their counterparts in England and Scotland.
- Children in Wales are significantly more likely to have had an accident for which medical attention was sought than in other countries of the UK.
- Children in Wales are significantly more likely to have been admitted to hospital for a non-accident health problem than in other countries of the UK.

Further examination of regional differences in these measures shows that the incidence of health problems among children in Wales is more similar to those in Northern England (North East and North West regions).

Are cross country differences in child health a consequence of differences in the characteristics of children and their family?

The characteristics of the child and their family show relatively limited variation across countries. There are some exceptions, for example, at 9 months of age, children in Wales are more likely to have a mother who is a lone parent, a mother who is aged less than 20 at childbirth and they are more likely to live in a low income household than in England or Scotland.

Multivariate analysis suggests that only a relatively small part of the differences in child health outcomes is explained by variation in the characteristics of the children and their families between Wales and the rest of the UK. Therefore, a child with similar personal characteristics and family background would be more likely to be obese, have an accident requiring medical attention and be admitted to hospital for a non-accident health problem if they were resident in Wales. This 'Welsh effect' could reflect differences in access to services, national health policies or cultural differences across countries which have not been controlled for in this analysis.[49] The conclusion is not that child and family characteristics are unimportant, but that focusing on these alone will not eliminate the cross country early childhood gaps in these indicators. For example, a child with identical observable personal and maternal characteristics is 3 percentage points more likely to be overweight or obese if he/she resident in Wales than in England. A child resident in Wales is also 2 percentage points more likely to have had an accident and nearly 7 percentage points more likely to have had a non-accident hospital admission. The magnitude of this final effect in particular is worth noting, since increasing the qualifications of a child's mother from no qualifications to degree level would only decrease his/her risk of a non-accident hospital admission by 3.5 percentage points.

Child Development

The cognitive development indicators show less consistent variation across countries, with the exception that children in Scotland are relatively more developed (see Dex *et al*. 2008a). Children in Wales are not consistently less developed relative to those in England on entry to formal schooling. However, multivariate analysis of the naming vocabulary subtest of the British Ability Scales indicates that, after controlling for differences in the characteristics of the children and their parents across countries, children in Wales are significantly less developed. The gap is evident at age 5 years where children in Wales are about 2 points (or about 2.5 months) less developed. The development of this country specific gap between the ages of 3 and 5 is of concern, since it may suggest this gap will widen in the future. Monitoring the interaction between the gap in BAS scores and formal schooling is thus important.

Variation in child health and development by area deprivation

Within Wales, even by age 5, significant and more dramatic differences exist between children who entered the sample at MCS1 (at age 9 months) from different areas defined by economic deprivation. Measures of hospital admissions and parental-reported child general health indicate that children from the deprived area in Wales have inferior health outcomes. However, the measures of obesity and accidents which were significantly higher in Wales show more limited variation by area deprivation, consistent with the high

[49] Introducing further controls for the characteristics of the local area does not eliminate the 'Welsh effect'.

prevalence being an “all Wales phenomenon”. In terms of development, a consistent picture emerges whereby children from the disadvantaged area have inferior outcomes, virtually all of which widen by age 5. Indeed, at age 5 and the start of formal schooling, regardless of the precise measure of cognitive development or behaviour used, children from the more deprived area have already fallen behind. For example:

- At age 5, a child who entered the sample from the deprived area in Wales is nearly 5 months less developed on the naming vocabulary subtest of the BAS which aims to test verbal communication.
- At age 5, a child who entered the sample from the deprived area in Wales is 3 months less developed on the picture similarity subtest of the BAS which aims to test pictorial reasoning.
- At age 5, a child who entered the sample from the deprived area in Wales is 1 month less developed on the pattern construction subtest of the BAS which aims to test spatial awareness.
- At age 5, the Strengths and Difficulties Questionnaire also suggests children who entered the sample from the deprived area are more than twice as likely to have abnormal behaviour.

Are these differences in child health between more and less deprived areas a consequence of differences in the characteristics of children and their family?

Children from the disadvantaged area are more likely to live in a lone parent family, have a mother under 20, have a mother with no or low qualifications, have parents out of employment and live in a household with low income. After controlling for personal and parental characteristics, the effect of local area deprivation on child health (as measured by hospital admissions) is eliminated and the impact on child development and behaviour is considerably reduced. As such, much of the headline difference in outcomes between areas actually reflects the differences in the characteristics of children (and families) rather than the actual influence of the area or neighbourhood in which they are from.[50] One solution to the geographic concentration of disadvantage in child health and development would be to improve the characteristics (and behaviour) of their parents (through, for example, education). This is entirely consistent with parenting development policies highlighted by Waldfogel and Washbrook (2008) which would need to be spatially targeted. For some indicators of child development (BAS naming vocabulary subtest) and child behaviour, deprivation in the local area has a residual negative effect over and above the effect of the characteristics of the child and its family. For example, a child with identical personal and family characteristics would be over 1.5 percentage points more likely to have abnormal behaviour if he/she is from the deprived area, relative to a more advantaged area, suggesting the importance of social networks or peer group effects.

[50] Similar conclusions can be made if local controls for area characteristics are included in the models. It is the characteristics of the family (and not the neighbourhood) that are most important. Further, neighbourhood characteristics are more important for child development (and particularly behaviour) than child health.

Overarching Themes

Throughout the multivariate analysis maternal characteristics are consistently correlated with the health and development of their child. Although there are exceptions, the health and education of the mother generally has a strong positive correlation with that of their child. For indicators of child health, maternal health has a dominant role consistent with Propper *et al*. (2004) and for indicators of child development maternal education is particularly important. The magnitude of some of these effects is worth noting. A child with a mother who was obese before pregnancy is 12 percentage points more likely to be overweight or obese between at age 5. At age 5, a child with a mother who is educated to degree level has, on average, 10 points higher on BAS naming vocabulary score, which is roughly equivalent to being 12 months more advanced in terms of development. As such, policies aimed at improving the level of education and health of adults (mothers) generally will have a considerable positive intergenerational benefit over and above the direct benefit to the individuals themselves. The effects of these improvements will also cumulate over time through successive generations. Of course, the reverse is also true, in that lower levels of educational attainment in adults in Wales will impact negatively on child development, their economic performance as adults and the future performance of the Welsh economy. As such, while it would seem plausible for the Welsh Assembly Government to aim to eliminate variation in child outcomes on the basis of "where they live" (*Fair Future for our Children,* page 1), it is virtually impossible to achieve parity on the basis of "family circumstances" (*Fair Future for our Children,* page 1).

There has been a policy focus on reducing low income and child poverty in Wales (see, for example, *A Fair Future for our Children,* Welsh Assembly Government) and in the rest of the UK. There is no doubt that child outcomes are highly correlated with family income, but multivariate analysis shows the intense focus on poverty may be misplaced. After controlling for a wide range of potential determinants of child outcomes, household poverty is not found to affect the probability of a childhood accident, hospital admission or obesity.[51] This is not inconsistent with previous studies on child health see, for example, Propper *et al*. (2004). Furthermore, where poverty has an independent effect (on cognitive development) its influence is reduced after controlling for other family characteristics. For example, at age 5, the difference in BAS naming vocabulary score between children living in poverty and those not is the equivalent of 9 months development. After controlling for child and family characteristics a child living in poverty is found to be 3 months less developed. Therefore, increasing a family's income alone may not improve the outcomes of children as much as simple correlations suggest, because families with high income also tend to exhibit more favourable parental and parenting characteristics. As such, policies aimed only at increasing household income are unlikely to be as successful unless they tackle the characteristics of the individuals that explain their low income status.

[51] These results are not sensitive to the precise measure of household income or poverty utilised.

When using simple indicators of maternal employment at the time of interview there is generally either no association or a positive association between maternal employment and child health, development and behaviour. Clearly maternal employment may pick up unobserved influences including maternal motivation and is not necessarily causal in effect, but there is certainly no evidence to suggest maternal employment is detrimental to child outcomes.[52] More detailed investigation to examine the nature and timing of employment and to examine differences in the impact of employment between socio-economic groups is, however, warranted.

Future Research

The MCS is a comprehensive data source on indicators of child health and development, parental and family characteristics. There are, therefore, potentially important measures of child health and parental characteristics available in the MCS that have not been examined here. In particular, future research could consider the role of the characteristics of the partner (father), of school or pre-school care and of the extended family. Further, in many cases the MCS provides more detailed information on some of the headline indicators which have been examined here. For example, it is possible to examine the type, precise timing of the accident or hospital admission and what type of healthcare was received. This type of information may improve our understanding of the nature of the country specific effects identified.[53]

There are also many other quite separate issues that could be considered using these data. For example, it is possible to use the panel nature of the data to investigate changes in household composition and/or partnership formation in Wales, or to consider return to work decision amongst new mothers. This report illustrates the potential this survey has for social and economic investigation in Wales. Indeed, its value will only increase as additional information is collected on the children as they age. As part of monitoring how differences between countries develop over the lifecycle, additional data will allow researchers to consider the impact of formal full-time schooling on child outcomes between countries. The next sweep of data (MCS4) based on the children at age 7 will be available shortly. Further, in the longer-term it will be possible to examine the transition into adulthood and ultimately, therefore, the relationship between childhood outcomes and socio-economic status in adulthood.

[52] The same is true if the measure of maternal employment is replaced with a measure of being at work or in full-time education at 9 months.

[53] This restricts the size of the sample considerably since, by definition, the information is only provided by those who have had an accident or hospital admission.

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Data

4683 Millennium Cohort Study: First Survey, 2001-2003
5350 Millennium Cohort Study: Second Survey, 2003-2005
5795 Millennium Cohort Study: Third Survey, 2006
5730 Millennium Cohort Study, 2001-2005: Geographical Identifiers, Output Area Level: Special Licence Access. Restricted Access Data.

Appendix

Table A.1. Multivariate analysis variable definitions

Variable	Definition	UK	Wales
Overweight	Dummy variable which equals 1 if child is overweight or obese as defined by age and gender adjusted BMI critical values; 0 otherwise	0.23	0.25
Total accident	Dummy variable which equals 1 if child has had an accident (for which medical attention was sought) before the time of interview; 0 otherwise	0.29	0.32
Total hospital	Dummy variable which equals 1 if child has been admitted to hospital for a non-accident health problem before the time of interview; 0 otherwise	0.24	0.31
BAS naming vocabulary score	Ability adjusted score on the naming vocabulary subtest of the British Ability Scales.	90.80	91.07
BAS naming vocabulary T score	T scores (mean=50, standard deviation=10) compare BAS naming vocabulary score to standardisation sample.	51.84	51.76
BAS picture score	Ability adjusted score on the picture similarity subtest of the British Ability Scales.	82.13	82.60
BAS picture T score	T scores (mean=50, standard deviation=10) compare BAS picture score to standardisation sample.	55.56	55.30
BAS pattern score	Ability adjusted score on the pattern construction subtest of the British Ability Scales.	87.48	89.99
BAS pattern T score	T scores (mean=50, standard deviation=10) compare BAS pattern score to standardisation sample.	50.39	50.61
Total strengths and difficulties score	Total score (sum of elements of 4 domains) from the strengths and difficulties questionnaire.	7.88	7.93
Behavioural problems	Dummy variable which equals 1 if total strengths and difficulties score is greater than 17; 0 otherwise.	0.06	0.06
England	Dummy variable which equals 1 if child is resident in England at time of interview; 0 otherwise	0.63	-
Wales	Dummy variable which equals 1 if child is resident in Wales at time of interview; 0 otherwise	0.15	-
Scotland	Dummy variable which equals 1 if child is resident in Scotland at time of interview; 0 otherwise	0.12	-
Northern Ireland	Dummy variable which equals 1 if child is resident in Northern Ireland at time of interview; 0 otherwise	0.10	-
MCS1	Dummy variable which equals 1 if observation taken at MCS1 (about 9 months of age); 0 otherwise	0.38	0.39
MCS2	Dummy variable which equals 1 if observation taken at MCS2 (about 3 years of age); 0 otherwise	0.32	0.31
MCS3	Dummy variable which equals 1 if observation taken at MCS3 (about 5 years of age); 0 otherwise	0.31	0.30
Male	Dummy variable equals 1 if child is male; 0 otherwise	0.51	0.52
Age	Child age at interview in days	1058.76	1054.32
White	Dummy variable equals 1 if child is white; 0 otherwise	0.84	0.97
Firstborn	Dummy variable equals 1 if child has no natural siblings in household at time of interview, 0 otherwise	0.49	0.52
Lone parent	Child in household where nobody is eligible for partner interview, 0 otherwise	0.18	0.21
Mother age at birth <20	Dummy variable equals 1 if child's mother was aged less than 20 at time of birth; 0 otherwise	0.12	0.15
Mother age at birth 20-30	Dummy variable equals 1 if child's mother was aged between 20 and 30 at time of birth interview; 0 otherwise	0.49	0.50

Mother age at birth >30	Dummy variable equals 1 if child's mother was aged less than 20 at time of birth; 0 otherwise	0.39	0.34
Mother Degree	Dummy variable equals 1 if child's mother has highest qualification of degree of higher degree at MCS1 interview; 0 otherwise	0.26	0.23
Mother A level	Dummy variable equals 1 if child's mother has highest qualification of A level or equivalent at MCS1 interview; 0 otherwise	0.10	0.08
Mother O level	Dummy variable equals 1 if child's mother has highest qualification of O level or equivalent at MCS1 interview; 0 otherwise	0.34	0.37
Mother other qual	Dummy variable equals 1 if child's mother has highest qualification of other at MCS1 interview; 0 otherwise	0.13	0.13
Mother no qual (base)	Dummy variable equals 1 if child's mother has no qualifications at MCS1 interview; 0 otherwise	0.18	0.19
Mother employed	Dummy variable equals 1 if child's mother is in employment at time of interview; 0 otherwise	0.52	0.54
Poverty	Dummy variable equals 1 if child's household has equivalised income less than 60% of median in that sweep; 0 otherwise[54]	0.32	0.35
Low birth weight	Dummy variable which equals 1 if child's birthweight is less than 2.5kg; 0 otherwise	0.07	0.06
Multiple birth	Dummy variable which equals 1 if child is part of a multiple birth (twins/triplets); 0 otherwise	0.01	0.01
Garden	Dummy variable which equals 1 if child lives in house with access to a garden at interview; 0 otherwise	0.91	0.97
Mother smoke	Dummy variable which equals 1 if child's mother a smoker at interview; 0 otherwise	0.30	0.37
Log number in household	Log of total number of people in household at interview.	1.38	1.35
Not breast fed.	Dummy variable which equals 1 if child never breastfed or breastfed for less than 1 week; 0 otherwise	0.44	0.53
Breastfed <1 month	Dummy variable which equals 1 if child was breastfed for more than 1 week but less than 1 month; 0 otherwise	0.10	0.10
Breastfed 1-3 months	Dummy variable which equals 1 if child was breastfed for between 1 and 3 months; 0 otherwise	0.14	0.13
Breastfed 3-6 months	Dummy variable which equals 1 if child was breastfed for between 3 and 6 months; 0 otherwise	0.13	0.10
Breastfed 6-9 months	Dummy variable which equals 1 if child was breastfed for between 6 and 9 months; 0 otherwise	0.06	0.05
Breastfed 9 months + (base)	Dummy variable which equals 1 if child was breastfed for 9 months or more; 0 otherwise	0.12	0.09
Solid food	Dummy variable which equals 1 if the child was fed solid foods before 3 months of age; 0 otherwise	0.26	0.32
Mother long-term illness	Dummy variable which equals 1 if child's mother self-reports a limiting long-term health problem at interview; 0 otherwise	0.22	0.24
Mother depression	Dummy variable which equals 1 if child's mother has been diagnosed with depression at first interview; 0 otherwise	0.25	0.28
Mother	Dummy variable which equals 1 if child's mother has	0.02	0.01

[54] Equivalised income adjusts reported household income for the composition of the household. In a similar manner to Hansen and Joshi (2007) family income is standardised on the basis of a couple with no children. The main respondent has a weight of 0.61, a partner respondent has a weight of 0.39 and each child has a weight of 0.23.

diabetes	been diagnosed with diabetes at first interview; 0 otherwise		
Mother underweight	Dummy variable which equals 1 if child's mother has a BMI of less than 18.5 before pregnancy; 0 otherwise	0.06	0.05
Mother normal weight	Dummy variable which equals 1 if child's mother has a BMI between 18.5 and 25 before pregnancy; 0 otherwise	0.65	0.64
Mother overweight	Dummy variable which equals 1 if child's mother has a BMI between 25 and 30 before pregnancy; 0 otherwise	0.20	0.21
Mother obese	Dummy variable which equals 1 if child's mother has a BMI of 30 or more before pregnancy; 0 otherwise	0.09	0.09
Physical activity (2)	Dummy variable which equals 1 if someone at home helps child to learn sport etc; 0 otherwise	0.79	0.79
Physical activity (3)	Dummy variable which equals 1 if child's mother plays physically active games with child at least once or twice a week; 0 otherwise	0.60	0.65
Physical activity at school (3)	Dummy variable which equals 1 if child does sport or exercise classes at least once a week; 0 otherwise	0.52	0.54
Fruit veg	Dummy variable which equals 1 if child has fresh fruit or vegetables at least once a day; 0 otherwise	0.97	0.97
Fruit- 0 (base)	Dummy variable which equals 1 if child eats 0 portions of fruit a day; 0 otherwise	0.04	0.03
Fruit- 1	Dummy variable which equals 1 if child eats 1 portion of fruit a day; 0 otherwise	0.17	0.17
Fruit-2	Dummy variable which equals 1 if child eats 2 portions of fruit a day; 0 otherwise	0.28	0.28
Fruit-3	Dummy variable which equals 1 if child eats 3 or more portions of fruit a day; 0 otherwise	0.49	0.51
TV (2)	Dummy variable which equals 1 if child watches TV or videos for 3 or more hours per day; 0 otherwise	0.18	0.22
TV (3)	Dummy variable which equals 1 if child watches TV or videos for 3 or more hours a day during term-time; 0 otherwise	0.15	0.16
Breakfast	Dummy variable which equals 1 if child eats breakfast everyday; 0 otherwise	0.92	0.91
Library	Dummy variable which equals 1 if parent reports child gets taken to the library; 0 otherwise.	0.41	0.35
Reading1 (2)	Dummy variable which equals 1 if parent reports child gets read to every day; 0 otherwise.	0.58	0.57
Reading2 (2)	Dummy variable which equals 1 if parent reports child gets read to less than daily but more than once a week; 0 otherwise.	0.35	0.35
Reading3 (2) (base)	Dummy variable which equals 1 if parent reports child gets read to less than once a week; 0 otherwise.	0.08	0.08
Alphabet	Dummy variable which equals 1 if parent reports child gets help to learn the alphabet at home; 0 otherwise.	0.81	0.83
Numbers	Dummy variable which equals 1 if parent reports child gets taught counting at home; 0 otherwise.	0.96	0.97
Bed (2)	Dummy variable which equals 1 if parent reports child has a regular bedtime (usually or always); 0 otherwise.	0.79	0.77
Bed (3)	Dummy variable which equals 1 if parent reports child has a regular term-time bedtime (usually or always); 0 otherwise.	0.89	0.88
Reading (3)	Dummy variable which equals 1 if parents report child gets help with reading, 0 otherwise	0.98	0.97

Writing (3)	Dummy variable which equals 1 if parents report child gets help with writing, 0 otherwise	0.91	0.91
Numbers (3)	Dummy variable which equals 1 if parents report child gets help with numbers, counting or adding up, 0 otherwise	0.93	0.94
Disadvantaged	Dummy variable which equals 1 if the child entered the survey from a disadvantaged neighbourhood; 0 otherwise[55]	-	0.69
Urban	Dummy variable which equals 1 if the child lives in an urban area; 0 otherwise[56]	-	0.76
Social group 1	Proportion of the super output area population who are *Higher and intermediate managerial / administrative / professional*.	-	0.17
Social group 2	Proportion of the super output area population who are *Supervisory, clerical, junior managerial / administrative / professional*	-	0.27
Social group 3	Proportion of the super output area population who are *Skilled manual workers*	-	0.17
Social group 4	Proportion of the super output area population who are *Semi-skilled and unskilled manual workers*		0.22
Social group 5	Proportion of the super output area population who are *On state benefit, unemployed, lowest grade workers*	-	0.17

Notes to table: Means relate to pooled sample (as appropriate to measure) and are unweighted.

[55] Disadvantaged neighbourhoods refer to the poorest quarter of wards defined using the Child Poverty Index for England and Wales

[56] Urban is defined using the 2005 Rural Urban Morphology Code.

Table A.2 Multivariate analysis of BAS naming vocabulary subtest (age adjusted T score).

	Pooled		3 years	5 years
Constant	48.135***	52.642***	42.162***	46.481***
	(79.02)	(61.69)	(32.08)	(31.87)
Wales	**-1.175*** **	**-0.982*** **	**0.014**	**-1.730*** **
	(3.05)	**(3.18)**	**(0.03)**	**(5.63)**
Scotland	1.044***	0.787***	1.540***	0.363
	(2.97)	(2.62)	(3.61)	(0.91)
Northern Ireland	0.448	0.588	1.403***	0.301
	(1.04)	(1.55)	(3.39)	(0.57)
Male	-1.683***	-1.654***	-2.618***	-0.515**
	(8.97)	(9.01)	(12.80)	(2.31)
White	7.825***	5.850***	5.571***	5.517***
	(12.72)	(13.35)	(11.13)	(11.07)
Firstborn	2.195***	1.631***	1.693***	1.510***
	(10.75)	(7.39)	(6.31)	(6.23)
Lone parent		-2.048***	-1.619***	-2.108***
		(7.78)	(4.25)	(6.32)
Mother <20 at birth		-2.819***	-2.096***	-3.365***
		(7.87)	(4.73)	(8.42)
Mother <30 at birth		-0.926***	-0.703***	-1.142***
		(4.68)	(2.94)	(4.93)
Mother degree		6.591***	4.474***	7.082***
		(17.50)	(10.29)	(15.02)
Mother A level		4.592***	3.558***	4.219***
		(11.37)	(8.19)	(8.27)
Mother O level		3.341***	2.458***	3.396***
		(9.69)	(6.55)	(8.48)
Mother other qualification		1.595***	0.872*	1.979***
		(3.95)	(1.89)	(4.21)
Mother employed		0.255	0.255	0.382
		(1.29)	(1.02)	(1.43)
Household poverty		-2.034***	-2.242***	-1.624***
		(8.76)	(7.56)	(4.89)
Low birth weight		-1.213***	-1.890***	-0.450
		(3.45)	(4.38)	(0.99)
Multiple birth		-0.602	-0.644	-0.585
		(0.77)	(0.70)	(0.64)
Garden		0.881**	1.082**	0.505
		(2.05)	(2.21)	(0.94)
Mother smokes		-0.073	0.258	0.034
		(0.37)	(1.04)	(0.14)
Log of number in household		-3.827***	-3.003***	-3.711***
		(9.95)	(6.11)	(7.72)
Mother long-term ill		-0.502***	-0.686***	-0.350
		(2.67)	(2.74)	(1.38)
Mother diagnosed depression		-0.049	0.225	-0.225
		(0.24)	(0.85)	(0.97)
Support reading				3.124***
				(3.41)
Support writing				0.925**
				(2.21)
Support numbers				0.216
				(0.41)
Regular term bedtime				2.003***

				(5.10)
Daily support reading			4.247***	
			(8.25)	
Weekly support reading			2.264***	
			(4.52)	
Library			1.159***	
			(5.38)	
Support Alphabet			0.814***	
			(2.76)	
Support numbers			-0.003	
			(0.00)	
Regular bedtime			1.058***	
			(3.58)	
MCS2	-4.852***	-5.194***		
	(25.99)	(26.54)		
Observations	27332	23321	11581	11588
R-squared	0.11	0.20	0.18	0.17

Notes to table: See notes to table 5.20.

Table A.3. Multivariate analysis of intra-regional differences in cognitive ability (age adjusted T scores).

	BAS				
	Naming Vocabulary			Pattern construction	Picture similarity
	Pooled	3 years	5 years	5 years	5 years
Constant	56.395***	47.600***	47.951***	50.235***	51.251***
	(26.62)	(16.20)	(15.35)	(16.93)	(15.26)
Disadvantaged area	**-0.584**	**0.107**	**-1.284*****	**0.001**	**-0.898**
	(1.18)	**(0.15)**	**(2.78)**	**(0.00)**	**(1.28)**
Male	-1.537***	-2.733***	0.084	-1.202***	-1.078**
	(3.40)	(5.66)	(0.16)	(2.91)	(2.51)
White	2.311*	1.764	2.191	2.504*	2.278*
	(1.96)	(1.13)	(1.48)	(1.91)	(1.96)
Firstborn	2.028***	1.644***	2.196***	0.353	1.579***
	(5.43)	(3.71)	(4.35)	(0.64)	(2.84)
Lone parent	-2.013***	-1.819**	-1.941***	-1.612**	0.533
	(4.75)	(2.63)	(3.90)	(2.23)	(0.65)
Mother <20 at birth	-2.396***	-2.257***	-2.550***	-1.370	-0.944
	(3.01)	(2.76)	(2.69)	(1.53)	(1.20)
Mother <30 at birth	-0.404	-0.347	-0.495	-0.409	-0.672
	(0.94)	(0.69)	(0.89)	(0.79)	(1.51)
Mother degree	4.249***	3.061***	3.807***	2.525***	3.219***
	(6.15)	(4.17)	(4.68)	(2.77)	(3.51)
Mother A level	3.599***	2.590**	3.125***	2.067**	1.947*
	(3.33)	(2.28)	(2.65)	(2.19)	(1.85)
Mother O level	1.883***	1.253**	1.621***	1.348	1.567**
	(3.92)	(2.02)	(2.98)	(1.63)	(2.02)
Mother other qualification	0.736	0.417	0.483	1.530	0.988
	(1.10)	(0.47)	(0.63)	(1.49)	(1.17)
Mother employed	0.182	0.519	-0.202	0.725	0.082
	(0.47)	(0.89)	(0.53)	(1.14)	(0.12)
Household poverty	-1.836***	-1.831***	-1.530**	-0.178	-1.215*
	(3.79)	(3.10)	(2.60)	(0.21)	(1.72)
Low birth weight	-0.466	-0.317	-0.685	-1.357	-0.031
	(0.51)	(0.23)	(0.71)	(1.12)	(0.03)
Multiple birth	-3.079	-1.523	-5.254**	-1.238	-2.876
	(1.59)	(0.67)	(2.17)	(0.69)	(1.56)
Garden	0.114	-0.742	0.870	0.947	1.917
	(0.14)	(0.73)	(0.76)	(0.77)	(1.10)
Mother smoke	-0.411	-0.151	-0.241	-1.433***	-0.961*
	(0.86)	(0.24)	(0.45)	(2.83)	(1.85)
Log of number in household	-3.752***	-2.882***	-3.812***	-1.976	-0.348
	(4.71)	(2.83)	(3.97)	(1.58)	(0.30)
Mother long-term ill	0.385	0.331	0.711	-0.153	0.223
	(0.85)	(0.45)	(1.38)	(0.28)	(0.39)
Mother depression	-0.244	-0.007	-0.461	-0.573	-0.017
	(0.50)	(0.01)	(0.92)	(0.92)	(0.03)
Welsh speaking	-2.378***	-0.794	-3.571***	-0.771*	1.376*
	(3.38)	(0.78)	(5.68)	(1.68)	(1.79)
Daily support reading		4.486***			
		(4.57)			
Weekly support reading		2.464**			
		(2.49)			
Library		0.764			
		(1.31)			

Support alphabet		1.669***			
		(2.69)			
Support numbers		0.270			
		(0.18)			
Regular bedtime		0.587			
		(0.87)			
Support reading			8.002***		
			(5.24)		
Support writing			-0.283		
			(0.33)		
Support numbers			-1.272		
			(1.25)		
Regular term bedtime			1.727**		
			(2.25)		
MCS 2	-3.690***				
	(9.99)				
Observations	3557	1792	1763	1762	1764
R-squared	0.14	0.15	0.15	0.05	0.05

Notes to table: See notes to table 5.24.

Table A.4. Neighbourhood effects.

	Any accident	Any hospital	Overweight/obese	BAS naming vocabulary
Constant	-2.009***	-1.779***	-0.739	-25.327***
	(12.08)	(11.64)	(1.49)	(5.24)
Wales	**0.079*****	**0.198*****	**0.125*****	**-1.186*****
	(2.64)	**(6.10)**	**(3.79)**	**(2.92)**
Age	0.196***	0.092***	0.046	10.218***
	(32.21)	(21.78)	(0.69)	(17.73)
Age squared	-0.005***	-0.002***	-0.002	-0.186***
	(20.69)	(13.66)	(0.86)	(9.97)
Male	0.199***	0.160***	-0.101***	-2.431***
	(8.86)	(6.48)	(3.50)	(8.80)
White	0.193***	0.053	-0.064	8.669***
	(5.31)	(1.09)	(1.39)	(13.10)
Firstborn	-0.010	0.032	0.035	2.399***
	(0.42)	(1.13)	(1.09)	(7.60)
Lone parent	0.007	0.046	-0.011	-2.917***
	(0.20)	(1.32)	(0.23)	(7.35)
Mother <20 at birth	0.241***	0.149***	-0.096*	-3.033***
	(5.84)	(3.22)	(1.73)	(5.43)
Mother <30 at birth	0.113***	0.075**	-0.086***	-0.734**
	(4.60)	(2.52)	(2.99)	(2.33)
Mother degree	0.097**	-0.088*	-0.059	8.137***
	(2.21)	(1.91)	(1.10)	(14.34)
Mother A level	0.104*	-0.089	-0.084	6.034***
	(1.92)	(1.55)	(1.24)	(9.18)
Mother O level	0.103***	-0.001	-0.037	4.392***
	(2.90)	(0.04)	(0.78)	(8.59)
Mother other qualification	0.064	-0.035	0.022	2.154***
	(1.51)	(0.82)	(0.40)	(3.58)
Mother employed	-0.026	-0.021	0.051*	0.668**
	(1.21)	(0.89)	(1.70)	(2.30)
Household poverty	-0.009	-0.005	-0.004	-2.643***
	(0.31)	(0.20)	(0.10)	(7.52)
Low birthweight	-0.094**	0.369***	-0.296***	-1.818***
	(2.38)	(7.26)	(4.74)	(3.30)
Multiple birth	-0.140	0.037	-0.201	-1.314
	(1.26)	(0.32)	(1.36)	(1.08)
Garden	-0.014	-0.002	-0.052	1.328*
	(0.37)	(0.05)	(0.88)	(1.93)
Mother smoke	0.013	0.059**	0.123***	0.324
	(0.53)	(2.02)	(3.85)	(1.04)
Log number in household	-0.172***	-0.019	-0.078	-5.219***
	(3.63)	(0.41)	(1.32)	(8.82)
Mother long-term ill	0.048**	0.119***	-0.098***	-0.459
	(2.27)	(4.74)	(3.52)	(1.60)
Mother depression	0.129***	0.121***		0.004
	(5.50)	(3.99)		(0.01)
Social group 1 (proportion)	0.002	-0.032	-0.141	6.473***
	(0.01)	(0.17)	(0.63)	(3.28)
Social group 2 (proportion)	-0.654***	0.116	-0.441*	7.765***
	(3.25)	(0.53)	(1.74)	(3.26)
Social group 3	-0.133	0.105	-0.227	0.872

(proportion)				
	(0.63)	(0.50)	(0.85)	(0.36)
Social group 4 (proportion)	0.041	0.613**	-0.388	-1.216
	(0.18)	(2.51)	(1.28)	(0.47)
Urban	0.052	0.024	0.020	-0.750
	(1.61)	(0.65)	(0.52)	(1.62)
Not breast fed			0.137***	
			(3.09)	
Breastfed <1 month			0.134**	
			(2.39)	
Breastfed 1-3 months			0.116**	
			(2.15)	
Breastfed 3-6 months			0.078	
			(1.59)	
Breastfed 6-9 months			0.104*	
			(1.74)	
Solid food 3 months			0.166***	
			(5.12)	
Mother underweight			-0.276***	
			(3.55)	
Mother overweight			0.315***	
			(9.75)	
Mother obese			0.527***	
			(11.62)	
Mother diabetes			0.219**	
			(2.17)	
Observations	31289	31296	17005	18126

Notes to table: Data are weighted by weight2. Sample is restricted to a single cohort member per family where the natural mother is the main carer at all productive responses. The sample is also restricted to children born and resident in Wales or England at the time of interview. All models pool data across ages. Social group refers to area at birth. Sample refers to unweighted number of observations.

Table A.5 Gender differences.

	Any accident		Any hospital		Overweight/obese		BAS naming vocabulary	
	Male	Female	Male	Female	Male	Female	Male	Female
Constant	-2.002***	-2.077***	-1.372***	-1.518***	-0.807	-0.953	-35.524***	-12.922**
	(15.49)	(14.43)	(10.56)	(11.58)	(1.19)	(1.49)	(5.08)	(2.43)
Wales	**0.069**	**0.091*** **	**0.224*** **	**0.193*** **	**0.091* **	**0.137*** **	**-1.288** **	**-1.314** **
	(1.44)	**(2.76)**	**(4.49)**	**(4.04)**	**(1.94)**	**(2.92)**	**(2.14)**	**(2.53)**
Scotland	-0.060	0.077*	-0.043	-0.059	0.057	0.045	0.767	1.128**
	(1.50)	(1.89)	(1.05)	(1.10)	(1.03)	(0.87)	(1.26)	(2.11)
Northern Ireland	-0.085**	-0.007	0.133**	0.083	0.216***	0.102*	0.914	1.403*
	(2.05)	(0.15)	(2.48)	(1.35)	(3.60)	(1.70)	(1.32)	(1.72)
Age	0.209***	0.178***	0.088***	0.087***	0.016	0.053	11.548***	9.066***
	(26.44)	(21.67)	(17.29)	(14.27)	(0.18)	(0.63)	(12.80)	(12.78)
Age squared	-0.005***	-0.004***	-0.002***	-0.002***	-0.001	-0.002	-0.222***	-0.155***
	(17.44)	(13.89)	(10.06)	(8.63)	(0.38)	(0.65)	(7.59)	(6.69)
White	0.181***	0.205***	0.068	-0.004	-0.059	-0.070	9.319***	8.948***
	(3.79)	(3.81)	(1.25)	(0.05)	(0.86)	(1.28)	(10.22)	(10.77)
First born	0.005	-0.034	0.025	0.027	0.043	0.017	2.086***	2.486***
	(0.14)	(1.04)	(0.69)	(0.70)	(1.02)	(0.37)	(4.66)	(6.43)
Lone parent	-0.025	0.042	0.067	0.006	-0.020	-0.000	-2.636***	-3.467***
	(0.55)	(0.89)	(1.31)	(0.12)	(0.32)	(0.01)	(4.38)	(6.43)
Mother <20 at birth	0.271***	0.255***	0.163**	0.130**	-0.049	-0.099	-3.842***	-4.227***
	(4.89)	(4.24)	(2.54)	(2.03)	(0.68)	(1.29)	(4.86)	(6.45)
Mother <30 at birth	0.085***	0.131***	0.103**	0.070*	-0.107**	-0.058	-1.502***	-1.251***
	(2.67)	(3.84)	(2.52)	(1.84)	(2.55)	(1.51)	(3.48)	(3.13)
Mother degree	0.003	0.120**	-0.161***	-0.097	0.016	-0.110	10.039***	9.305***
	(0.06)	(2.16)	(2.73)	(1.46)	(0.21)	(1.55)	(11.96)	(13.41)
Mother A level	0.076	0.025	-0.204***	-0.032	-0.057	-0.177*	6.690***	6.849***
	(1.14)	(0.37)	(3.13)	(0.42)	(0.66)	(1.96)	(6.82)	(8.93)
Mother O level	0.055	0.099**	-0.054	0.025	0.029	-0.101	5.062***	5.246***
	(1.17)	(2.09)	(1.08)	(0.45)	(0.43)	(1.63)	(6.25)	(8.54)
Mother other qualification	0.061	0.058	-0.033	-0.027	-0.018	0.046	2.125**	2.822***
	(1.09)	(1.04)	(0.56)	(0.40)	(0.22)	(0.61)	(2.35)	(3.74)
Mother employed	-0.026	-0.060*	-0.004	0.008	0.009	0.064*	0.905**	0.176
	(0.87)	(1.85)	(0.13)	(0.25)	(0.21)	(1.71)	(2.34)	(0.45)
Household poverty	-0.011	0.008	-0.050	0.084**	-0.001	-0.005	-2.970***	-3.249***
	(0.27)	(0.21)	(1.45)	(2.09)	(0.03)	(0.09)	(6.23)	(7.02)
Low birth weight	-0.074	-0.072	0.469***	0.354***	-0.330***	-0.308***	-1.723**	-2.118***
	(1.27)	(1.29)	(6.29)	(5.39)	(3.49)	(3.61)	(2.14)	(2.77)
Multiple birth	-0.079	-0.297**	-0.011	-0.072	-0.143	-0.336**	-1.214	-0.375
	(0.61)	(2.07)	(0.06)	(0.49)	(0.67)	(1.99)	(0.70)	(0.24)
Garden	-0.022	-0.004	-0.053	0.059	-0.052	-0.143**	0.152	2.617***
	(0.45)	(0.07)	(1.07)	(0.94)	(0.67)	(2.21)	(0.16)	(3.11)
Mother smokes	0.036	0.022	0.077*	0.054	0.161***	0.109**	-0.476	0.340
	(1.18)	(0.66)	(1.96)	(1.30)	(3.84)	(2.49)	(1.13)	(0.92)
Log of number in household	-0.186***	-0.137**	-0.017	-0.075	-0.099	-0.104	-5.293***	-6.056***
	(2.87)	(2.25)	(0.24)	(1.07)	(1.18)	(1.15)	(5.94)	(8.13)
Mother long-	0.103***	0.045	0.140***	0.077**	-0.084**	-0.077*	-1.077***	-0.403

term ill								
	(3.58)	(1.38)	(4.30)	(2.22)	(1.99)	(1.79)	(2.61)	(1.09)
Mother depression	0.144***	0.090**	0.079**	0.170***			-0.061	-0.110
	(4.14)	(2.59)	(2.23)	(4.17)			(0.14)	(0.25)
Not breast fed					0.073	0.144**		
					(1.14)	(2.27)		
Breastfed <1 month					0.169**	0.034		
					(2.14)	(0.43)		
Breastfed 1-3 months					0.038	0.123		
					(0.59)	(1.56)		
Breastfed 3-6 months					0.006	0.179**		
					(0.09)	(2.51)		
Breastfed 6-9 months					0.147**	0.028		
					(2.01)	(0.32)		
Solid food 3 months					0.192***	0.136***		
					(4.26)	(2.66)		
Mother underweight					-0.169	-0.346***		
					(1.58)	(3.95)		
Mother overweight					0.349***	0.316***		
					(8.05)	(7.04)		
Mother obese					0.532***	0.558***		
					(8.97)	(9.78)		
Mother diabetes					0.318**	0.226		
					(2.50)	(1.58)		
Observations	20683	19712	20689	19714	11185	10759	11863	11458

Notes to table: see notes to Table 5.20.