Childhood Obesity in Wales

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Introduction

The human capital, or the health, education and skills of the next generation, will be fundamental in determining their labour market success and the future prosperity of the Welsh economy. While it is today's children who will form this future generation economic analysis typically ignores this group until they reach working age. However, there is now a growing body of theoretical and empirical research which demonstrates that an individual's health and development in childhood is an important determinant of their later (adult) economic outcomes (see, for example, Case, Fertig and Paxson, 2005). Further, it is argued that early policy intervention is more effective in changing the fortunes of those from disadvantaged backgrounds, with the rate of return to policy interventions among young children being higher than those among adolescents (see, for example, Cunha and Heckman, 2007).

It is therefore interesting to ask if the disadvantage observed among adults in Wales actually stems from differences in childhood. Currently available data does not permit researchers to examine this question. It has, however, become possible to answer a different (but related) question. Instead of looking backwards at the childhood outcomes of adults, it is possible to look forwards to examine whether the health and development of children in Wales is different from their counterparts in the rest of the UK. This approach should facilitate the early identification of disadvantage which may then contribute to cross country differences in adult outcomes among a future generation. Indeed, this issue has been examined in a recent project "An Investigation into Regional Differences in Child Health and Cognitive Function" supported by the Economic Research Unit of the Welsh Assembly Government.[2] This paper provides a brief overview of some of the key findings in the report before focusing more specifically on one key indicator of child health, namely, childhood obesity. The main objective here, therefore, is to document and explore regional differences in childhood obesity and to examine characteristics of the child and its family that affect the risk of obesity.

Is Child Health and Cognitive Development different in Wales?

In the latest of the series of British birth cohort studies, the Millennium Cohort Study (MCS), there has been a boost to the sample of children in Wales, Scotland and Northern Ireland to facilitate cross country comparisons. Indeed, the MCS collects data on 19,244 families with children born in the Millennium of which 2,760 were sampled from Wales[3]. At the time of writing information is available on these children from birth until age 5. More specifically, three sweeps of the data are available, the first of which collects data when the cohort are aged about 9 months. At the second and third sweeps the cohort are aged about 3 and 5 years respectively[4]. The survey contains a comprehensive set of information on the outcomes of the child and the characteristics and behaviour of their parents. While the precise measures depend upon the age at which the child is assessed indicators of child health include measures of health problems during pregnancy and birth, birth weight, childhood accidents and non-accident hospital admissions, parental reported child health and height and weight. Information is collected on a well established set of measures of child development including the Denver Development Screening Test, various elements of the British Ability Scales (BAS) and the Bracken School Readiness Test. Information on child behaviour is also assessed using the Strengths and Difficulties Questionnaire. In the subsequent analysis the sample is restricted to the first child of any multiple birth families and to children where the natural mother is the main respondent at all productive sweeps.

Statistical evidence presented in the full report shows that several of the indicators of child health and cognitive development exhibit no significant cross country variation. For example, there are no significant differences in maternal reports of a child's limiting illness. There are also no definite patterns in terms of early child development (at 9 months) and child behaviour at age 3 and age 5. There are, however, several indicators where a more consistent picture of cross country variation emerges. For example, in terms of health, children in Wales are more likely to have received medical help either for a non-accident hospital admission or for an accident or injury than in any other UK country. Children in Wales are also more likely to be overweight with 28% being classed as overweight or obese at age 3 compared to 23% in England. By age 5, there is also some evidence to suggest children in Wales have fallen slightly behind all other UK countries in terms of vocabulary when assessed using the naming vocabulary subtest of the BAS.

Greater disparities are found to exist within Wales between areas defined on the basis of the level of deprivation. This is particularly the case for indicators of development, where disparities appear to widen as the child ages. Indeed, at age 5, children from the disadvantaged area (see later definition) are less developed in terms of a range of tests of ability, including tests designed to measure vocabulary (BAS naming vocabulary test), problem solving skills (BAS picture similarity test) and spatial awareness (BAS pattern construction test). In addition, children from the disadvantaged area are more than twice as likely to have abnormal behaviour as identified by the Strengths and Difficulties Questionnaire.

The report goes on to investigate possible explanations for these differences and while it is beyond the scope of this paper to consider each measure of health and development, the results share some common features which are worth highlighting. Multivariate analysis suggests that the cross country differences in child health and development identified above exist even after controlling for the characteristics of the child and its family. As such, they reflect influences, such as differences in national policy or culture, which are not included in the model. In contrast, differences between areas within Wales on the basis of deprivation are largely explained by differences in the characteristics of the child and its family. Therefore, only a very small part, if any, of the raw difference between more and less deprived areas actually reflects the influence of local area deprivation.

A Focus on Childhood Obesity

In the remainder of this paper we explore the findings with respect to childhood obesity in more detail. There has been increasing interest in obesity generally and childhood obesity in particular. One reason for this is the dramatic increase in childhood obesity observed in the UK. Recent figures suggest rates of childhood obesity more than doubled between 1984 and 2002 (Wang and Lobstein, 2006). Obesity in childhood has been found to be related to adult obesity and a range of other health problems in later life and, as such, represents an increasing burden on public services (see Audit Commission, Healthcare Commission, and National Audit Office, 2006 for full details). In addition to the effects on

health, obesity in adolescence has been linked to a range of social and economic consequences in adulthood and these relationships exist even after controlling for socioeconomic background and child ability (see Gortmaker *et al*., 1993). It is therefore unsurprising that government initiatives have been developed which attempt to tackle the issue. For example, the Welsh Assembly has recently introduced the MEND programme which aims to help overweight or obese children (aged between 7 and 13) improve their diet and physical activity levels.

In both the second and third sweep of the MCS, trained interviewers weighed and measured the MCS cohort. This information is used to calculate Body Mass Index (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 measure of body fat. Waist circumference measures have recently been found to be a more accurate predictor of health in later life (see, for example, Schmidt *et al*., 2011).

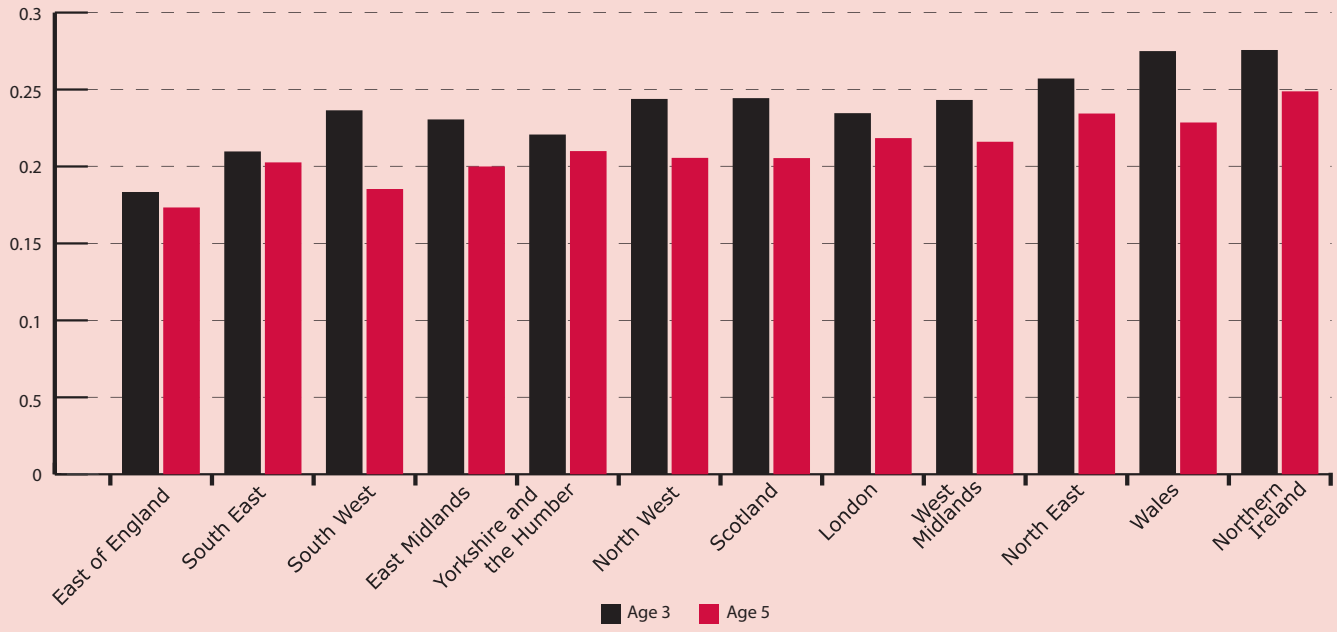
The results are presented in Table 1, which shows cross country differences by gender for the cohort when aged 3 and 5 respectively. At age 3, over a quarter of children in Wales are classed as overweight or obese, with the rates being slightly higher for females than males. Further, the rates are significantly higher than the corresponding figures in England. For example, 26.3% of male children and 28.9% of female children in Wales are overweight or obese compared to 22.2% and 22.8% in England respectively. The rates in Wales are

Table 1. Obesity by UK country at age 3 and age 5.

Percent	England		Wales		Scotland		Northern Ireland	
Age 3	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
BMI- normal	77.82**	77.17***	73.71	71.11	76.32	74.43	71.64	73.43
BMI- overweight	17.47	17.51***	19.86	23.67	17.35	20.04*	20.86	20.66
BMI- obese	4.71**	5.32	6.43	5.22	6.33	5.53	7.50	5.91
Observations	4,451	4,376	1,048	970	830	806	656	651
Age 5								
BMI- normal	81.85**	77.46**	79.02	73.33	82.37*	76.95*	76.74	73.82
BMI- overweight	13.34***	17.06**	16.26	20.06	13.12**	16.68**	15.36	20.42
BMI- obese	4.81	5.48	4.73	6.62	4.51	6.37	7.90**	5.77
Observations	4,620	4,440	1,088	1,001	893	857	730	734

Notes to table: Data are weighted and '*','**' and '***' are used to denote the difference from Wales is statistically significant at the 10%, 5% and 1% level respectively. The sample is restricted to the first child of any multiple birth (twin/triplets) families and to members of the cohort where their natural mother responds at all productive sweeps. The number of observations reflects an unweighted count.

Figure 1. Proportion of children who are overweight or obese at age 3 and 5, by region.



Notes to table: Data are weighted. The sample is restricted to the first child of any multiple birth (twin/triplets) families and to members of the cohort where their natural mother responds at all productive sweeps.

Table 2. Obesity in Wales, by local area deprivation, at age 3 and age 5.

Percent	**Advantaged**		**Disadvantaged**	
Age 3	Male	Female	Male	Female
BMI- normal	71.79	70.07	75.99	72.34
BMI- overweight	22.26	25.17	17.01**	21.89
BMI- obese	5.96	4.76	7.00	5.77
Observations	319	294	729	676
Age 5				
BMI- normal	79.82	73.14	78.03	73.56
BMI- overweight	15.73	20.39	16.91	19.65
BMI- obese	4.45	6.47	5.06	6.79
Observations	337	309	751	692

Notes to table: Sample is restricted to children resident in Wales. Data are weighted and '*','**' and '***' are used to denote statistical significance from the advantaged area in Wales at the 10%, 5% and 1% level respectively. The sample is restricted to the first child of any multiple birth (twin/triplets) families and to members of the cohort where their natural mother responds at all productive sweeps.

more similar to those in Northern Ireland, where childhood obesity is also more prevalent. Between the age of 3 and 5 there is a fall in the proportion of children classed as overweight or obese across all UK countries. At age 5, 21.0% and 26.7% of male and female children in Wales are overweight or obese. Despite this, cross country differences remain significant. Relative to children in England and Scotland the probability of being overweight at age 5 is significantly higher in Wales. Consistent with this, children in Wales are also more likely to have a 'high' waist to height ratio[5] relative to Scotland or England.

Further regional analysis of BMI values among the cohort is presented in Figure 1. Statistics are presented for the proportion of children who are obese or overweight at age 3 and 5 respectively. The regions are ranked from lowest to highest based on (average) rates of overweightness or obesity. It confirms many of the findings from the previous table but also shows that Wales and Northern Ireland have a higher concentration of children who are obese or overweight than any of the regions with England. It also demonstrates the regional variation that exists within the UK. For example, while nearly 25% of children in Northern Ireland are above 'normal' weight the corresponding figure in the East of England is 17%.

In contrast to many indicators of child health, which often show dramatic variation on the basis of deprivation or socio-economic grouping (see, for example, Case *et al*., 2002), childhood obesity, at least among young children, does not vary dramatically by local deprivation. Table 2 presents obesity rates for children resident in Wales by deprivation in the local area around the time of birth. More specifically, the disadvantaged area is defined as the poorest quarter of wards as measured by the Child Poverty Index for England and Wales. The remaining wards are referred to as the advantaged area. Interestingly, at age 3, a greater proportion of children in the disadvantaged area are classed as 'normal' weight. For males, the difference is significant with 22.3% of those resident in the advantaged area being overweight compared to 17.0% in the disadvantaged area. By age 5, there are no significant differences in childhood obesity between those from the more and less deprived area, consistent with deprivation not being the main driver of the relatively high rates of obesity in Wales.

The Influence of Child and Family Characteristic

There are several possible explanations for the cross country differences in child obesity identified in Table 1. Firstly, it may be that children in Wales and their parents have different characteristics and/or behaviours to those elsewhere in the UK. Differences in parental characteristics (such as obesity) potentially generate an intergenerational transmission mechanism where the child's 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. Using the MCS, it is possible to control for differences in the composition of the population between countries and examine if the influence of the country of residence remains significant. Importantly, this type of analysis also identifies child and parenting behaviour which are correlated with childhood obesity. The results from multivariate analysis are summarised in Table 3, where the dependent variable is a measure of being overweight or obese at age 3 (column 2) and age 5 (column 3) respectively.

Interestingly, country of residence is still important after controlling for personal and household related characteristics and parenting behaviour. At age 3 children in Wales and Northern Ireland have a significantly higher probability of being overweight or obese relative to those in England. Indeed, at this age, being resident in Wales increases the probability of a child being overweight or obese by nearly 5 percentage points. Further, this gap across the countries does not narrow as additional controls for personal, parental and parenting characteristics are included. This suggests that differences in the composition of the population are not the main driver of the high rates of overweight/obesity in Table 1. Instead, at age 3, a child with identical personal and household characteristics would have a higher risk of being obese/overweight if resident in Wales. The explanation for this must, therefore, lie in differences between countries that are not controlled for in the model, for example, differences in culture, government policy or the physical environment. This evidence is entirely consistent with Hawkins *et al*. (2008b) who find that, at age 3, 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. When obesity is measured at age 5, the country effect remains significant for Northern Ireland. However, importantly, the inclusion of the child and family characteristics reduces the influence of being resident in Wales and it becomes statistically insignificant at conventional levels. Importantly therefore, the 'Welsh effect' appears to diminish as the child ages. Future sweeps of the data will, however, enable this to be examined further.

Table 3. Multivariate analysis of childhood obesity or overweightness.

Explanatory Variable	Age 3	Age 5
Country of residence	✓ Wales (+) Northern Ireland (+)	✓ Northern Ireland (+)
Gender	-	✓ Male (-)
Ethnicity	-	✓ White (-)
Lone parent	-	-
Mother's age at birth	✓ Mother 20>age<30 (-)	✓ Mother 20>age<30 (-)
Mother's education	-	✓ Mother Degree (-) Mother A Level (-)
Low birth weight	✓ Low birth weight (-)	✓ Low birth weight (-)
Multiple birth	✓ Twin or triplet (-)	-
Mother smokes	✓ Mother smokes (+)	✓ Mother smokes (+)
Mother employed	-	-
Household poverty	-	-
Early introduction of solid food	✓ Solid food within 3 months (+)	✓ Solid food within 3 months (+)
Duration breastfed	✓ Never breastfed (+)	✓ Never breastfed (+) Short duration of breastfed (+)
Mother's obesity	✓ Mother underweight (-) Mother overweight (+) Mother obese (+)	✓ Mother underweight (-) Mother overweight (+) Mother obese (+)
Mother limiting illness	✓ Mother long term ill health (-)	✓ Mother long term ill health (-)
Mother diabetes	✓ Mother diabetes (+)	✓ Mother diabetes (+)
Breakfast daily	N.A.	✓ Breakfast daily (-)
Consumption of fruit	-	-
Physical activity	-	-
Hours spent watching TV	-	✓ TV more than 3 hours per day (+)

Notes to table: Table summarises coefficient estimates from a probit model where the dependent variable is child obesity or overweightness at age 3 and age 5 respectively.a indicates significant at the 10% level or better and the direction of the relationship is indicated within brackets. '–' indicates that the variable was included but has no significant effect and N.A. indicates the variable was not available to include as a control. The sample is restricted to the first child of any multiple birth (twin/triplets) families and to members of the cohort where their natural mother responds at all productive sweeps.

In terms of child characteristics, males and white children are significantly less likely to be overweight at age 5. Children with a mother qualified to 'A level' standard or above are less likely to be overweight at age 5 than those whose mother has no qualifications. Living in a lone parent family has no effect on obesity at either age 3 or 5, whereas, having a mother aged between 20 and 30 (at childbirth) reduces the risk of childhood obesity relative to the omitted group of mothers aged over 30. Recent evidence has found a positive relationship between maternal employment and childhood obesity (see, for example, Anderson *et al*., 2003 and Hawkins *et al*., 2008a) but, in this analysis, the indicator for current employment is not significant at either age. This, however, may be a result of the nature of the measure which captures maternal employment status at the time of interview rather than the intensity of maternal employment over the early years.

Consistent with the absence of a relationship between local area deprivation and obesity, noted above, there is also no influence of family income. A child living in a household in poverty is no more or less likely to be overweight or obese, after controlling for other family characteristics. What appears to be more important is parenting behaviour in the early years. For example, children with no (or short durations of) breastfeeding are more likely to be overweight/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; those of low birth weight are less likely to be overweight or obese at age 3 or 5, consistent with the positive correlation of weight across the lifecycle[6]. There is also evidence of strong positive intergenerational correlation of obesity between the mother (measured before pregnancy) and child. For example, having an obese mother increases the risk of a child being overweight or obese by 18 percentage points at age 5. This may reflect genetic influences or similarity in the diet and physical activity of the 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 the link is a consequence of common lifestyle characteristics rather than a genetic influence. It is, however, worth noting that no significant cross country differences in maternal obesity (measured pre-pregnancy) are identified, with 29% of mothers being overweight or obese in Wales. Table 3 also shows that other measures of maternal health are important, for example, 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 much smaller negative effect.

Surprisingly, few of the controls for diet or physical activity are significant determinants of childhood obesity. However, some of the variables may be poorly measured. For example, the consumption of fruit may reflect appetite more generally as well as the composition of the child's diet. There is, however, one important exception, having breakfast daily is negatively correlated with childhood obesity[7]. Despite higher rates of attendance at school breakfast clubs, children in Wales are significantly less likely than those in England to have breakfast every day. 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, although more direct questions about physical activity (with mother or at school) are not important.

Longitudinal Analysis

In addition to undertaking analysis focused on obesity measured at a specific age (as above) the longitudinal nature of the data enables researchers to examine changes over the lifecycle. Table 4 examines the obesity of the cohort at age 5 conditional on their weight at age 3. As expected, there is evidence of persistence. For example, 91% of children who are normal weight at age 3 are still normal weight at age 5. However, reassuringly, the evidence shows mobility out of the obese/overweight groups; 46% of children who were overweight at age 3 are of normal weight at age 5 and the corresponding figure for those initially obese is 20%. Overall the rate of exit from being overweight or obese (expressed as a proportion of all children) is higher (9.5%) than the rate of entry (7.2%) which is consistent with the decline in the rate of obesity/overweightness between age 3 and 5.

Conditional on being normal weight, children resident in Wales are significantly more likely to become overweight or obese between the ages of 3 and 5 than those in England. However, conditional on being overweight or obese at age 3, children in Wales also have a higher probability of moving to normal weight at age 5[8]. It is also interesting to examine the factors associated with becoming overweight / obese and exiting this state. Multivariate analysis (results not reported) shows that the probability of becoming overweight is lower for males, those of white ethnic origin, those with low birth weight and who are part of a twin/triplet birth. The probability is also lower for those whose mothers were aged between 20 and 30 at childbirth and for those with mothers who hold degree level qualifications. In contrast, having a mother that smokes or was herself obese prior to pregnancy increases the risk of becoming overweight/obese. It is particularly interesting to note that being fed solid food before 3 months of age increases the probability of becoming obese between the age of 3

Table 4. Obesity at age 3 and age 5, UK.

	Age 5		
Age 3	Normal	Overweight	Obese
Normal	8363 (91%)	743 (8%)	132 (1%)
Overweight	999 (46%)	954 (45%)	240 (10%)
Obese	148 (20%)	223 (33%)	309 (47%)

Notes to table: Figures refer to (unweighted) cell counts whereas figures in parenthesis refer to weighted row frequencies. Probabilities may not sum to 1 due to rounding. The sample is restricted to the first child of any multiple birth (twin/triplets) families and to members of the cohort where their natural mother responds at all productive sweeps.

and 5, suggesting parenting behaviour during infancy may have longer term effects beyond what is evident immediately[9].

Males and white children also have a higher probability of moving out of the obese/overweight group between the ages of 3 and 5. In contrast, maternal education has no influence but maternal obesity remains important. Children whose mothers are overweight or obese are themselves less likely to exit this state. The early introduction of solid foods has a weak but negative effect on exit and, for the first the first time in this analysis, physical activity is important, being positively associated with exiting overweightness/obesity.

Conclusion

The Millennium Cohort Study provides an opportunity for researchers to identify and examine cross country differences in child health and development among a contemporary cohort. These data reveal significant cross country differences in overweightness and obesity among young children (at age 3 and 5). Children in Wales (and Northern Ireland) are more likely to be overweight or obese than those in England (and Scotland). At age 3 this gap is not explained by differences in observable family characteristics between countries. However, at age 5 the raw gap is smaller and is further narrowed by introducing controls for family characteristics and parenting behaviour. Parenting behaviour in the child's early years is particularly important; differences between Wales and England in the prevalence and duration of breastfeeding and the date at which solid foods are introduced into the child's diet contribute to the differences in overweightness and obesity. While more detailed investigation is clearly warranted, policies designed to inform parenting behaviour would seem to have the potential for immediate benefits at a relatively modest cost.

Existing policies in Wales, such as the free breakfast club initiative, while beyond formal evaluation in this paper, have the potential to reduce childhood obesity, especially if participation is among children who would otherwise not eat breakfast daily. Long term policies, such as those which aim to raise educational attainment generally, will have positive intergenerational effects and there is evidence in this paper that these effects could spread as far childhood obesity. However, in this analysis, the largest influence on the child's obesity status is the obesity level of their mother. Policies to tackle childhood obesity must, therefore, go hand in hand with those aimed at adults. Indeed, there will be positive spillover effects between these types of policies in the long-run.

The MCS will become an increasingly valuable source of data for analysis on Wales. As the cohort age it will be possible to monitor progress of some of the indicators and issues discussed. Further, future sweeps of the data will facilitate the examination of formal schooling, the transition into adulthood and of cross country differences in the relationship between childhood and adult indicators. Ultimately therefore, it should be possible to shed light on the wider issues mentioned in the introduction, particularly, how much of any disadvantage observed among adults in Wales actually stems from differences in their experience as children and, importantly, at what stage over the lifecycle any cross country gaps in health and educational attainment emerge.

Acknowledgements

The Millennium Cohort Study is sponsored by the Economic and Social Research Council, Office for National Statistics, Department for Education and Skills, Department for Work and Pensions, Department of Health, Welsh Assembly Government, Scottish Executive and Northern Ireland Executive. It is accessible from the UK Data Archive, University of Essex, Colchester and is copyright of University of London, Centre for Longitudinal Studies. The analysis was undertaken as part of a research grant from the Economic Research Unit of the Welsh Assembly Government. None of these organisations bears any responsibility for the analysis or interpretation undertaken here.

Notes

1. Melanie Jones, David Blackaby and Philip Murphy are members of the Wales Institute of Social and Economic Research, Data and Methods (WISERD) and the Welsh Economy and Labour Market Evaluation and Research Centre (WELMERC). David Blackaby and Philip Murphy are also members of the Spatial Economics Research Centre (SERC).
2. The full report is available at http://wales.gov.uk/docs//dfm/research/100524childhealthen.pdf
3. Joshi and Hawkes (2005) are among the first to specifically utilise the boost to the sample in Wales. They focus on cross country differences in the characteristics of mothers, particularly the 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.
4. Information has also been collected at age 7 (MCS4) and future sweeps of the data will be collected as the children age.
5. A ratio of more than 0.5 has used to identify abdominal obesity (see, Garnett, *et al*., 2008).
6. Children in Wales have a slightly lower average birth weight than those born in Scotland or Northern Ireland. There are, however, no significant differences in the proportion of low birth weight (defined as less than 2.5kg). Within Wales, there are also no significant differences in the proportion classed as low birth weight by areas of relative deprivation, although children born in the disadvantaged area are lighter on average.
7. Importantly, this does not just reflect the presence of routines within the household since it is significant after controlling for a measure of having a regular bedtime.
8. It should be acknowledged that some of the transitions may represent quite substantial changes in BMI (relative to the age cohort) while, due to the nature of the cut off points between normal weight and overweight/obesity, other transitions may only represent very small changes in BMI. No consideration is given to this issue in this analysis.
9. Of course, the control for early introduction of solid foods may capture elements of the child's diet between age 3 and 5 which are unobserved in this study.

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