

Maternal indicators in pregnancy and children's infancy that signal future outcomes for children's development, behaviour and health: evidence from the Millennium Cohort Study

Kathleen Kiernan and Fiona Mensah

**Department of Social Policy and Social Work
University of York**

Report prepared for: The National Child and Maternal Health Observatory (ChiMat) on behalf of the Department of Health

Citation K.E Kiernan and F.K.Mensah (2009) Maternal indicators in pregnancy and children's infancy that signal future outcomes for children's development, behaviour and health: evidence from the Millennium Cohort Study. University of York

Executive Summary

Maternal indicators in pregnancy and children's infancy that signal future outcomes for children's development, behaviour and health: evidence from the Millennium Cohort Study

Introduction

The aim of this study was to identify early life course factors associated with children's later development in three main spheres: cognitive development, behavioural difficulties and health status. The rationale for the study was to provide evidence that might be used to inform PREview the predictive tool for child health and well-being. To this end data from the English sample of the Millennium Cohort Study was analysed to assess how maternal attributes, maternal behaviours during pregnancy and characteristics of children's families during infancy related to child outcomes at age 5 years and the predictive power of these factors was assessed.

Contents

The report contains a detailed description and analysis of the factors associated with the child outcomes.

The factors were subset into four groupings.

- Mother's pre-birth attributes
- Mother's feelings and behaviours in pregnancy
- Mother's health and well being
- Mother's socioeconomic situation.

The analytic approach was incremental.

- First we ascertained the individual effects and which factors within these groupings remained important for the child outcomes after controlling for the other factors in the set.
- Secondly, we used a model selection process to identify salient variables to be included in the predictive models from all the variables across the four groupings.

For the predictions we investigated:

- how effectively children's outcomes were predicted using risk propensity estimates derived from the models
- and we compared the effectiveness of these detailed models to models which could be derived from information currently collected during the antenatal period.

The report also provides a description of specific groups of families whose children showed an increased vulnerability for poorer outcomes and how these families may be recognised by cross-classifying a number of the important attributes that emanated from the analysis.

An assessment of the importance of ethnic origin and birth weight for children's future outcomes is also covered.

The report finishes with some reflections on the approach taken.

The Millennium Cohort Study

The sample for this study includes 9249 children born in England whose natural mother was the main respondent at the first wave of the survey, carried out approximately when the child was 9 months old, and whose families participated at the age 5 survey.

The outcome measures

Three outcomes were considered relating to different dimensions of child development and well-being.

Children's educational progress: Foundation Stage Profile

The Foundation Stage Profile (FSP) which has been linked into the MCS provides a teacher assessment of children's developmental achievement over the first year of primary school. In this study we compare the experiences of children in the bottom ten per cent of the distribution with the rest.

Strength and Difficulties Questionnaire

At the age 5 interview the children's mothers or the main carer completed the Strengths and Difficulties Questionnaire. This is a 25 item behavioural screening questionnaire covering 5 different dimensions of children's behaviour: conduct problems, inattention-hyperactivity, emotional symptoms, peer problems and pro-social behaviour. The first 4 scales were combined to yield a total behaviour problem score. In this study we compare children in approximately the highest decile of difficulties with the rest of the children with lower scores.

Children's Health Status

We used a measure of overall health status where the child's health status at age 5 years was categorised by the mother as being excellent or very good or good or fair or poor. In the MCS sample 4 per cent of the mothers reported that their child was in fair or poor health and 17 per cent that they were in good or fair or poor health. We present information for both these categorisations.

Explanatory Factors - Background Characteristics

Our focus was on background characteristics that related to as early in the child's life as possible. The first wave of the MCS occurred when the child was approximately 9 months old which included direct questions on the ante-natal period and others that had the potential to be asked in the ante-natal period. The characteristics and experiences of the children's families were divided into four main groupings.

1. Pre-birth and Demographic Characteristics

The factors included under this grouping were mother's age at the time of the birth of the cohort child, her age at the time of her first birth, level of highest qualification, experience of employment, whether ever in care or lived away from home at an early age, experience of parental separation, marital status at the birth of the baby and language spoken in the home. Additionally, information on parity, family size and multiple births was also included.

2. Mother's Feelings and Behaviours during pregnancy

Mothers were asked at the 9 month old survey about whether their pregnancy was planned or whether it had been a surprise and also whether when she first knew she was pregnant she felt happy or not at the prospect of having the baby. Information was also collected on the week in which she first received ante-natal care and on smoking and drinking behaviour during pregnancy.

3. Mother's Health and Well-Being at the 9 month old survey

The first occasion on which we have information on the mother's health and well-being is at the time the baby is 9 months old. Our analysis includes information on mother's general health status, depression and some information on degree of self efficacy.

4. Socio-economic situation at the 9 month old survey

Socio-economic situation can be measured in a variety of ways. In this study we included information on employment, income, poverty, benefit receipt and housing tenure. We also included information on whether the family had housing difficulties since the baby was born and the index of multiple deprivation for the area in which the child lived.

Child's gender and age

Analyses included controls for the sex of the child and their age at the time of the assessments. Controlling for gender was important as more of the boys had poor outcomes than did the girls.

Key indicators for the child outcomes

Model selection

The model selection began by considering all of the indicators across the four subsets outlined above. Within these models many of the indicators became redundant, in that no statistical association was seen once other factors had been taken into account. There were commonalities and differences in the key indicators selected across the different child outcomes.

Foundation Stage Profile

The key indicators for whether children were assessed as being in the lowest decile of the Foundation Stage Profile included:

- mother's age at first birth, the level of qualifications she had attained and whether she had ever been in employment
- language spoken in the home, family size and whether the child was a twin or a triplet
- mother's self rated health and whether she was depressed
- living in poverty, type of housing tenure and living in a deprived area.

Behaviour Difficulties

The key indicators for whether the children were in the top decile (9 per cent of the children) of the total difficulties behaviour included:

- mothers level of qualification,
- whether the mother was happy about being pregnant or smoked during pregnancy

- parent's relationship at the time of the birth,
- language usually spoken in the home, whether the child was first born or a multiple birth.
- mother's general health, her malaise score and self efficacy.
- housing and area also mattered in terms of housing tenure, whether the family had experienced housing difficulties and whether they lived in a deprived area.

Child health

For the 17 per cent who reported that their child was not in excellent or very good health the important factors included:

- mother's age at first birth, her qualifications, whether she had lived away from home before age 17,
- language spoken in the home,
- whether she had been happy to be pregnant,
- her own self-rated general health, whether she had suffered from post-natal depression and self efficacy.
- The only socio-economic factor that came through was level of income.

For the 4 per cent who reported their child to be in fair/poor health key predictors included:

- late presentation for or no ante-natal care
- continuing to smoke during the pregnancy
- mother's own self rated health, post-natal depression and current depression
- language spoken in the home and large family size (4 or more children in the home)
- mother had seen her parents separate during her childhood.
- level of income

Summary

There were a number of factors that were common across all the outcomes, including:

- maternal qualifications, language spoken in the home and mother's self rated health.
- one or other of the measures of depression was associated with all the outcomes,
- one or other of the measures of socioeconomic situation.
- There were also factors that were more specific to a particular outcome, such as, smoking during pregnancy and children's behavioural difficulties and health status.

Ethnicity and Child Outcomes

In the MCS sample 13 per cent of the babies were born to mothers from ethnic minority populations. Compared with children born to White mothers, after adjustment for all the background factors, only children of Pakistani origin appeared not to be faring well on the outcomes.

Birth Weight and Child Outcomes

After adjustment for all the background factors babies of less than 2.5 kg were more likely to be doing less well at school and to have poorer health. However, there was little evidence that low birth weight was associated with later behaviour difficulties.

Ways in which this study might inform the PREview tool

The analyses showed that there were different levels of risk or vulnerability amongst children conceived, born and growing up in different contexts. We provide two examples of how this information might inform a PREview tool: results from propensity score analysis and the identification of vulnerable families.

Propensity Score Analysis

How well do the MCS background factors predict which children will fall into a given range?

Using the coefficient estimates derived from our models we calculated a linear prediction score for each child in the sample. These scores were grouped into strata which identified the children in the highest 1 per cent predicted risk group through to children in the lowest 10 per cent predicted risk group.

Foundation Stage Profile

Amongst the 1 per cent of children predicted to have the highest risk scores the observed frequency for poor learning and development was 49 per cent. The observed frequencies decreased gradually for children with lower predicted risks through to 0.8 per cent amongst the children in the lowest risk propensity strata.

Considering this analysis in terms of its potential for identifying all children who would experience poor learning and development we calculated that 5 per cent of these children were within the highest risk propensity strata, 19 per cent were within the highest or second strata, and 32 per cent were within the first three strata, that is amongst the 10 per cent of children with the highest predicted risk.

Behaviour difficulties

For behaviour difficulties amongst the 1 per cent of children predicted with the highest risk scores the observed frequency of behavioural difficulties was 41 per cent decreasing to 1.3 per cent amongst the children in the lowest risk propensity strata.

From the standpoint of identifying all children who might experience high levels of behaviour difficulties our estimates show that 5 per cent of these children were within the highest risk propensity strata, 20 per cent were within the highest or second strata, and 37 per cent were within the first three strata, that is amongst the 10 per cent of children with the highest predicted risk.

Child Health

With regard to the identification of all children who would experience fair or poor health, 4 per cent of these children were within the highest risk propensity strata, 16 per cent were within the highest or second strata, and 28 per cent were within the first three strata. Among the highest risk strata 34 per cent of the children experienced less than very good health in addition to the 15 per cent experiencing fair or poor health.

Summary for all the outcomes

From the risk propensity models children's behavioural difficulties was the best predicted outcome.

Thirty-seven per cent of children with the highest level of difficulties were identified within the top 10 per cent of the predicted risk, 72 per cent within the top 30 per cent and 81 within the top 40 per cent.

Prediction of difficulties in learning and development was only slightly less effective, 32 per cent of children with the highest level of difficulties were identified within the top 10 per cent of the predicted risk, 65 per cent within the top 30 per cent and 77 per cent within the top 40 per cent.

Prediction of fair or poor health was somewhat less effective still, 29 per cent of children with the highest level of difficulties were identified within the top 10 per cent of the predicted risk, 63 per cent within the top 30 per cent and 72 within the top 40 per cent .

Indicators currently collected through the maternity and child health systems: How well does this set predict children's outcomes?

The model selection and estimation of risk propensity models was carried out for a restricted set of MCS variables that most closely corresponded to data currently collected during pregnancy by the local maternal and child health systems. This exercise showed that the extension of the current data collection could improve the potential for predicting children's behavioural difficulties substantially, and the prediction of learning and development and health difficulties to a lesser degree.

Illustrative Analysis of Vulnerable Groups

Another way in which the evidence from the MCS might inform the targeting of services is through the provision of evidence that poor outcomes for children are more likely to occur amongst specific groups of the population.

For example, in the MCS sample lower levels of child learning and development was most common amongst mothers who had their first child in their teens and had no qualifications or only NVQ level 1 qualifications only, and amongst the mothers who were aged 20-22 at first birth and had no qualifications. These three groups of mothers represented 12 per cent of the population, but 30 per cent of the children who experienced poor learning and development were within these groups; as were 24 per cent of those who experienced behavioural difficulties; and around 20 per cent of those who experienced health difficulties. Moreover, there was a clear gradation of risk for children's outcomes across these groups of mothers. This type of identification might be helpful if the intention is to have progressive levels of intervention for different groups of families within the population as detailed in The Child Health Promotion Programme (Shribman and Billingham, 2008).

Conclusions

The key indicators from the MCS analysis showed important associations with the child outcomes and the propensity score exercise showed that these factors had some power for predicting outcomes. However, different sets of factors were more or less influential depending on the child outcome under consideration. Socio-economic characteristics were strongly related to how well the child was doing on the foundation stage profile but maternal mental well-being and her assessment of her health tended to be more important in relation to her child's behaviour and health outcomes. This suggests that it may be more appropriate to take a more holistic approach to understanding how families influence their children's development and well-being.

References

Shribman S, Billingham K (2008) *The Child Health Promotion Programme. Pregnancy and the first five years of life*. Department for Children, Schools and Families. Department of Health

Maternal indicators in pregnancy and children's infancy that signal future outcomes for children's development, behaviour and health: evidence from the Millennium Cohort Study

Introduction

The underlying aim of this study is to identify early life course factors that are associated with children's later development in three main spheres: cognitive development, behavioural difficulties and health status. Specifically, the study uses data from the Millennium Cohort Study to assess how maternal attributes, maternal behaviours during pregnancy and characteristics of children's families during infancy relate to child outcomes at age 5 years. The rationale for this research was to provide evidence to inform the choice of a (population level) tool and its content that might be useful in predicting child outcomes.

The report contains a detailed description and analysis of the factors associated with the child outcomes. The factors are subset into four groupings: mother's pre-birth attributes; mother's feelings and behaviours in pregnancy; mother's health and well being; and mother's socioeconomic situation. Our analytic approach is incremental. Firstly, we ascertain which factors within these subsets remain important for the child outcomes after controlling for the other factors in the set and secondly we include all the factors in an overall model and identify the salient variables to be included in our predictive models. We also present an assessment of the importance of ethnic origin and birth weight for children's future outcomes.

We proceed to consider how the evidence might be used to inform a PREview tool. Firstly, we investigate how effectively children's outcomes may be predicted using risk propensity estimates derived from the models and we also compare the effectiveness of these detailed models to models which could be derived from information which is currently collected during the antenatal period. Secondly we describe specific groups of families whose children show increased vulnerability for poorer outcomes and how these may be recognised by cross-classifying a number of the important attributes emanating from our analysis. The report finishes with some reflections on the approach taken.

The Millennium Cohort Study

The Millennium Cohort Study (MCS) is a nationally representative, large-scale longitudinal survey of children in the United Kingdom (Dex & Joshi 2005). For this analysis only children born in England are included. The first sweep of English families contained information from 11,533 families, including 11,695 children aged between 9 and 11 month but most of the children were aged 9 months. These children were born between September 2000 and August 2001 and thus would officially begin attending primary school in 2005.

The families have been followed up when the child was aged 3 and 5 years with achieved response rates of 78 and 79 per cent of the target sample respectively. Detailed information on

the sampling strategy and response rates for the surveys can be found in (Hansen 2008). Additionally, details on the survey, its origins, objectives, sampling and content of the surveys are contained in the documentation attached to the data deposited with the UK Data Archive at Essex University.

The MCS sample design allowed for over-representation of families living in areas with high rates of child poverty or high proportions of ethnic minorities which increased the power of the study to describe effects for these groups of families. The analyses presented are weighted to take account of the initial sampling design as well as non-response in the recruitment of the original sample and sample attrition over the follow up period to age 5. The study results are thus broadly representative for England (Plewis 2007, Ketente, 2008).

The sample used in this study

The sample for this study includes all children born in England whose natural mother was the main respondent at the first wave of the survey, carried out approximately when the child was 9 months old, and whose families participated at the age 5 survey. The total number of children was 9249 of which 8997 were singletons, 240 were twins and 12 were triplets.

The outcome measures

Three outcomes were considered relating to different dimensions of child development and well-being. The child's cognitive development was assessed via the Foundation Stage Profile carried out by teachers which have been linked into the MCS records; their behaviour was assessed from mothers (or main carers) responses to the Strength and Difficulties Questionnaire and their health status was also based on mother's reports.

Children's educational progress: Foundation Stage Profile

The Foundation Stage Profile (FSP) is an assessment of children's developmental achievement over the first year of primary school, assessing the Early Learning Goals for the children between ages 4 and 5 (Qualifications and Curriculum Authority 2003). The assessment was completed by the child's teacher for six areas of learning: personal, social and emotional development; communication, language and literacy; mathematical development; knowledge and understanding of the world; creative development and physical development. The assessment includes continued observation over the year period and the assessments are routinely moderated. These data are collected for children in English state schools by the Department for Children, Schools and Families (formerly known as the Department for Education and Skills). The MCS survey data were linked to FSP assessments made over the academic year from 2005 to 2006, with a success rate of 95% for the cohort children attending state schools in England (Hansen & Jones 2008). The FSP aims to provide a rounded picture of a child's progress and development within their usual educational setting, and is appropriate for children of all abilities and children for whom English is an additional language (Qualifications and Curriculum Authority 2003). This assessment may be preferable to survey assessments which are usually made under test conditions, and which may be less appropriate for children of very low ability or

for children with limited fluency in English. In this study we compare the experiences of children in the bottom ten per cent of the distribution with the rest.

Strength and Difficulties Questionnaire

At the age 5 interview the children's mothers or the main carer completed the Strengths and Difficulties Questionnaire (SDQ) (Goodman, 1997). This is a 25 item behavioural screening questionnaire covering 5 different dimensions of children's behaviour: conduct problems, (often fights, often has temper/tantrums, generally obedient, argumentative with adults, can be spiteful to others); inattention-hyperactivity (restless/overactive, constantly fidgeting, easily distracted, can stop and think out before acting, sees tasks through to end), emotional symptoms (often unhappy, often complains of headaches, many worries, nervous or clingy, many fears), peer problems (rather solitary, tends to play alone; has at least one good friend; generally liked by other children; picked or bullied by other children; gets on better with adults than other children), and pro-social behaviour (considerate of other people's feelings; shares readily with other children; helpful if someone is hurt, upset or feeling ill; kind to younger children; often volunteers to help others). Each attribute was rated by the mother using a scale from 0 to 2 (not true, somewhat true, and certainly true) and coding was reversed for the positive attributes within the difficulties scales. Responses were summed to provide a total score for each dimension. The first 4 scales were combined to yield a total behaviour problem score. A score of 17 or more across the population of children of all ages is regarded as a high score and typically identifies 10 per cent of children, although it varies according to the ages of the children (Goodman, 1997 and 2001). In this study the closest cut-off point to include children in the highest decile of difficulties was a score of 14 or more which captured 9 per cent of the children. We compared this group with the rest of the children with lower scores.

Children's Health Status

For this study we use a measure of overall health status where the child's health status at age 5 years was categorised by the mother as being excellent or very good or good or fair or poor. This measure has been shown to correlate strongly with more concrete aspects of health including children's chronic conditions and episodes of hospitalisation (Case et al, 2002). In the MCS sample 4 per cent of the mothers reported that their child was in fair or poor health and 17 per cent that they were in good or fair or poor health. We present information for both these categorisations. It is worth noting that this self reported measure of health has been shown to be a reasonably good indicator of social inequalities in health when compared with more direct health measures (Subramanian and Ertel, 2008).

Explanatory Factors - Background Characteristics

The rationale for the selection of the explanatory variables was guided by what is known from the extant literature on salient variables associated with child outcomes. Our focus was on characteristics that related to as early in the child's life as possible. The first wave of the MCS occurred when the child was approximately 9 months old which included direct questions on the ante-natal period and others that had the potential to be asked in the ante-natal period. Inevitably we were also constrained by what information was collected in the MCS which is a multi-

purpose study and thus lacks in-depth information on sub groups of the population such as, vulnerable and or hard to reach families or families that have particular problems that are important but rare at the population level.

The characteristics and experiences of the children's families were divided into four main groupings: pre-birth and demographic characteristics; the mother's feelings and behaviours during pregnancy; the mother's health and well-being when the child was 9 months old; and the socio-economic situation at the time of the 9 month old survey. Additionally, we consider two further attributes that have a bearing on children's outcomes namely, mother's ethnic group and the child's birth weight.

Pre-birth and Demographic Characteristics

The factors included under this grouping were mother's age at the time of the birth of the cohort child, her age at the time of her first birth, level of highest qualification, experience of employment, whether ever in care or lived away from home at an early age, experience of parental separation, marital status at the birth of the baby and language spoken in the home. Additionally, information on parity, family size and multiple births was also included. Some of these factors require an explanation as to their derivation and how they were coded for the analysis. The distributions are shown in the first column of Table 1.

Mother's age at birth of the cohort child was based on mothers self report. The mother's age when she had her first child was derived from the dates of birth reported for children resident in the family home at the first survey and reports on any children she had previously. The mother's academic or vocational qualifications reported at the first survey were classified into 5 levels equivalent to the National Vocational Qualification scale (NVQ) ranging from no qualifications, through level 1 which is equivalent to having attained grades D-G at GCSE and up to level 4 or 5 representing professional or academic qualifications at degree level, nursing or other medical qualifications (Qualifications and Curriculum Authority - <http://www.qca.org.uk>). Thirteen per cent of the mothers had no qualifications. The mother's experience of employment was divided into those groups with some experience (92%) and those without any employment experience at all (8%). Information was collected on whether the mother had ever lived away from home before the age of 17 years and the reason for this. Two per cent of the mothers had been in social care; defined as having lived in a children's home or been in foster care. Additionally, information on parental separation was collected. Twenty-six per cent of the mothers had seen their parents separate by the time they were age 16 years. The type of relationship the child's parents had at the time of the birth was also included: 60 per cent were married, 25 per cent were cohabiting and 15 per cent were not living together. Information on the language usually spoken in the home was also included in this set of attributes. Nine per cent of families spoke English and another language and 3 per cent spoke only a language other than English. The number of children in the family home came from the 9 month old survey as did information on whether the birth was a singleton, twins or triplets. Whether the child was the mother's first or later born child was derived from the dates of birth reported for children resident in the family home at the first survey or any children she had had previously.

Mother's Feelings and Behaviours during pregnancy

Mothers were asked at the 9 month old survey about whether their pregnancy was planned or whether it had been a surprise and also whether when she first knew she was pregnant she felt happy or not at the prospect of having the baby. From the distributions shown in the first column of Table 2 we see that 58 per cent of the mothers reported that the pregnancy was planned and that 84 per cent were happy or very happy to be pregnant. Information was also collected on the week in which she first received ante-natal care and on smoking and drinking behaviour during pregnancy. Light, moderate and heavy/binge drinking were defined following criteria previously described for the MCS data by Kelly et al 2009b, which were based on the National Alcohol Strategy (HM Government 2007). From Table 2 we see that 9 per cent of the mothers received ante-natal care after 16 weeks or not at all, 20 per cent continued to smoke and 7 per cent drank moderately or heavily.

Mother's Health and Well-Being at the 9 month old survey

The first occasion on which we have information on the mother's health and well-being is at the time the baby is 9 months old. Our analysis includes information on mother's general health status, depression and some information on degree of agency/self efficacy and the distributions are shown in Table 3. Sixteen per cent of the mothers reported they were in fair or poor health. The MCS included several questions relating to depression. These were whether the mother reported postnatal depression (in response to the question "since (the baby) was born, has there been a time lasting two weeks or more when you felt low or sad?"); whether the mother had ever been diagnosed with depression by a doctor, and a summary variable derived from a reduced form of the Rutter Malaise Inventory which contained 9 items to which the mother responded yes or no (Kelly et al, 2004). The items were as follows: Do you feel tired most of the time? Do you feel miserable or depressed? Do you often get worried about things? Do you often get into a violent rage? Do you often suddenly become scared for no good reason? Are you easily upset or irritated? Are you constantly keyed up or jittery? Does every little thing get on your nerves and wear you out? Does your heart often race like mad? According to the three different measures, 33 per cent of mothers suffered from postnatal depression, 24 per cent had ever been diagnosed with depression by a doctor, and 13 per cent had a malaise score of at least 4 points. Three questions on self-efficacy were also included in the 9 month old survey which aimed to capture how the mother felt about her life so far including the extent to which she felt that she gets what she wants out of life, felt in control and can run her own life. The specific questions were as follows: I never really seem to get what I want out of life / I usually get what I want out of life; I usually have a free choice and control over my life / whatever I do has no real effect on what happens to me; usually I can run my life more or less as I want to / I usually find life's problems just too much for me. The mothers were divided into those who indicated negatively on any of these three items (22 per cent) versus the rest.

Socio-economic situation at the 9 month old survey

Socio-economic situation can be measured in a variety of ways. In this study we included information on employment, income, poverty, benefit receipt and housing tenure. We also

included information on whether the family had housing difficulties since the baby was born and the index of multiple deprivation for the area in which the child lived. The distributions are shown in the first column of Table 4.

We used a simple indicator of household employment namely whether any one in the household was in employment versus none. Seventeen per cent the children lived in workless households. The family income of the household was reported by selecting a net household income band from a show card. We have grouped the incomes into four bands broadly representing the quartiles of the distribution. We have also included a number poverty of measures in our analysis. The family was deemed to be living in poverty if the equivalised household income was 60 per cent below the median before housing costs and on this basis 28 per cent of children were living in poor families at the time of the 9 month old survey. Another useful measure, especially in the absence of income data, which can provide an indication of families living on low incomes is information on whether they are in receipt of means-tested benefits. Thirty six per cent of the MCS families were in receipt of at least one such benefit. A subset of these families, constituting 19 per cent of all the families, were deemed to be poor on the benefit measure i.e. they were receiving Income Support or were in receipt of Working Family Tax Credit or Job Seeker's Allowance as well as receiving Housing Benefit or Council Tax Benefit.

The tenure of the family home at the 9 month old was classified as owner occupier (62 per cent), privately rented (9 per cent), social housing including renting from a local authority or housing association (24 per cent), or other type of tenure which for the majority of families represented living with their parents. We also included a measure of housing difficulties derived from a number of items. These were whether the family had ever experienced homelessness since the cohort child was born; and whether they had to move for example because they could no longer afford their home, or experienced eviction or re-possession or had had problems with neighbours. On this basis nearly three per cent of families had experienced housing difficulties.

The 2004 Index of Multiple Deprivation which combines a number of indicators, chosen to cover a range of economic, social and housing issues, into a single deprivation score for each small area in England have also been linked into the MCS Survey data (Office of the Deputy Prime Minister, 2004). For this analysis the scores for the area in which the child resided at 9 months old were used and have been broadly divided into quintiles.

Child's gender and age

All our adjusted analyses include controls for the sex of the child and their age at the time of the assessments. Controlling for gender was important as more of the boys had poor outcomes than did the girls. So for example whereas 8 per cent of the girls had low scores on the Foundation Stage Profile, 13 per cent of the boys did. Eleven per cent of the boys had high scores on the behavioural difficulties scale as compared with 7 per cent of the girls, and mothers reported that 19 per cent of boys were in good/fair/poor health as compared with 16 per cent of girls and that 5 per cent of the boys were in fair/poor health as compared with 4 per cent of girls.

Logistic Regression Analyses – Childhood outcomes

In Tables 1 to 4 we show how the explanatory factors relate to the child outcomes both in terms of how they are distributed and also the results from logistic regression analyses expressed in terms of odds ratios which allow us to assess the importance of individual factors as well as sets of factors. The adjusted odds ratios include controls for all the factors in the set as well the sex and the age of the child. To facilitate interpretation we also present the unadjusted and adjusted odds ratios in graphical form in Figures 1 to 4 illustrating some of the comparisons which were made.

Pre-birth and Demographic Characteristics

Table 1 shows the values for the pre-birth and demographic factors for the three sets of outcome measures. The first set of odds ratios are those without any controls and the second set are adjusted for sex and age and all the factors included in the pre-pregnancy and demographic set. We exclude mother's age at birth of the cohort child from the adjusted odds ratios as there was a great deal of overlap between this factor and mother's age at first birth, and mother's age at first birth was more strongly related to the outcomes than mother's age at birth of the cohort member.

From Table 1 we see that virtually all the individual factors were significantly associated with the outcomes. From the distributions and unadjusted ratios it is clear that mother's age at first birth, her qualification level, whether she has ever been in employment and her experiences in childhood in terms of whether her parents had separated or she had lived away from home or been in social care were all associated with how well her child was doing in school, behaviourally and health wise at age 5. Similarly, children whose parents were unmarried or where they had more than two siblings or were a second or later born child were in the main more likely to have poorer outcomes. Additionally, where other languages were spoken in the home the children fared less well. Exposing children to other languages is unlikely to be a negative *per se* but it perhaps provides an indication of how much English is spoken in the home which is important for children's school readiness. Also it might be a proxy especially for the group where no English is spoken of more recent immigration and potential problems of communication and difficulties in understanding English when in contact with services. We discuss issues relating to ethnicity later in the report.

Turning to the adjusted odds ratios we see from Table 1 and Figure 1 that after taking into account all the other factors in the set that a good deal of attenuation in the individual factors occurs and some factors are no longer significantly associated with the child outcomes. With reference to learning and development we see that young motherhood (under age 24 years) having low level or no qualifications, having a mother who has never worked, being born to a lone mother and language spoken in the home are important factors associated with how well the child is doing on the school assessment.

The influential factors with regard to behavioural difficulties are very similar to those for learning and development except that mother's work status is not significantly associated with this outcome but having a mother who lived away from home at a young age or who was

unmarried at the child's birth were. These are factors that potentially may carry more emotional scarring that may affect the mother's parenting or her interpretation of her child's behaviour.

Turning to the two health measures we observed some differences between the factors associated with those described as being in fair or poor health, which for ease of description we refer to as being in poor health, and those in good or fair or poor health which we will refer to as the unhealthy group. Factors that were commonly associated with both measures were mother's qualification level, living away from home before age 17 but not in social care, and whether English was usually spoken in the home. Those children who were reported as being in poor health were more likely to have mothers who had experienced parental separation during their own childhood and who were not living together with the father at the time they gave birth. And those children in the more widely defined unhealthy category were more likely to have mothers who had been in social care.

Mother's Feelings and Behaviours during pregnancy

Table 2 (and Figure 2) show analogous data for the set of factors relating to pregnancy. Again it is clear from the information shown here that unplanned pregnancies and being less than very happy about the pregnancy are associated with poorer child outcomes; particularly for the learning and development outcome. Receiving no ante-natal care is unequivocally associated with poorer child outcomes but there is less clarity with regard to the timing of antenatal care. Presenting anytime after 12 weeks is negatively associated with children's learning and development scores but is more weakly related to the behavioural and health outcomes. However receiving antenatal care at 20 weeks or later was important in relation to the poorer health group. Continuing to smoke during pregnancy was also negatively associated with all the child outcomes whereas the association between drinking alcohol during pregnancy and child outcomes was less clear cut. Children of the group who never drank tended to have the highest odds of doing less well on the outcomes. This may be due to the variance in characteristics of women in the different groups. Women who drink are more likely to be drawn from the higher socio-economic status groups (Dex and Joshi, 2005) and their children on average have fewer difficulties than women from lower socio-economic groups.

Mother's Health and Well-Being

In Table 3 (and Figure 3) we focus on maternal health. It is clear from these data that those mothers who reported that their own health was fair or poor when their child was an infant were more likely to have children who exhibited poorer outcomes at age 5 years. Whereas the children of mothers who felt they had control over their lives were less likely to have poor outcomes. We included three measures that assessed psychological distress amongst the mothers: a high score on the Malaise Inventory, ever having been diagnosed with depression or anxiety and whether she had felt low or sad for a period of two weeks or more since the baby was born. Without any adjustment for the other factors in the maternal well-being set, all these measures were significantly associated with the child outcomes. Perhaps not surprisingly given the likely overlap between these measures the significance of the adjusted odds varied and they also varied according to the child outcome. However, one or other measure continued to be significant for the behavioural difficulties and child health outcomes. The lack of significance after adjustment

with regard to the learning and development outcomes is in accord with our findings when we examined the effects of early maternal depression on children's cognitive development at age 3 years (Kiernan and Huerta, 2008).

Socio-economic situation at the 9 month old survey

We now turn our attention to the socio-economic characteristics of the children's families. It is well known that Socio-economic disparities are associated with child outcomes (Feinstein et al, 2008) and it is clear from the data shown in Table 4 that nearly all the factors are strongly related to the child outcomes. Parental unemployment, level of household income, living in poverty, being in receipt of means-tested benefits, living in rented accommodation or living in a relatively deprived area are all associated with negative child outcomes. Many of these factors are inter-related and after adjustment for all the other factors some no longer are significantly related (in a statistical sense) to the outcome measures, and we note that there are some differences across the outcomes. For example, children living in workless households in infancy do less well on their assessments for the Foundation Stage Profile but their behaviour difficulties scores and the state of their health does not differ that much from those of children living in household where at least one parent is in employment. Low household income matters for all the outcomes, but poverty and benefit receipt matter for some outcomes but not others. This may be due to the overlaps that exist between for example income level and these other measures. Living in social housing or in areas in the bottom two quintiles of the index of multiple deprivation are also negatively associated with all the outcomes, except the more stringent health outcome.

In this section we have described the important indicators associated with child outcomes from within the four domains of the mother's lives. We now go on to put all the domains together in order to identify the key indicators that have a bearing on the child outcomes.

Table 1: Association between pre-birth demographic characteristics and children's outcomes

		Sample %	Learning and development (FSP)		Behavioural difficulties (SDQ)		General health		OR (good/fair/poor)		OR (fair/poor)			
			0-62 (10.2%)	Odds Ratio (OR) Unadjusted Adjusted ¹	14-40 (9.0%)	OR Unadjusted Adjusted ¹	Good (13.4%)	Fair/poor (4.0%)	OR (good/fair/poor) Unadjusted Adjusted ¹	OR (fair/poor) Unadjusted Adjusted ¹				
Mother's age at child's birth	13-19	7.3	18.1	2.61***		18.5	3.29***	15.3	7.8	1.65***		2.51***		
	20-24	16.2	14.5	2.00***		14.6	2.48***	17.6	4.4	1.55***		1.37†		
	25-29	28.4	10.6	1.39*		8.3	1.32†	13.1	4.0	1.13		1.24		
	30-34	30.7	6.9	0.87		6.3	0.97	11.8	3.3	0.97		1.02		
	35+	17.5	7.8	(ref)		6.5	(ref)	12.2	3.3	(ref)		(ref)		
Mother's age at 1 st birth	13-19	18.2	19.1	5.22***	2.57**	16.8	4.81***	2.26*	16.9	6.3	2.02***	1.34†	2.39**	1.32
	20-24	25.7	13.4	3.42***	2.00*	11.6	3.14***	2.08*	17.3	5.2	1.94***	1.46*	1.94*	1.31
	25-29	29.7	6.5	1.52	1.23	6.1	1.56	1.54	11.1	3.0	1.10	1.02	1.10	1.00
	30-34	20.2	4.1	0.94	0.96	5.3	1.33	1.52	9.5	2.2	0.88	0.90	0.80	0.83
	35+	6.2	4.3	(ref)	(ref)	4.0	(ref)	(ref)	10.3	2.8	(ref)	(ref)	(ref)	(ref)
Mother's qualifications	NVQ level 4/5	32.6	4.1	(ref)	(ref)	4.2	(ref)	(ref)	10.0	2.1	(ref)	(ref)	(ref)	(ref)
	NVQ level 3	13.3	6.8	1.73**	1.29	7.6	1.85***	1.40*	11.3	3.5	1.26*	1.08	1.67**	1.38†
	NVQ level 2	30.3	9.9	2.61***	1.86***	9.6	2.40***	1.72***	13.3	4.5	1.56***	1.32**	2.16***	1.71**
	NVQ level 1	11.3	18.0	5.19***	3.03***	14.8	3.93***	2.30***	17.9	5.4	2.20***	1.57***	2.63***	1.75**
	No qualifications	12.6	22.7	6.96***	3.02***	20.0	5.66***	2.80***	20.8	7.0	2.77***	1.69***	3.44***	1.90**
Mother ever worked	Yes	92.3	9.0	(ref)	(ref)	8.4	(ref)	(ref)	12.8	3.8	(ref)	(ref)	(ref)	(ref)
	No	7.7	25.5	3.45***	1.42**	18.8	2.53***	1.09	20.8	7.3	1.97***	0.97	2.02***	1.11
Mother lived away from home before 17	No	86.1	9.5	(ref)	(ref)	7.9	(ref)	(ref)	12.6	3.6	(ref)	(ref)	(ref)	(ref)
	Yes	12.0	14.4	1.61***	0.99	16.4	2.29***	1.45**	17.0	6.7	1.59***	1.26**	1.89***	1.35†
	Yes (social care)	1.9	15.0	1.68*	0.73	15.5	2.14**	1.14	25.9	4.9	2.29***	1.68*	1.35	0.83
Mother's parents separated	No	68.6	9.2	(ref)	(ref)	7.8	(ref)	(ref)	13.2	3.6	(ref)	(ref)	(ref)	(ref)
	Yes, 17 or older	5.9	10.3	1.13	1.29	6.6	0.83	0.80	9.9	2.6	0.71**	0.76*	0.72	0.77
	Yes, 16 or younger	25.6	12.8	1.45***	1.11	12.8	1.72***	1.16	14.8	5.5	1.27**	1.10	1.58**	1.31†
Relationship with child's father at birth	Married	59.7	7.9	(ref)	(ref)	5.9	(ref)	(ref)	12.7	3.4	(ref)	(ref)	(ref)	(ref)
	Cohabiting	25.4	10.9	1.42***	1.19	11.3	2.05***	1.62***	13.4	3.9	1.09	1.00	1.16	0.96
	Not living together	15.0	17.8	2.51***	1.45**	18.7	3.71***	2.07***	16.3	6.8	1.58***	1.13	2.10***	1.35†
Language usually spoken in home	English	88.5	9.3	(ref)	(ref)	8.7	(ref)	(ref)	12.2	3.8	(ref)	(ref)	(ref)	(ref)
	English and other	8.8	17.4	2.06***	1.62**	10.9	1.29†	1.34†	23.1	5.9	2.14***	1.99***	1.59**	1.47*
	Other language only	2.7	20.4	2.52***	1.53*	18.2	2.34***	2.40**	20.7	6.1	1.92***	1.61**	1.67	1.41
Children in home	1 child	40.9	8.1	(ref)	(ref)	9.3	(ref)	(ref)	11.9	3.7	(ref)	(ref)	(ref)	(ref)
	2 children	36.5	8.9	1.10	0.99	8.0	0.85†	1.19	13.5	3.4	1.11	0.88	0.93	1.12
	3 children	15.2	14.3	1.88***	1.37	8.8	0.94	1.13	14.6	5.2	1.35**	0.91	1.45*	1.54
	4+ children	7.4	20.0	2.82***	1.45	13.0	1.47*	1.31	19.0	6.4	1.85***	1.03	1.79**	1.57
Child first born	First birth	41.8	7.8	(ref)	(ref)	9.2	(ref)	(ref)	11.6	3.7	(ref)	(ref)	(ref)	(ref)
	Second or later birth	58.2	11.7	1.57***	1.11	8.7	0.94	0.72	14.7	4.3	1.30***	1.22	1.17	0.80
Child twin/triplet	Single birth	97.3	10.1	(ref)	(ref)	8.9	(ref)	(ref)	13.4	4.0	(ref)	(ref)	(ref)	(ref)
	Twin or triplet	2.7	14.1	1.45	1.71†	10.4	1.18	1.39	15.4	4.3	1.17	1.33	1.08	1.07

¹Adjusted for all other factors in this domain plus child's age and gender, note mother's age at birth and mother's age at first birth were not included simultaneously within the adjusted model.

†p<0.1, *p<0.05, ** p<0.01, ***p<0.001.

Frequency of unreported data: mother's age at birth of child 0.1%, age at first birth 0.9%, qualifications <0.1%, ever worked 0.1%, lived away from home before 17 <0.1%, mother's parents separated <0.1%, relationship at birth 0.2%, language spoken in the home 0, children in the home 0, child first born 0.9%, child twin or triplet 0.

Figure 1: Association between pre-birth demographic characteristics and children's outcomes

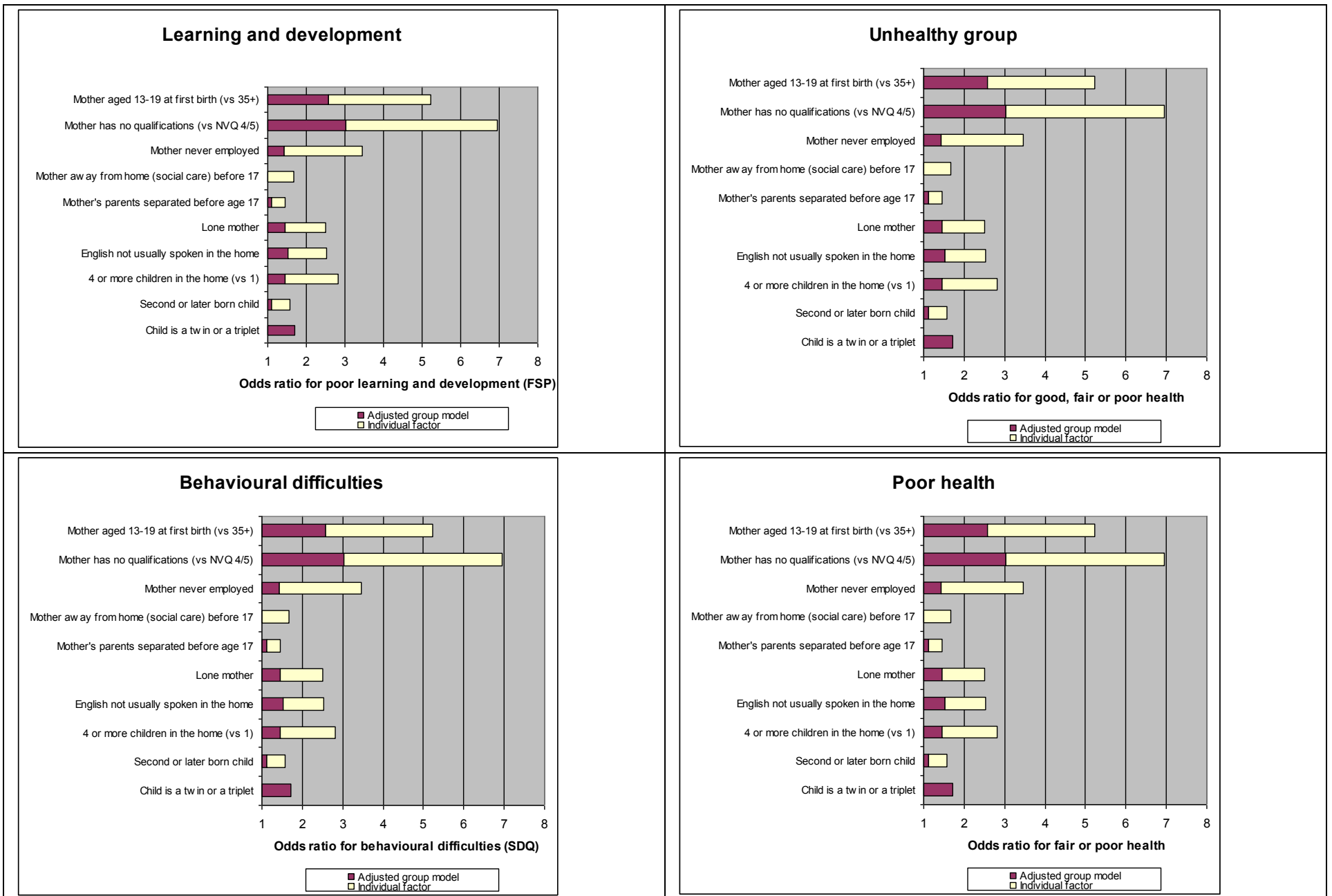


Table 2: Association between mother's feelings and behaviours during pregnancy and children's outcomes

		Sample %	Learning and development (FSP) 0-62 (10.2%)			Behavioural difficulties (SDQ) 14-40 (9.0%)			General health (13.4%)		OR (good/fair/poor) Unadjusted Adjusted ¹		OR (fair/poor) Unadjusted Adjusted ¹	
			Odds Ratio (OR) Unadjusted	Odds Ratio (OR) Adjusted ¹		OR Unadjusted	OR Adjusted ¹	Good	Fair/poor (4.0%)					
Pregnancy planned	Planned	58.0	7.6	(ref)	(ref)	6.6	(ref)	(ref)	11.9	3.1	(ref)	(ref)	(ref)	(ref)
	Surprise	42.0	13.6	1.92***	1.58***	12.5	2.02***	1.16	15.6	5.3	1.50***	1.15†	1.77***	1.26†
Feelings about Pregnancy	Very happy	58.5	8.1	(ref)	(ref)	6.3	(ref)	(ref)	11.7	3.2	(ref)	(ref)	(ref)	(ref)
	Happy	25.5	12.5	1.61***	1.20†	11.0	1.82***	1.51**	14.9	4.3	1.36***	1.22**	1.35*	1.08
	Not bothered / unhappy	16.0	13.9	1.82***	1.15	15.9	2.80***	2.02***	17.4	6.5	1.80***	1.48***	2.10***	1.44*
First antenatal care	12 weeks or earlier	75.9	9.1	(ref)	(ref)	8.6	(ref)	(ref)	13.0	3.6	(ref)	(ref)	(ref)	(ref)
	13-16 weeks	15.4	11.4	1.28*	1.19	8.7	1.00	0.90	13.0	4.3	1.05	1.01	1.23	1.14
	17-20 weeks	3.8	16.7	2.01***	1.82**	9.8	1.15	0.84	15.9	5.7	1.39*	1.21	1.64	1.34
	After 20 weeks	1.9	14.8	1.74*	1.51	11.7	1.40	1.08	14.0	7.6	1.39	1.20	2.22*	1.84†
	No antenatal care	3.1	19.2	2.37***	2.29***	15.7	1.97**	1.46†	19.9	8.7	2.01***	1.73**	2.56***	2.10**
Smoking in pregnancy	Non smoker	66.3	8.9	(ref)	(ref)	6.4	(ref)	(ref)	12.8	3.2	(ref)	(ref)	(ref)	(ref)
	Gave up	13.4	9.3	1.06	0.96	9.3	1.49**	1.34*	11.5	3.8	0.94	0.89	1.19	1.09
	Continued	20.3	15.1	1.83***	1.50***	17.4	3.05***	2.45***	16.5	6.8	1.60***	1.37***	2.22***	1.86***
Alcohol in pregnancy	Never	66.7	11.6	1.75***	1.60***	9.7	1.50***	1.39**	14.9	4.4	1.54***	1.46***	1.44*	1.32†
	Light	25.9	7.0	(ref)	(ref)	6.7	(ref)	(ref)	10.3	3.1	(ref)	(ref)	(ref)	(ref)
	Moderate	5.2	8.4	1.23	1.05	10.9	1.71**	1.39†	9.9	3.8	1.03	0.91	1.24	1.03
	Heavy / binge	2.1	10.4	1.56	1.19	8.7	1.33	0.84	13.3	4.9	1.43†	1.15	1.60	1.08

¹Adjusted for all other factors in this domain plus child's age and gender.

†p<0.1, *p<0.05, ** p<0.01, ***p<0.001.

Frequency of unreported data: pregnancy planned 0.2%, feelings about pregnancy 0.4%, first antenatal care 2.6%, mother's smoking in pregnancy 0.3%, mother's alcohol intake in pregnancy 0.1%.

Figure 2: Association between mother's feelings and behaviours during pregnancy and children's outcomes

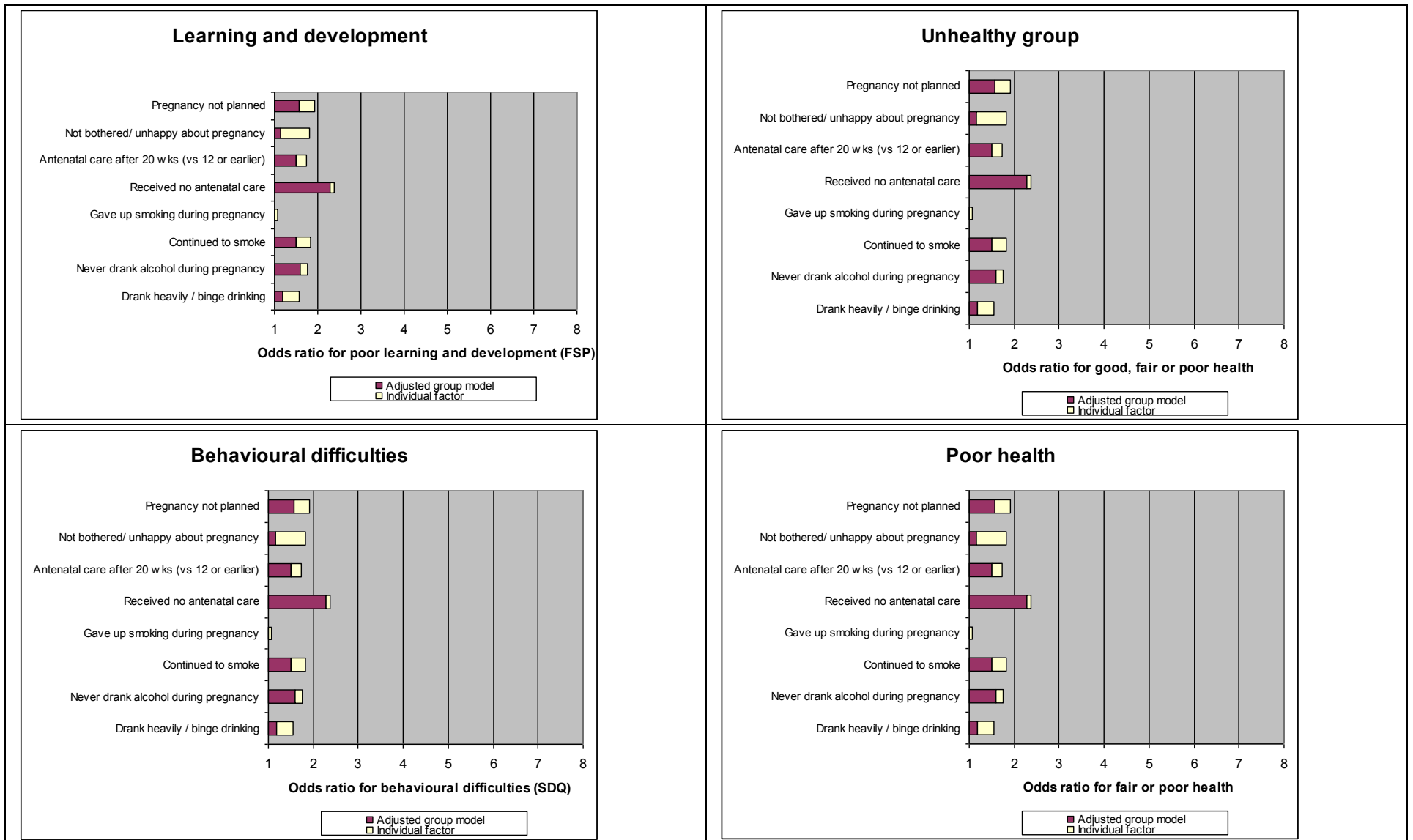


Table 3: Association between mother's health and well being and children's outcomes

		Sample %	Learning and development (FSP) 0-62 (10.2%)		Behavioural difficulties (SDQ) 14-40 (9.0%)		General health Good (13.4%) Fair/poor (4.0%)		OR (good/fair/poor)		OR (fair/poor)			
			Unadjusted	Adjusted ¹	Unadjusted	Adjusted ¹	Unadjusted	Adjusted ¹	Unadjusted	Adjusted ¹	Unadjusted	Adjusted ¹		
General health	Excellent	30.9	7.0	(ref)	(ref)	5.7	(ref)	(ref)	8.6	2.3	(ref)	(ref)	(ref)	(ref)
	Good	52.5	10.1	1.49***	1.37**	8.7	1.56***	1.26*	14.0	3.7	1.76***	1.58***	1.63**	1.43*
	Fair	14.0	15.4	2.43***	1.91***	15.8	3.08***	1.71***	21.1	7.9	3.36***	2.59***	3.71***	2.61***
	Poor	2.5	21.6	3.67***	2.54***	24.6	5.36***	2.39***	17.0	11.7	3.30***	2.26***	5.69***	3.39***
Malaise score (psychological distress)	0 to 3	86.5	8.9	(ref)	(ref)	7.1	(ref)	(ref)	12.4	3.4	(ref)	(ref)	(ref)	(ref)
	4 to 9 (high)	13.5	15.9	1.93***	1.21	20.9	3.44***	1.71***	18.2	7.9	1.89***	1.12	2.46***	1.27
Felt low or sad (for at least 2 weeks)	No	67.2	8.9	(ref)	(ref)	7.0	(ref)	(ref)	11.8	3.0	(ref)	(ref)	(ref)	(ref)
	Yes	32.8	12.8	1.50***	1.12	13.4	2.08***	1.14	16.7	6.2	1.70***	1.27***	2.13***	1.43**
Ever diagnosed with depression or anxiety	No	76.1	9.6	(ref)	(ref)	7.5	(ref)	(ref)	12.6	3.4	(ref)	(ref)	(ref)	(ref)
	Yes	23.9	12.1	1.30**	0.92	13.8	1.99***	1.22†	16.0	6.0	1.48***	1.03	1.81***	1.10
Self efficacy	No negative indication	78.3	7.6	(ref)	(ref)	5.5	(ref)	(ref)	10.8	3.0	(ref)	(ref)	(ref)	(ref)
	Any negative indication	21.7	16.1	2.32***	1.97***	19.8	4.25***	2.95***	18.1	6.6	2.05***	1.53***	2.30***	1.46*

¹Adjusted for all other factors in this domain plus child's age and gender.

†p<0.1, *p<0.05, ** p<0.01, ***p<0.001.

Frequency of unreported data: general health <0.1%, malaise score 2.7%, felt low or sad <0.1%, ever diagnosed with depression <0.1%, locus of control 19.0%.

Figure 3: Association between mother's health and well being and children's outcomes

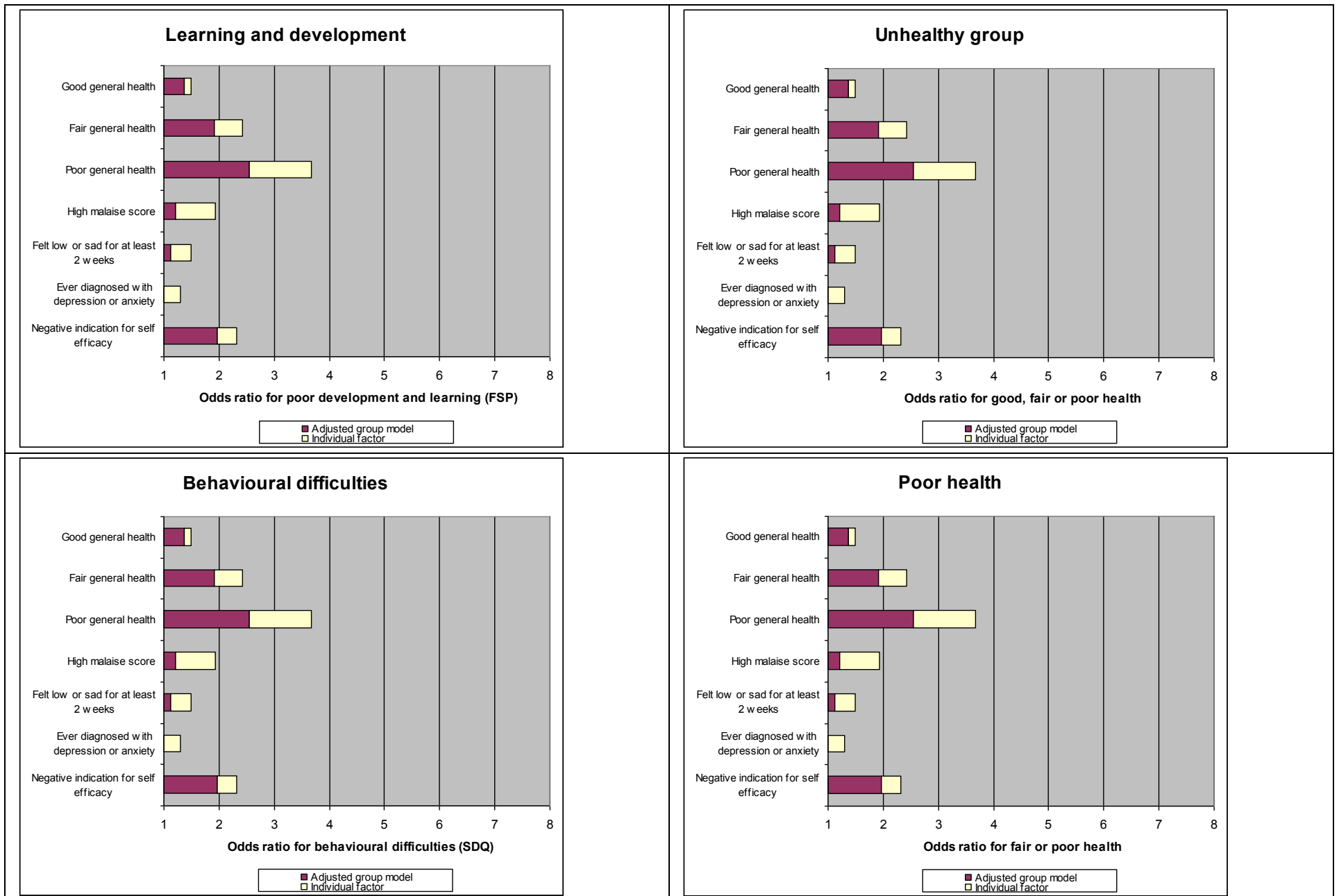


Table 4: Association between mother's socioeconomic situation and children's outcomes

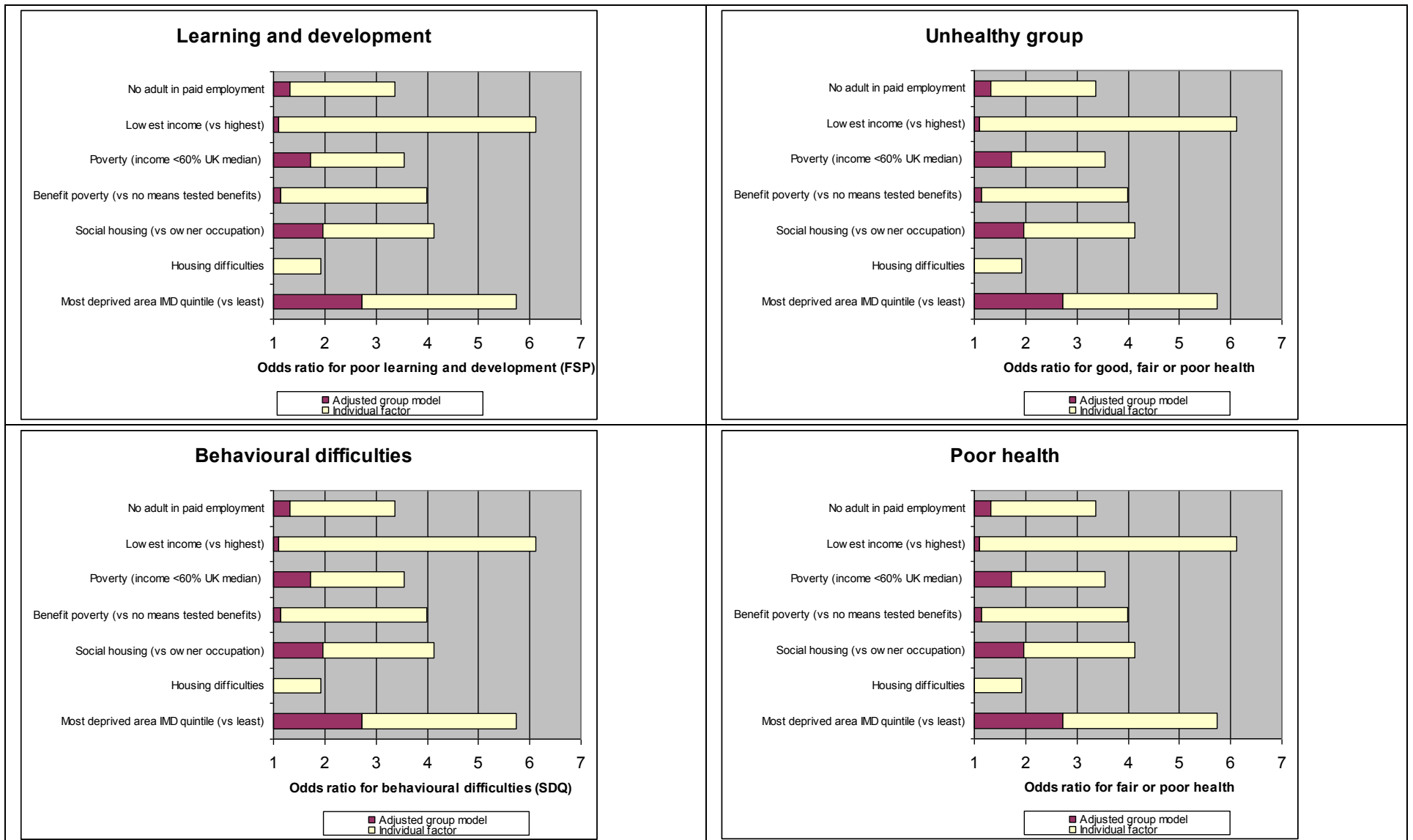
		Sample %	Learning and development (FSP)		Behavioural difficulties (SDQ)		General health		OR (good/fair/poor)		OR (fair/poor)			
			0-62 (10.2%)	Odds Ratio (OR) Unadjusted Adjusted ¹	14-40 (9.0%)	OR Unadjusted Adjusted ¹	Good (13.4%)	Fair/poor (4.0%)	Unadjusted Adjusted ¹	Unadjusted Adjusted ¹				
Adult in employment	1 or more	83.4	7.8	(ref)	(ref)	7.4	(ref)	(ref)	12.4	3.3	(ref)	(ref)	(ref)	(ref)
	None	16.6	22.2	3.36***	1.33*	18.5	2.84***	1.08	18.5	7.9	1.93***	1.13	2.55***	1.28
Net household income	£31,200+	24.0	3.8	(ref)	(ref)	3.7	(ref)	(ref)	9.4	1.7	(ref)	(ref)	(ref)	(ref)
	£20,800-£31,200	22.5	5.9	1.59*	1.35	6.0	1.66**	1.42*	11.1	2.5	1.25†	1.17	1.44†	1.34
	£10,400-£20,800	32.1	11.2	3.22***	1.45*	10.3	2.98***	1.60**	14.5	4.6	1.88***	1.41**	2.72***	1.95**
	£0-£10,400	21.5	19.4	6.11***	1.11	17.4	5.48***	1.82*	17.8	7.2	2.67***	1.37†	4.39***	2.14*
Income poverty (<60% UK median)	No	72.0	6.4	(ref)	(ref)	6.5	(ref)	(ref)	11.4	2.9	(ref)	(ref)	(ref)	(ref)
	Yes	28.0	19.5	3.55***	1.73***	16.2	2.79***	0.97	17.9	6.9	1.97***	1.20	2.48***	1.07
Receipt of means tested benefits	No benefits	64.0	6.3	(ref)	(ref)	5.8	(ref)	(ref)	11.4	2.7	(ref)	(ref)	(ref)	(ref)
	Any benefit	17.0	12.6	2.16***	1.16	12.1	2.23***	1.35*	15.5	5.0	1.57***	1.16†	1.88***	1.24
	Benefit poverty	19.0	21.0	3.99***	1.14	18.6	3.69***	1.35†	18.3	7.6	2.14***	1.20	2.98***	1.29
Housing tenure	Owner occupier	62.3	5.5	(ref)	(ref)	5.4	(ref)	(ref)	11.3	2.8	(ref)	(ref)	(ref)	(ref)
	Private rented	8.6	13.9	2.78***	1.80***	15.0	3.11***	2.03***	14.4	5.4	1.50***	1.11	1.96***	1.17
	Social housing	23.6	19.4	4.13***	1.96***	16.7	3.55***	1.75***	17.5	6.7	1.94***	1.22*	2.47***	1.20
	Other	5.5	17.0	3.52***	2.14***	13.4	2.75***	1.67*	18.1	4.4	1.77***	1.26†	1.58†	0.89
Housing difficulties	No	97.3	10.0	(ref)	(ref)	8.7	(ref)	(ref)	13.4	4.0	(ref)	(ref)	(ref)	(ref)
	Yes	2.7	17.6	1.92**	1.01	21.0	2.79***	1.58*	14.0	5.9	1.18	0.82	1.53	0.94
Area index of multiple Deprivation (IMD)	Highest quintile	18.2	3.9	(ref)	(ref)	4.4	(ref)	(ref)	9.3	2.4	(ref)	(ref)	(ref)	(ref)
	60 - < 80	18.5	4.6	1.18	1.15	5.2	1.19	1.13	11.9	2.7	1.28*	1.22†	1.10	1.00
	40 - < 60	20.9	9.3	2.53***	1.94**	8.1	1.92**	1.49†	13.0	3.0	1.44**	1.21	1.25	0.95
	20 - < 40	19.3	12.0	3.37***	2.14**	10.4	2.55***	1.66**	14.5	5.4	1.87***	1.39**	2.30**	1.45
	Lowest quintile	23.1	18.9	5.74***	2.73***	16.8	4.40***	2.19***	17.3	6.2	2.30***	1.43**	2.64***	1.31

¹Adjusted for all other factors in this domain plus child's age and gender.

†p<0.1, *p<0.05, ** p<0.01, ***p<0.001.

Frequency of unreported data: adult in employment 0.1%, household income 7.0%, income poverty 7.0%, benefit poverty 0.1%, housing tenure 0.1%, housing difficulties 0%, index of multiple deprivation (IMD) <0.1%.

Figure 4: Association between mother's socioeconomic situation and children's outcomes



Key indicators for the child outcomes

Model selection

The model selection began by considering all of the indicators across the four domains. Within these models many of the indicators became redundant, that is, no association was seen once other factors had been taken into account. A model selection technique was applied to remove these factors one by one until all the factors which remained in the model were making a significant contribution to the prediction of the outcome. The statistical significance of each of the indicators was evaluated using the Wald test (UCLA Academic Technology Services 2008) and indicators were maintained in the model if either the Wald test for all the categories together was significant or the Wald test for any individual category was significant. A cut off point at the 10 per cent significance level was taken so that factors which were marginally significant statistically could be considered within the models as well as those which were more strongly significant.

Selected key indicators

In Figure 5 we highlight the factors that net of all the other factors continue to have significant or marginally significant associations with the child outcomes. The detailed Tables which accompany this summary follow in Tables 5-8 with corresponding illustrations in Figures 6-9.

Foundation Stage Profile

The key indicators for whether children are assessed as being in the lowest decile of the Foundation Stage Profile include: mother's age at first birth, the level of qualifications she had attained and whether she has ever been in employment as well as language spoken in the home, family size and whether the child was a twin or a triplet. Mother's self rated health and whether she was depressed as assessed by the malaise inventory were also important factors as were living in poverty, type of housing tenure and living in a deprived area.

Behaviour Difficulties

The factors found to be important in identifying those children who were in approximately the top decile (9 per cent of the children) of the total difficulties behaviour included: mothers level of qualification, parent's relationship at the time of the birth, language usually spoken in the home, whether the child was first born or a multiple birth. Whether the mother was happy about being pregnant or smoked during pregnancy were also important factors as were mother's general health, her malaise score and self efficacy. Housing and area also mattered in terms of housing tenure, whether the family had experienced housing difficulties and whether they lived in a deprived area.

Child health

For the 17 per cent who reported that their child was not in excellent or very good health the important factors included mother's age at first birth, her qualifications, whether she had lived away from home before age 17, language spoken in the home, whether she had been happy to be pregnant, her own self-rated general health whether she had suffered from post-natal depression and whether she felt in control of her own life (self efficacy). The only socio-economic factor that came through was level of income.

Level of income was also the only socio-economic factor that came through for the more stringent health category which included children that the mother described as being in fair or poor health which constituted 4 per cent of the 5 year old children. For this group mothers' self rated health was also important and two indicators of depression came through; the malaise score and the indicator of post-natal depression. The post-natal indicator showed a stronger association than the malaise. For this small group of children late presentation for ante-natal care or no ante-natal care was also important, as was whether the mother continued to smoke during the pregnancy. The language factor was also important as were whether there were 4 or more children in the home as well as whether the mother had seen her parents separate during her childhood.

In sum there were a number of factors that were common across all the outcomes, including: maternal qualifications, language spoken in the home and mother's self rated health. Additionally, one or other measure of depression was associated with all the outcomes, as well as one or other of the measures of socioeconomic situation. There were also factors that were more specifically to a particular outcome such as smoking during pregnancy and children's behavioural difficulties and health status.

Figure 5: Factors maintained as predictive for children’s outcomes in model selection

	FSP ¹	SDQ ²	Health ³	Health ⁴
Pre-birth demographic characteristics				
Mother’s age at child’s birth				
Mother’s age at first birth	*		*	
Mother’s qualifications	*	*	*	
Mother never employed	*			
Mother lived away from home before age 17			*	
Mother’s parents separated before age 17				*
Parents relationship – married/cohabiting/lone mother		*		
Language usually spoken in the home	*	*	*	*
Number of children in the home	*			*
Child is first born		*		
Child is a twin or a triplet	*	*		
Mother’s feelings and behaviours in pregnancy				
Pregnancy planned				
Feelings about pregnancy		*	*	
Presentation for antenatal care				*
Smoking during pregnancy		*		*
Intake of alcohol during pregnancy				
Mother’s health and wellbeing at 9 months post the birth				
Self rated general health	*	*	*	*
Malaise score	*	*		*
Felt low or sad for at least 2 weeks			*	*
Ever diagnosed with anxiety or depression				
Self efficacy		*	*	
Socioeconomic situation at 9 months post the birth				
Adult in the home in paid employment				
Net household income			*	*
Poverty (equivalised income <60% UK median)	*			
Receipt of means tested benefits				
Housing tenure	*	*		
Housing difficulties		*		
Area deprivation (IMD 2004 score)	*	*		

¹ Poorest 10 percent on Foundation Stage Profile total assessment of learning and development

² Highest 9 percent for total difficulties score from Strengths and Difficulties Questionnaire

³ General health rated as good, fair or poor (17 percent) versus excellent or very good.

⁴ General health rated as fair or poor (4 percent) versus excellent, very good or good.

Table 5: Selected predictive factors for children's learning and development

Learning and development (FSP total score 0-62, 10.2%)		Adjusted estimates			Notes: reason selected
		OR	95% CI	p	
Child's gender	Female				
	Male	1.93	(1.64, 2.26)	0.000	[Control]
Child's birth month within intake (relative to Sept 2000)		1.16	(1.13, 1.19)	0.000	[Control]
Mother's age at 1 st birth	13-19	1.57	(0.89, 2.77)	0.121	
	20-24	1.42	(0.83, 2.41)	0.196	
	25-29	1.11	(0.64, 1.91)	0.710	
	30-34	0.98	(0.57, 1.67)	0.937	Combined Wald test: p=0.042
	35+	(ref)			
Mother's qualifications	NVQ level 4/5	(ref)			
	NVQ level 3	1.12	(0.76, 1.65)	0.568	
	NVQ level 2	1.57	(1.19, 2.08)	0.002	
	NVQ level 1	2.32	(1.67, 3.21)	0.000	
	No qualifications	2.13	(1.55, 2.91)	0.000	Combined Wald test: p=0.000
Mother ever worked	Yes	(ref)			
	No	1.34	(1.08, 1.65)	0.007	Wald test: p= 0.007
Language usually spoken in home	English	(ref)			Combined Wald test: p=0.123
	English and other	1.34	(0.97, 1.84)	0.075	But, marginal individual effect English and Other: p=0.075
	Other language only	1.22	(0.88, 1.69)	0.227	[note: if English and other/ other language grouped together: p=0.048]
Children in home	1 child	(ref)			
	2 children	1.10	(0.92, 1.31)	0.286	
	3 children	1.46	(1.15, 1.85)	0.002	
	4+ children	1.51	(1.10, 2.06)	0.010	Combined Wald test: p=0.007
Child twin/triplet	Single birth	(ref)			
	Twin or triplet	1.77	(1.05, 2.98)	0.032	Wald test: p= 0.032
General health	Excellent	(ref)			
	Good	1.18	(0.96, 1.44)	0.110	
	Fair	1.46	(1.13, 1.88)	0.004	
	Poor	1.78	(1.17, 2.73)	0.008	Combined Wald test: p=0.008
Malaise score (psychological distress)	0 to 3	(ref)			
	4 to 9 (high)	1.30	(1.00, 1.68)	0.049	Wald test: p=0.049
Income poverty (<60% UK median)	No	(ref)			
	Yes	1.34	(1.11, 1.62)	0.002	Wald test: p=0.002
Housing tenure	Owner occupier	(ref)			
	Private rented	1.67	(1.25, 2.23)	0.001	
	Social housing	1.68	(1.32, 2.13)	0.000	
	Other	1.79	(1.22, 2.64)	0.003	Combined Wald test: p=0.000
Area index of multiple Deprivation (IMD)	Highest quintile	(ref)			
	60 - < 80	1.06	(0.64, 1.76)	0.810	
	40 - < 60	1.78	(1.16, 2.72)	0.008	
	20 - < 40	1.83	(1.18, 2.85)	0.008	
	Lowest quintile	2.05	(1.32, 3.20)	0.002	Combined Wald test: p=0.001

Figure 6: Selected predictive factors for children’s learning and development

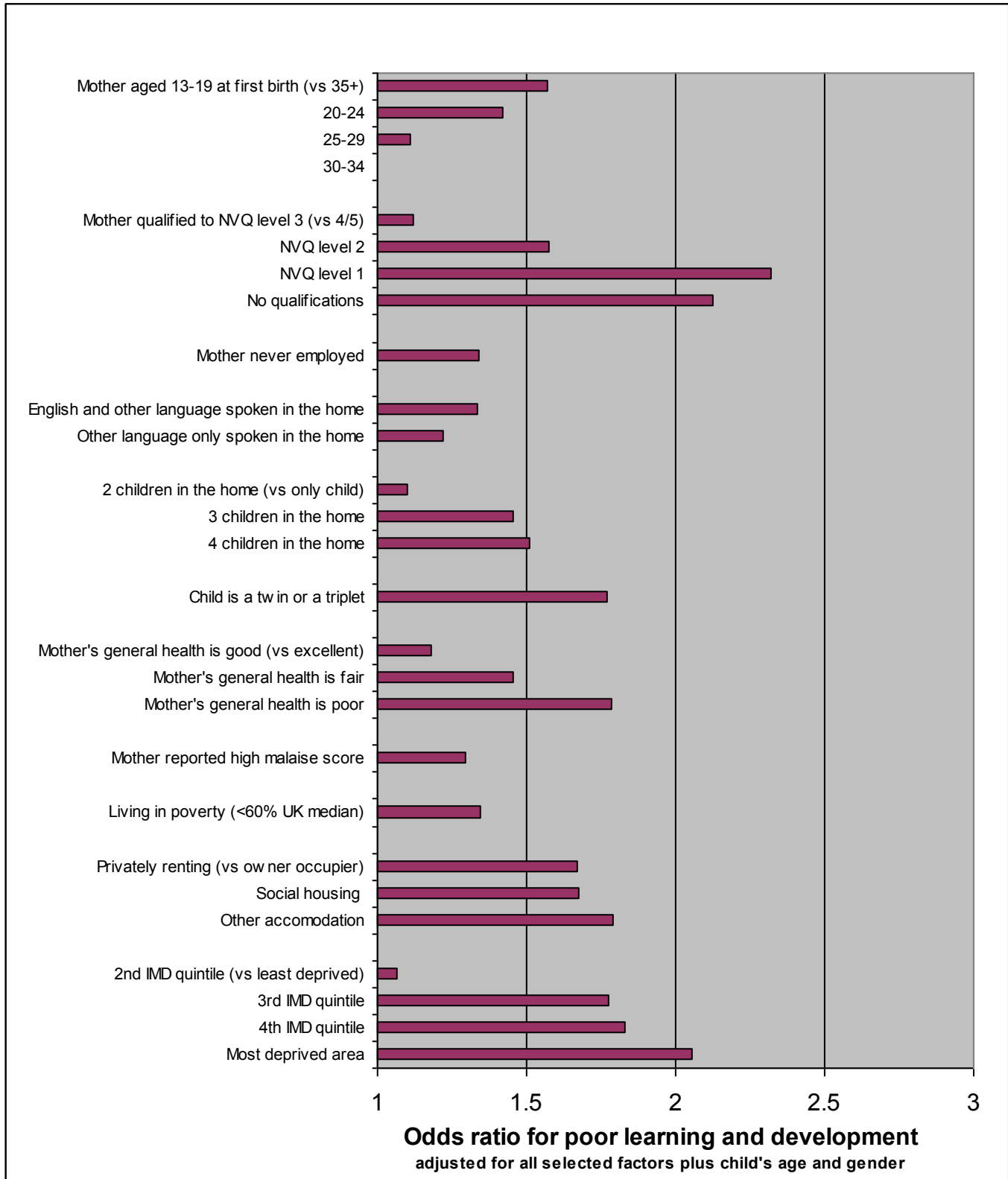


Table 6: Selected predictive factors for children's behavioural difficulties

Behavioural difficulties (SDQ total difficulties score 14-40, 9.0%)		Adjusted estimates			Notes: reason selected
		OR	95% CI	p	
Child's gender	Female	(ref)			
	Male	1.87	(1.58, 2.23)	0.000	[Control]
Child's age at interview (years) (relative to age 5)		1.00	(0.67, 1.49)	0.994	[Control]
Mother's qualifications	NVQ level 4/5	(ref)			
	NVQ level 3	1.26	(0.90, 1.77)	0.175	
	NVQ level 2	1.45	(1.10, 1.90)	0.008	
	NVQ level 1	1.75	(1.26, 2.42)	0.001	
	No qualifications	2.00	(1.41, 2.83)	0.000	Combined Wald test: p=0.002
Relationship with child's father at birth	Married	(ref)			Combined Wald test: p=0.1085
	Cohabiting	1.26	(1.01, 1.57)	0.037	But individual effect for cohabiting: p=0.037
	Not living together	1.24	(0.91, 1.69)	0.168	[note: if Cohabiting and Not living together grouped together: p=0.029]
Language usually spoken in home	English	(ref)			
	English and other	1.10	(0.79, 1.54)	0.562	Combined Wald test: p=0.1944
	Other language only	1.65	(0.96, 2.83)	0.070	But, marginal individual effect other language only: p=0.070
Child first born	First birth	(ref)			
	Second or later birth	0.76	(0.62, 0.93)	0.008	Wald test: p=0.008
Child twin/triplet	Single birth	(ref)			
	Twin or triplet	1.66	(0.97, 2.84)	0.063	Marginal Wald test: p=0.063
Feelings about Pregnancy	Very happy	(ref)			
	Happy	1.19	(0.95, 1.48)	0.123	
	Not bothered / unhappy	1.34	(1.04, 1.73)	0.022	Combined Wald test marginal: p=0.0541
Smoking in pregnancy	Non smoker	(ref)			
	Gave up	0.98	(0.74, 1.31)	0.905	
	Continued	1.46	(1.14, 1.88)	0.003	Combined Wald test: p=0.007
General health	Excellent	(ref)			
	Good	1.17	(0.95, 1.45)	0.131	
	Fair	1.48	(1.12, 1.95)	0.007	
	Poor	2.02	(1.27, 3.21)	0.003	Combined Wald test: p=0.01
Malaise score (psychological distress)	0 to 3	(ref)			
	4 to 9 (high)	1.89	(1.47, 2.42)	0.000	Wald test: p=0.000
Self efficacy	No negative indication	(ref)			
	Any negative indication	2.09	(1.67, 2.63)	0.000	Wald test: p=0.000
Housing tenure	Owner occupier	(ref)			
	Private rented	1.68	(1.17, 2.42)	0.005	
	Social housing	1.32	(0.99, 1.75)	0.055	
	Other	1.18	(0.77, 1.81)	0.453	Combined Wald test: p=0.03
Housing difficulties	No	(ref)			
	Yes	1.51	(0.96, 2.39)	0.075	Marginal Wald test: p=0.07
Area index of multiple Deprivation (IMD)	Highest quintile	(ref)			
	60 - < 80	1.10	(0.72, 1.67)	0.659	
	40 - < 60	1.35	(0.89, 2.03)	0.154	
	20 - < 40	1.38	(0.94, 2.03)	0.101	
	Lowest quintile	1.71	(1.18, 2.48)	0.005	Combined Wald test: p=0.02

Figure 7: Selected predictive factors for children's behavioural difficulties

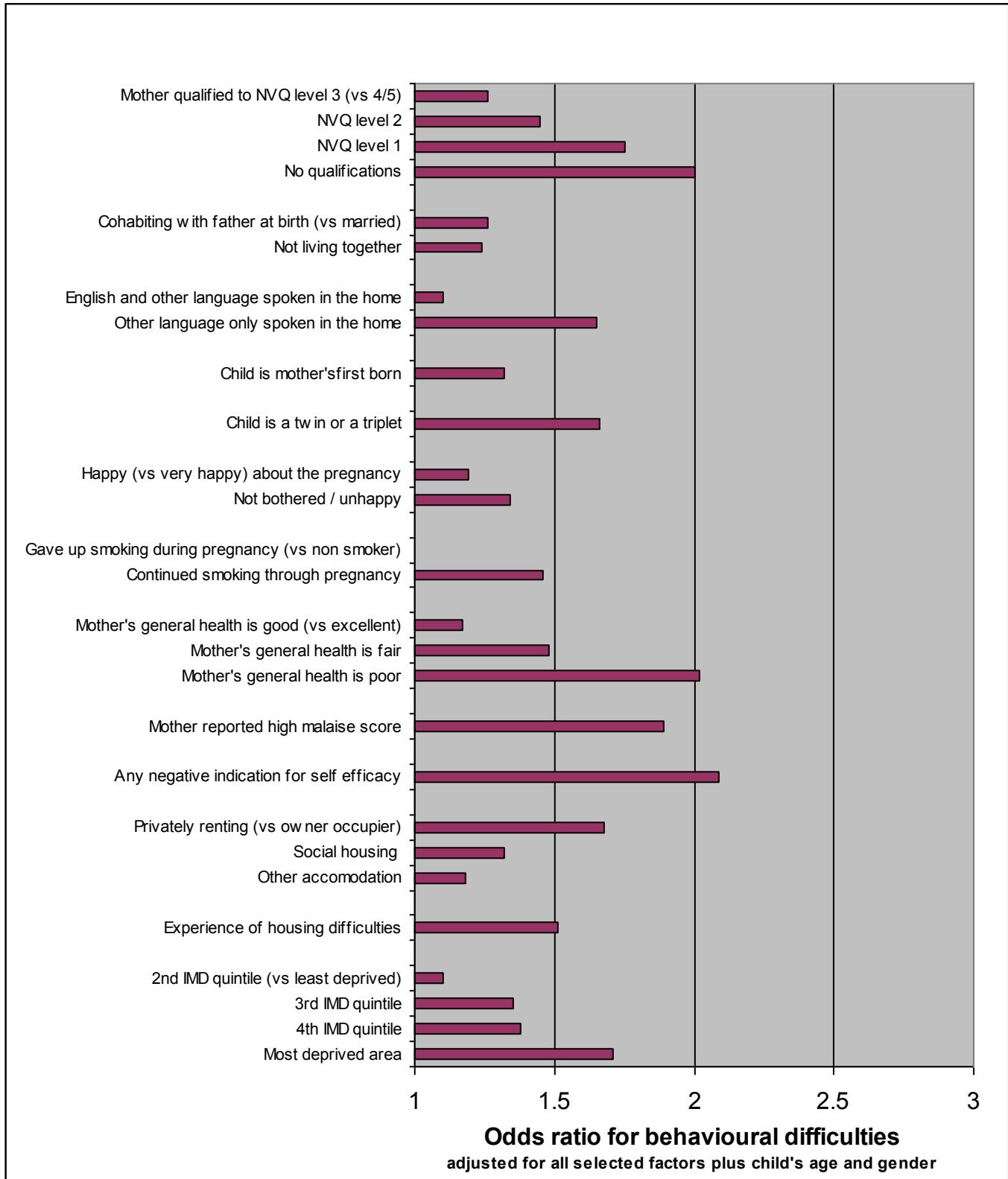


Table 7: Selected predictive factors for unhealthy group (children's health good, fair or poor)

General health (good/fair/poor 17.4%)		Adjusted estimates			Notes: reason selected
		OR	95% CI	p	
Child's gender	Female	(ref)			
	Male	1.24	(1.11, 1.39)	0.000	[Control]
Child's age at interview (years) (relative to age 5)		0.72	(0.55, 0.95)	0.019	[Control]
Mother's age at 1 st birth	13-19	1.19	(0.88, 1.61)	0.256	
	20-24	1.35	(1.02, 1.80)	0.038	
	25-29	1.01	(0.77, 1.32)	0.966	
	30-34	0.94	(0.69, 1.27)	0.676	Combined Wald test: p=0.02
	35+	(ref)			
Mother's qualifications	NVQ level 4/5	(ref)			
	NVQ level 3	1.00	(0.82, 1.21)	0.968	
	NVQ level 2	1.17	(0.98, 1.39)	0.087	
	NVQ level 1	1.37	(1.12, 1.68)	0.003	
	No qualifications	1.45	(1.15, 1.82)	0.002	Combined Wald test: p=0.01
Mother lived away from home before 17	No	(ref)			
	Yes	1.21	(1.02, 1.42)	0.024	Wald test: p=0.03
Language usually spoken in home	English	(ref)			
	English and other	1.85	(1.57, 2.19)	0.000	
	Other language only	1.44	(1.04, 1.99)	0.027	Combined Wald test: p=0.000
Feelings about Pregnancy	Very happy	(ref)			
	Happy	1.06	(0.93, 1.22)	0.388	Combined Wald test: p=0.13
	Not bothered / unhappy	1.18	(1.00, 1.40)	0.052	But marginal individual effect feelings about pregnancy: p=0.052
General health	Excellent	(ref)			
	Good	1.49	(1.26, 1.75)	0.000	
	Fair	2.32	(1.86, 2.90)	0.000	
	Poor	2.03	(1.44, 2.87)	0.000	Combined Wald test: p=0.000
Felt low or sad (for at least 2 weeks)	No	(ref)			
	Yes	1.30	(1.14, 1.47)	0.000	Wald test: p=0.000
Self efficacy	No negative indication	(ref)			
	Any negative indication	1.22	(1.03, 1.45)	0.023	Wald test: p=0.03
Net household income	£31,200+	(ref)			
	£20,800-£31,200	1.05	(0.84, 1.31)	0.659	
	£10,400-£20,800	1.16	(0.93, 1.43)	0.180	Combined Wald test: p=0.18
	£0-£10,400	1.28	(1.02, 1.60)	0.030	But individual effect lowest income group: p=0.03

Note smoking and alcohol maintained in model with marginal effects – protective effect for quitting smoking in pregnancy odds ratio 0.85, p=0.10 plus negative effect of never drinking compared to all other groups (combined Wald test 0.097) – chosen to remove as not 'risk factors' as such.

Figure 8: Selected predictive factors for unhealthy group (children's health good, fair or poor)

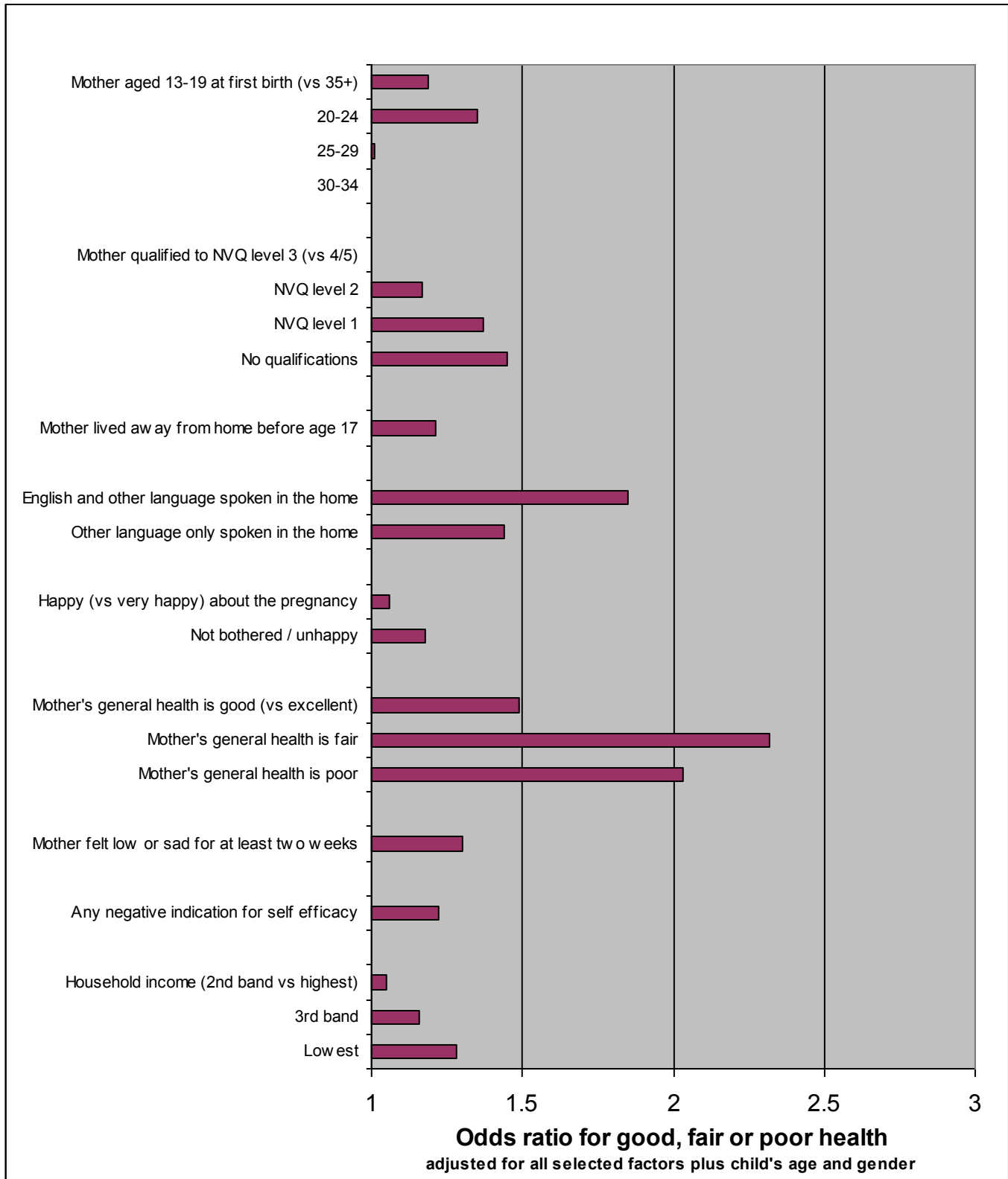
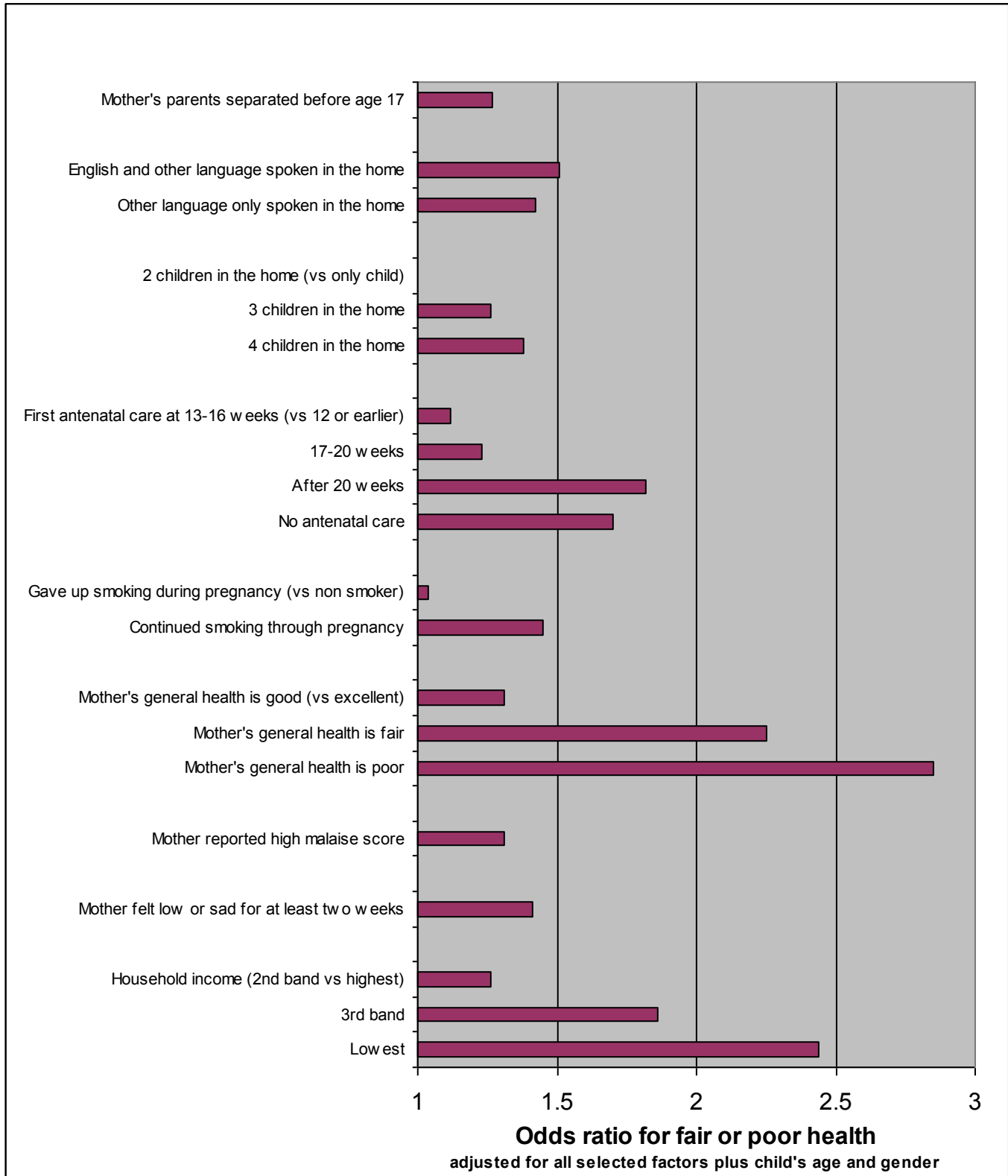


Table 8: Selected predictive factors for poor health (children's health fair or poor)

General health (fair/poor 4.0%)		Adjusted estimates			Notes: reason selected
		OR	95% CI	p	
Child's gender	Female	(ref)			
	Male	1.24	(1.01, 1.52)	0.037	[Control]
Child's age at interview (years) (relative to age 5)		0.73	(0.47, 1.13)	0.156	[Control]
Mother's parents separated before age 17	No	(ref)			
	Yes	1.27	(0.97, 1.67)	0.078	Marginal Wald test: p=0.078
Language usually spoken in home	English	(ref)			
	English and other	1.51	(1.10, 2.09)	0.011	
	Other language only	1.42	(0.76, 2.65)	0.265	Combined Wald test: p=0.038
Children in home	1 child	(ref)			
	2 children	0.89	(0.66, 1.20)	0.441	
	3 children	1.26	(0.91, 1.73)	0.160	Marginal combined Wald test: p=0.067
	4+ children	1.38	(0.95, 1.99)	0.091	Marginal individual effect 4+ children: p=0.09
First antenatal care	12 weeks or earlier	(ref)			
	13-16 weeks	1.12	(0.80, 1.58)	0.500	
	17-20 weeks	1.23	(0.77, 1.96)	0.385	
	After 20 weeks	1.82	(0.97, 3.40)	0.062	
	No antenatal care	1.70	(1.04, 2.75)	0.033	Marginal combined Wald test: p=0.078
Smoking in pregnancy	Non smoker	(ref)			
	Gave up	1.04	(0.73, 1.48)	0.840	
	Continued	1.45	(1.11, 1.90)	0.006	Combined Wald test: p=0.020
General health	Excellent	(ref)			
	Good	1.31	(0.97, 1.76)	0.079	
	Fair	2.25	(1.59, 3.19)	0.000	
	Poor	2.85	(1.76, 4.63)	0.000	Combined Wald test: p=0.000
Malaise score (psychological distress)	0 to 3	(ref)			
	4 to 9 (high)	1.31	(0.98, 1.74)	0.070	Marginal Wald test: p=0.070
Felt low or sad (for at least 2 weeks)	No	(ref)			
	Yes	1.41	(1.10, 1.80)	0.007	Wald test: p=0.0066
Net household income	£31,200+	(ref)			
	£20,800-£31,200	1.26	(0.83, 1.94)	0.279	
	£10,400-£20,800	1.86	(1.23, 2.83)	0.004	
	£0-£10,400	2.44	(1.55, 3.82)	0.000	Combined Wald test: p=0.0006

Figure 9: Selected predictive factors for poor health (children's health fair or poor)



Models for Different Groups of Children - Analysis of Interaction

A question that arose whilst specifying the models was whether a common set of risk propensity models would be applicable for different groups of children. This question was particularly pertinent for first born children, to whom services have traditionally been more targeted, compared to children born to mothers who already have children. There was some evidence that behavioural difficulties may be seen less frequently amongst children born to mothers who already have children compared to first born children, but this pattern was not seen for the other outcomes where no significant difference was described once other factors had been taken in to account. An analysis of interaction was used to investigate whether the predictive factors had a different meaning, or level of effect, for first born or later born children. This didn't provide strong or consistent evidence that the predictive factors had different levels of effect for first born or later born children.

A similar interaction analysis was made of whether any risk factor had a different level of effect for boys, who tend to experience poor outcomes more frequently compared to girls. This didn't provide strong or consistent evidence that the predictive factors had different levels of effect for boys compared to girls.

Ideally interaction analysis would have been used to determine whether there were predictive factors which had a different meaning or level of effect for children of mothers from different Ethnic minority groups. However even within the large MCS study the numbers of mothers from Ethnic minority groups were too small to carry out a reliable analysis of interaction so this could not be implemented. Nevertheless, we thought it would be useful to examine how ethnicity relates to the child outcomes and we do this in the next section.

Ethnicity and Child Outcomes

The UK has increasingly become an ethnically diverse society and in the MCS sample 13 per cent of the babies were born to mothers from ethnic minority populations. The MCS mothers were asked which ethnic identity category they felt they belonged to corresponding to the categories used in the UK census (Office for National Statistics 2003). For this analysis mother's ethnicity was grouped into the categorisation: White, Indian, Pakistani, Bangladeshi, Black Caribbean, Black African and Other following the classification system used in Kelly et al 2009a. The distributions are shown in the first column of Table 9.

It is apparent from Table 9, illustrated also in Figure 10, that maternal ethnicity is associated with the child outcomes. In this table we show the unadjusted odds, and adjusted estimates with and without adjustment for languages spoken at home. From the unadjusted odds ratios we see that children from all the ethnic groups bar those with mothers of Indian origin are more likely to be in the lowest 10 per cent of the Foundation Stage Profile. However, after taking into account the other background factors only children of mothers of Pakistani origin are found to be significantly different from the White children, and this is relatively weak relationship (significant at the 10 per cent level) once we add in the additional adjustment for language spoken in the home.

With regard to behavioural difficulties we see evidence of greater difficulties amongst the Pakistani, Bangladeshi and children with a Black Caribbean heritage, but after adjustment we see that once again it is only the Pakistani children that are significantly different from the reference group of children of White mothers. We are not in a position to know whether these

real cultural differences or possible response biases in their answers to the questions. The SDQ has been used on Bangladeshi older children and found to be a useful tool for identifying children with behaviour problems (Mullick and Goodman, 2001). Thus it might be expected that this may also be the case for other South Asian groups. Turning to the health outcomes we see that after all the adjustments the Pakistani children have poorer reported health status on both our health measures and Indian and Bangladeshi children are also relatively more unhealthy on the wider definition of health status. One of the clearer points to emerge from this analysis is that, relatively speaking, Pakistani children are faring less well educationally, behaviourally and health wise than children from other ethnic groups.

Although there were observed differences in the frequency of children's difficulties amongst the minority Ethnic groups it is difficult to conceptualise or order Ethnic origin as a 'risk' factor as such. Moreover, practically speaking the estimated associations between Ethnicity and children's outcome are strongly subject to sampling variation due to the small numbers of mothers within each group and as illustrated by the wide confidence intervals (Table 9) it is difficult to differentiate reliably between the groups. For these reasons, a detailed examination of Ethnic origin in which the largest minority groups in the UK were each represented was made following rather than within the model selection procedure. From the outset we regarded ethnicity to be a potentially important attribute in terms of maternal behaviour and child development. It was hoped that we would be able to do all our analyses separately by ethnic group. But, even in a large sample such as the MCS, and one that had over-sampled ethnic minority wards to increase the sample size, there was still insufficient numbers for us to be able to do this.

From these data we would hesitate to suggest estimates for risk propensity by Ethnicity but rather recommend that further research for the PREview tool ensures a strong representation of mothers from Ethnic minority groups and consideration of whether there may be services which could be of particular benefit to these mothers.

Table 9: Association between mother's ethnic origin and children's outcomes

Mother's Ethnicity	Sample %	Outcome %	Unadjusted estimates		Adjusted estimates ¹		Adjusted estimates ²	
			OR	95% CI	OR	95% CI	OR	95% CI
Learning and development (FSP total score 0-62, 10.2%)								
White	86.5	9.0	(ref)		(ref)		(ref)	
Indian	2.2	9.3	1.03	(0.65, 1.62)	0.91	(0.59, 1.40)	0.83	(0.49, 1.38)
Pakistani	3.7	24.7	3.30***	(2.32, 4.68)	1.85**	(1.18, 2.90)	1.68†	(0.98, 2.86)
Bangladeshi	1.3	23.1	3.03***	(1.79, 5.14)	1.26	(0.63, 2.53)	1.15	(0.52, 2.52)
Black Caribbean	1.9	18.5	2.28**	(1.35, 3.86)	1.49	(0.91, 2.45)	1.49	(0.91, 2.45)
Black African	2.1	16.1	1.94**	(1.31, 2.87)	0.97	(0.64, 1.47)	0.91	(0.59, 1.39)
Other	2.3	15.3	1.82**	(1.27, 2.61)	1.35	(0.92, 2.00)	1.26	(0.79, 2.00)
Behavioural difficulties (SDQ total difficulties score 14-40, 9.0%)								
White		8.5	(ref)		(ref)		(ref)	
Indian		10.3	1.24	(0.66, 2.34)	1.32	(0.67, 2.60)	1.31	(0.58, 2.95)
Pakistani		18.8	2.51***	(1.89, 3.33)	1.80**	(1.26, 2.58)	1.76*	(1.00, 3.09)
Bangladeshi		15.8	2.03*	(1.17, 3.52)	1.35	(0.78, 2.35)	1.29	(0.64, 2.60)
Black Caribbean		18.8	2.51**	(1.29, 4.87)	1.45	(0.73, 2.88)	1.45	(0.73, 2.88)
Black African		7.9	0.92	(0.46, 1.84)	0.58	(0.30, 1.13)	0.58	(0.28, 1.18)
Other		10.2	1.22	(0.67, 2.24)	1.00	(0.54, 1.87)	0.99	(0.52, 1.87)
General health (good/fair/poor 17.4%)								
White		15.7	(ref)		(ref)		(ref)	
Indian		29.9	2.29***	(1.60, 3.27)	2.15***	(1.48, 3.10)	1.88**	(1.22, 2.90)
Pakistani		40.1	3.59***	(2.96, 4.36)	2.70***	(2.21, 3.31)	2.39***	(1.70, 3.35)
Bangladeshi		29.3	2.22***	(1.57, 3.14)	1.63**	(1.13, 2.37)	1.46†	(0.93, 2.30)
Black Caribbean		24.1	1.70**	(1.23, 2.35)	1.30	(0.93, 1.80)	1.29	(0.93, 1.79)
Black African		17.5	1.13	(0.80, 1.61)	0.87	(0.59, 1.28)	0.79	(0.50, 1.25)
Other		21.8	1.49**	(1.12, 1.99)	1.30	(0.98, 1.74)	1.20	(0.86, 1.67)
General health (fair/poor 4.0%)								
White		3.7	(ref)		(ref)		(ref)	
Indian		4.5	1.22	(0.69, 2.14)	1.38	(0.78, 2.46)	1.29	(0.62, 2.70)
Pakistani		9.3	2.67***	(1.81, 3.93)	2.22***	(1.46, 3.37)	2.07*	(1.20, 3.58)
Bangladeshi		6.5	1.81**	(1.26, 2.60)	1.50†	(0.97, 2.32)	1.41	(0.77, 2.56)
Black Caribbean		7.2	2.02*	(1.16, 3.53)	1.34	(0.75, 2.42)	1.34	(0.75, 2.42)
Black African		3.0	0.80	(0.33, 1.90)	0.65	(0.25, 1.64)	0.61	(0.23, 1.63)
Other		5.5	1.51	(0.89, 2.56)	1.39	(0.80, 2.43)	1.34	(0.73, 2.43)

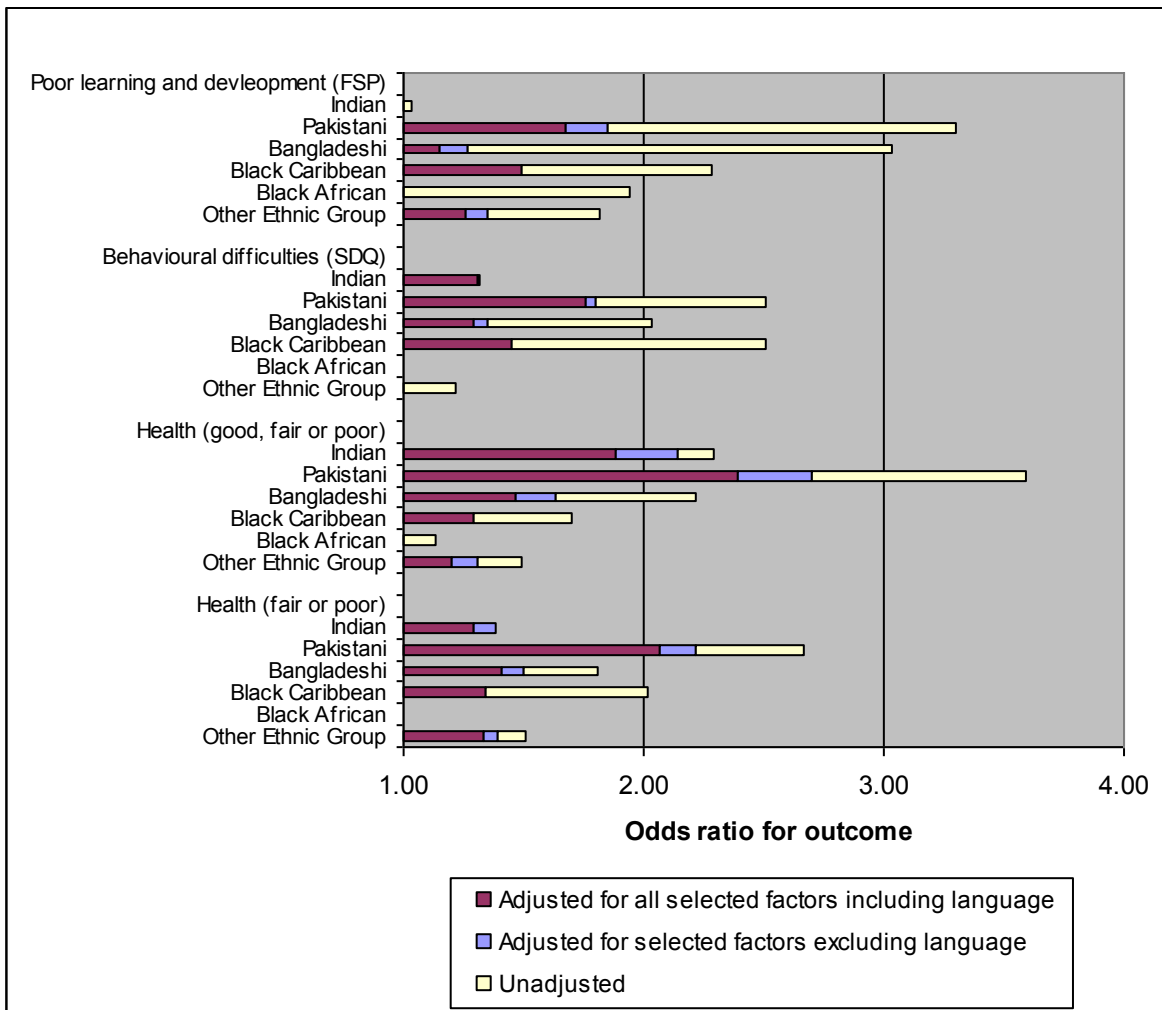
¹Adjusted for child's age and gender plus all other factors selected as significantly associated with the outcome excluding language spoken in the home (see Figure 5 for detail of factors)

²Adjusted for child's age and gender all other factors selected as significantly associated with the outcome including language spoken in the home

†p<0.10, *p<0.05, ** p<0.01, ***p<0.001.

Frequency of unreported data for ethnicity 0.3%.

Figure10: Association between mother's ethnic origin and children's outcomes



Birth Weight

The domains considered within the selection procedure did not include birth weight because a key intention of the analysis was to consider characteristics which could potentially be assessed during the antenatal period. However, an analysis of birth weight was made following the selection procedure as it can be an important mediator of antenatal circumstances for children’s developmental outcomes. Birth weight is also known to be an important measure for assessing a child’s future growth trajectory, and for investigating both early health risks and those in later childhood (Ong et al, 2002). It is also known to be related to children’s cognitive development (Kiernan and Mensah, 2009). In Table 10, and illustrated in Figure 11, we examine how birth weight relates to the age 5 child outcomes. In this table we also adjust for mother’s ethnic origin as many of the mothers in these groups have on average lighter babies than White mothers (Kelly et al 2009a). After adjustment for all the background factors we see that babies of less than 2.5 kg were more likely to be doing less well at school and to have poorer health. However, there was little evidence that low birth weight was associated with later behaviour difficulties.

Table 10: Association between children’s birth weight and outcomes

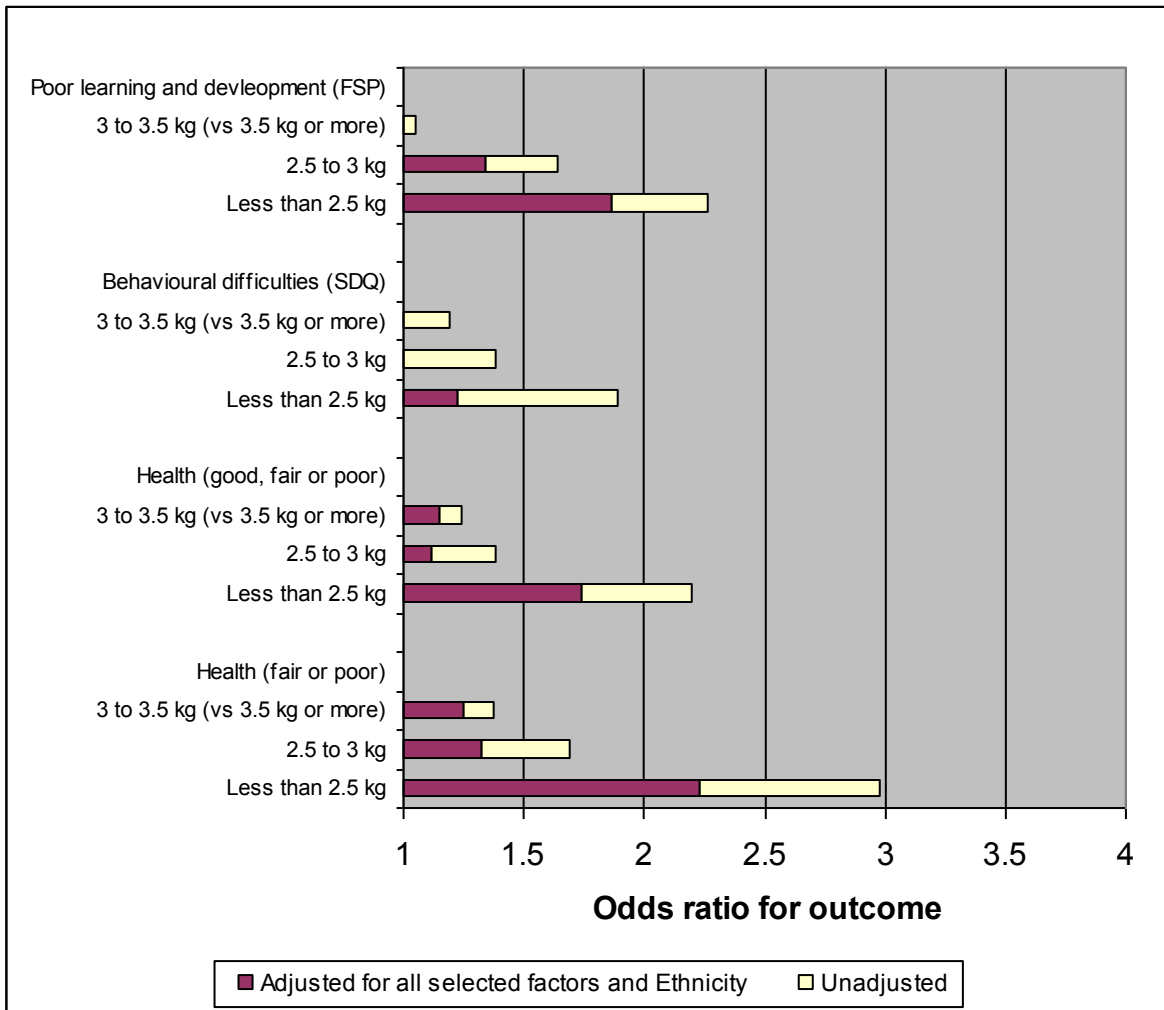
Child’s birth weight	Sample %	Outcome %	Unadjusted estimates		Adjusted estimates ¹	
			OR	95% CI	OR	95% CI
Learning and development (FSP total score 0-62, 10.2%)						
3.5kg or more	40.7	8.6	(ref)		(ref)	
3 to 3.5kg	35.2	9.0	1.05	(0.87, 1.27)	0.99	(0.81, 1.21)
2.5 to 3kg	16.4	13.4	1.64***	(1.30, 2.06)	1.34*	(1.06, 1.69)
Less than 2.5kg	7.7	17.6	2.26***	(1.76, 2.90)	1.86***	(1.36, 2.56)
Behavioural difficulties (SDQ total difficulties score 14-40, 9.0%)						
3.5kg or more		7.7	(ref)		(ref)	
3 to 3.5kg		9.0	1.19	(0.96, 1.48)	0.98	(0.78, 1.24)
2.5 to 3kg		10.3	1.38*	(1.08, 1.77)	0.95	(0.72, 1.25)
Less than 2.5kg		13.6	1.89***	(1.40, 2.55)	1.22	(0.87, 1.73)
General health (good/fair/poor 17.4%)						
3.5kg or more		14.7	(ref)		(ref)	
3 to 3.5kg		17.6	1.24**	(1.08, 1.42)	1.15†	(1.00, 1.32)
2.5 to 3kg		19.2	1.38***	(1.16, 1.65)	1.12	(0.93, 1.33)
Less than 2.5kg		27.4	2.20***	(1.81, 2.66)	1.74***	(1.41, 2.15)
General health (fair/poor 4.0%)						
3.5kg or more		2.9	(ref)		(ref)	
3 to 3.5kg		4.0	1.37*	(1.06, 1.76)	1.25†	(0.96, 1.63)
2.5 to 3kg		4.9	1.69**	(1.23, 2.33)	1.32	(0.94, 1.85)
Less than 2.5kg		8.3	2.98***	(2.23, 3.98)	2.23***	(1.63, 3.04)

¹Adjusted for child’s age and gender plus mother’s ethnicity and all other factors selected as significantly associated with the outcome (see Figure 5 for detail of factors)

†p<0.10, *p<0.05, ** p<0.01, ***p<0.001.

Frequency of unreported data for birth weight 0.1%.

Figure 11: Association between children's birth weight and outcomes



Ways in which this study might inform the PREview tool

Our analyses have shown that there are different levels of risk or vulnerability amongst children conceived, born and growing up in different contexts and it is apparent that even very early in life the odds are stacked towards some children experiencing more difficulties than others.

This kind of information potentially could be used to inform and plan intervention strategies and in the next two sections we present examples of how these types of analysis might inform a PREview tool. The first section illustrates how well the MCS background factors predict which children will fall into a given range and the second section provides some illustrations of how the evidence from the MCS might be used to identify vulnerable groups of families who might benefit from interventions.

Propensity Score Analysis

Having established the salient factors associated with the child outcomes and having established the robustness of the evidence for birth weight (at the request of the commissioners of this research) these factors were considered together and used to estimate risk propensity scores. Logistic regression models were fitted for each of the child outcomes which included the selected factors from Figure 5 as well as the child's birth weight, and our usual controls for gender and age at assessment. These models are given in detail in Appendix 1-4. Using the coefficient estimates from these models a linear prediction score was calculated for each child in the sample using the predict function in Stata (StataCorp LP, 2007). The linear prediction scores were grouped into strata which identified the children in the highest 1 per cent predicted risk group (propensity strata 99-100) through to children in the lowest 10 per cent predicted risk group (propensity strata 0-10).

Foundation Stage Profile

Table 11a shows the concordance between the predicted propensity strata for poor learning and development and the observed outcomes amongst the children in the sample. It can be seen that amongst the 1% of children predicted to have the highest risk scores the observed frequency for poor learning and development was 49.4%. The observed frequencies decreased gradually for children with lower predicted risks through to 0.8% amongst the children in the lowest risk propensity strata.

Considering this analysis in terms of its potential for identifying all children who would experience poor learning and development one sees that 5.1 per cent of these children were within the highest risk propensity strata, 19.4 per cent were within the highest or second strata, and 32.2 per cent were within the first three strata, that is amongst the 10 per cent of children with the highest predicted risk.

The analysis for learning and development so far has used the definition of poor learning and development which includes children with scores of 0-62 which is approximately the lowest decile of the distribution for the total FSP score. Considering children with scores from 63 to 72, approximately the next decile, the predictive risk strata were also to some degree effective for identifying children with this level of difficulty. For example, amongst the highest risk strata 15.6 per cent of the children experienced this degree of difficulty in addition to the 49.4 per cent experiencing the highest level of difficulties.

Behaviour difficulties

Turning to the behaviour difficulties outcome we see from Table 11b that amongst the 1% of children predicted with the highest risk scores the observed frequency of behavioural difficulties was 40.6%, decreasing to 1.3% amongst the children in the lowest risk propensity strata. From the standpoint of identifying all children who might experience high levels of behaviour difficulties we see that 5.2 per cent of these children were within the highest risk propensity strata, 19.9 per cent were within the highest or second strata, and 37.3 per cent were within the first three strata, that is amongst the 10 per cent of children with the highest predicted risk.

The predictive risk strata were also effective for identifying children with a slightly less extreme level of difficulty with scores of 11 to 13 which is approximately the second decile of the distribution. For example, amongst the highest risk strata 28.8 per cent of the children experienced this level of difficulty in addition to the 40.6 per cent experiencing the highest level of difficulties.

Child Health

In Tables 11c and 11d we present the analogous data for the two health measures. Table 11c shows the model based on predicting being in good, fair or poor health as opposed to excellent or good. In this model it can be seen that amongst the 1% of children predicted with the highest risk scores the observed frequency of fair or poor health was 14.7%, decreasing to 0.5% amongst the children in the lowest risk propensity strata. Considering this analysis in terms of its potential to identify all children who would experience fair or poor health, 3.9 per cent of these children were within the highest risk propensity strata, 16.1 per cent were within the highest or second strata, and 27.7 per cent were within the first three strata, that is amongst the 10 per cent of children with the highest predicted risk. Among the highest risk strata 34.0 per cent of the children experienced 'good' health in addition to the 14.7 per cent experiencing fair or poor health.

The model which predicted fair or poor health as opposed to the other categories is shown in Table 11d. This provided a slightly improved level of prediction for fair or poor health compared to the previous health model in Table 11c. 3.8 per cent of the children who experienced fair or poor health were within the highest risk propensity strata, 17.3 per cent were within the highest or second strata, and 28.8 per cent were within the first three strata. However prediction of 'good' health as opposed to excellent or very good was substantially less than in the previous model.

Summary for all the outcomes

Looking across all the outcomes it is apparent that children's behavioural difficulties is the most clearly predicted outcome from the risk propensity models. We see that 37.3 per cent of children with the highest level of difficulties were identified within the top 10 per cent of the predicted risk, 71.9 per cent within the top 30 per cent and 80.9 within the top 40 per cent (Table 11b). Prediction of difficulties in learning and development was slightly less effective, 32.2 per cent of children with the highest level of difficulties were identified within the top 10 per cent of the predicted risk, 64.7 per cent within the top 30 per cent and 76.8 within the top 40 per cent (Table 11a). Prediction of fair or poor health was slightly less

effective again, 28.8 per cent of children with the highest level of difficulties were identified within the top 10 per cent of the predicted risk, 62.5 per cent within the top 30 per cent and 72.3 within the top 40 per cent (Table 11d).

Table 11a: Illustration of risk propensity score estimation for children’s learning and development

Outcome level Propensity strata ¹	Lowest level (total score 0-62, 10.2%)		2 nd level (total score 63-72, 9.6%)	
	Observed frequency (%)	Identification (cumulative %)	Observed frequency (%)	Identification (cumulative %)
99-100	49.4	5.1	15.6	1.7
95-99	35.1	19.4	17.5	9.2
90-95	25.2	32.2	18.4	19.1
80-90	18.8	51.3	16.3	36.6
70-80	13.1	64.7	15.2	53.0
60-70	11.9	76.8	10.6	64.4
50-60	6.7	83.6	8.5	73.6
40-50	5.6	89.4	7.7	81.8
30-40	4.0	93.4	5.7	87.9
20-30	3.7	97.2	4.8	93.1
10-20	2.0	99.2	4.1	97.5
0-10	0.8	100.0	2.4	100.0

¹propensity strata categorised from predicted odds of being in the lowest level using the predictive factors: mother’s age at first birth, mother’s qualifications, mother never employed, language usually spoken in the home, number of children in the home, child is a twin or a triplet, mother’s general health, mother’s malaise score, poverty, housing tenure, area deprivation, child’s gender and birth weight. Child’s birth month and year also included as a control but not included in estimation of risk propensity. Model shown in Appendix 1. The analysis includes children with complete information for all predictive factors as listed.

Table 11b: Illustration of risk propensity score estimation for children’s behavioural difficulties

Outcome level Propensity strata ¹	Highest level (total score 14-40, 9.0%)		2 nd level (total score 11-13, 10.3%)	
	Observed frequency (%)	Identification (cumulative %)	Observed frequency (%)	Identification (cumulative %)
99-100	40.6	5.2	28.8	3.1
95-99	30.1	19.9	17.4	10.2
90-95	28.3	37.3	16.7	18.8
80-90	17.6	59.0	15.9	35.2
70-80	10.5	71.9	13.6	49.2
60-70	7.3	80.9	9.7	59.1
50-60	4.8	86.8	7.2	66.4
40-50	2.9	90.4	9.0	75.7
30-40	2.4	93.4	7.5	83.4
20-30	3.2	97.2	7.9	91.5
10-20	0.9	98.4	4.2	95.8
0-10	1.3	100.0	4.1	100.0

¹propensity strata categorised from predicted odds of being in the lowest level using the predictive factors: mother’s qualifications, parent’s relationship at birth, language usually spoken in the home, child is first or later born, child is a twin or a triplet, feelings about pregnancy, smoking during pregnancy, mother’s general health, mother’s malaise score, mother’s self efficacy, housing tenure, housing difficulties, area deprivation, child’s gender and birth weight. Child’s age at interview also included as a control but not in estimation of risk propensity. Model shown in Appendix 2. The analysis includes children with complete information for all predictive factors as listed.

Table 11c: Illustration of risk propensity score estimation for children's health (unhealthy group)

Outcome level	Fair/poor (4.0%)		Good (13.4%)	
	Observed frequency (%)	Identification (cumulative %)	Observed frequency (%)	Identification (cumulative %)
99-100	14.7	3.9	34.0	2.8
95-99	11.4	16.1	26.9	11.6
90-95	8.8	27.7	20.5	20.0
80-90	6.8	45.7	17.2	34.0
70-80	6.1	61.8	15.8	46.9
60-70	4.9	74.8	16.1	60.1
50-60	3.3	83.6	12.3	70.1
40-50	1.6	87.9	8.5	77.1
30-40	1.9	93.0	8.6	84.1
20-30	1.4	96.6	9.0	91.4
10-20	0.8	98.7	6.4	96.7
0-10	0.5	100.0	4.1	100.0

¹propensity strata categorised from predicted odds of good, fair or poor health versus excellent or very good using the predictive factors: mother's age at first birth, mother's qualifications, mother lived away from home prior to age 17, language usually spoken in the home, feelings about pregnancy, mother's general health, felt low or sad, mother's self efficacy, household income, child's gender and birth weight. Child's age at interview also included as a control but not in estimation of risk propensity. Model shown in Appendix 3. The analysis includes children with complete information for all predictive factors as listed.

Table 11d: Illustration of risk propensity score estimation for children's health (poor health)

Outcome level	Fair/poor (4.0%)		Good (13.4%)	
	Frequency (%) ⁴	Identification (cumulative %) ⁵	Frequency (%) ⁴	Identification (cumulative %) ⁵
99-100	14.9	3.8	19.8	1.5
95-99	13.2	17.3	22.0	8.5
90-95	9.2	28.8	21.7	16.8
80-90	7.7	48.2	19.9	32.3
70-80	5.6	62.5	16.5	45.1
60-70	3.8	72.3	14.3	56.2
50-60	3.7	81.6	13.8	66.9
40-50	2.9	89.1	11.6	76.0
30-40	2.0	94.1	8.8	82.7
20-30	1.3	97.3	9.0	89.7
10-20	0.7	99.1	7.3	95.4
0-10	0.4	100.0	5.9	100.0

¹propensity strata categorised from predicted odds of fair or poor health versus excellent, very good or good using the predictive factors: separation of mother's parents, language usually spoken in the home, number of children in the home, time of presentation for antenatal care, smoking during pregnancy, mother's general health, mother's malaise score, felt low or sad, household income, child's gender and birth weight. Child's age at interview also included as a control but not in estimation of risk propensity. Model shown in Appendix 4. The analysis includes children with complete information for all predictive factors as listed.

Indicators currently collected through the maternity and child health systems: How well do they predict children's outcomes?

The model selection and estimation of risk propensity models was carried out for a restricted set of MCS variables that most closely corresponded to data currently collected during pregnancy by the local maternal and child health systems which were supplied by the commissioner of the research. As the factors which are collected may vary according to area this analysis was carried with a set of factors which firstly included mother's qualifications and household employment situation, and secondly did not include these two variables. The available factors and those maintained by the model selection are summarised in Figures 12 and 13 and the full models are given in Appendix 5-12.

A comparison of the information collected in the maternal and child health system and the MCS data shows that there are both commonalities and differences across the two. Compared with the MCS the most notable differences are that the maternal and child health system does not yet contain information on mother's health and well-being nor does it have information on mother's experience of employment, stability in the mothers family background, language spoken in the home, feelings about the pregnancy, or indicators of income and housing situation.

In Tables 12a-d we show the comparison between the effectiveness of the prediction from using the currently collected variables compared to the more detailed MCS analyses. In the discussion that follows we refer to these as the current models and the detailed model respectively. For reasons of comparability birth weight and child's sex are not included in either of the sets of propensity risk score calculations.

From Table 12a we see that there was some reduction in the prediction of poor learning and development from the current model compared to the detailed model. For example from the current model 26.7 per cent of the children experiencing poor learning and development were identified to be amongst the highest risk 10 per cent of children as compared with 29.2 per cent identified by the detailed model. In the current model without mother's qualifications or household employment the identification was slightly lower again at 24.6 per cent.

In contrast the level of prediction of behavioural difficulties from the current model was substantially lower than the detailed model, Table 12b. For example, 25.7 per cent of the children experiencing a high level of behavioural difficulties were identified as being amongst the highest risk 10 per cent of children in the current model which was substantially less than the 36.6 per cent identified by the detailed model. Identification of children who would experience difficulties was similar in the current models with or without mother's qualifications, 25.7 per cent and 25.1 per cent of the children were identified as being amongst the highest risk 10 per cent by each of these models.

For both health models, Tables 12c and 12d, the levels of prediction from the current models were also lower than those from the detailed models. For example, 16.9 per cent of the children experiencing good, fair or poor health were identified to be amongst the highest risk 10 per cent of children predicted by the current model compared to 21.4 per cent identified by the detailed model. In the current model without household employment the identification was slightly lower again at 16.5 per cent.

For all our outcomes the predictions when maternal education and household employment are not included are similar but we note that other factors take on more importance such as mother's age at first and the index of deprivation which highlights the potential relatedness of these socio-economic indicators.

This exercise supports that the extension of the current data collection could improve the potential for predicting children's behavioural difficulties substantially, as well as the prediction of learning and development and health difficulties to some degree.

Figure 12: Factors maintained as predictive for children’s outcomes in model selection restricted to currently collected data

	FSP ¹	SDQ ²	Health ³	Health ⁴
Pre-birth demographic characteristics				
Mother’s age at birth				
Mother’s age at first birth	*	*	*	
Mother’s qualifications	*	*	*	*
Parents relationship – married/cohabiting/lone mother		*		
Number of children in the home	*			
Child is first born		*		
Child is a twin or a triplet	*	*		
Mother’s feelings and behaviours in pregnancy				
Presentation for antenatal care	*		*	*
Smoking during pregnancy		*		*
Socioeconomic situation at 9 months post the birth				
Adult in the home in paid employment	*		*	*
Area deprivation (IMD 2004 score)	*	*	*	*

¹ Poorest 10 percent on Foundation Stage Profile total assessment of learning and development

² Highest 9 percent for total difficulties score from Strengths and Difficulties Questionnaire

³ General health rated as good, fair or poor (17 percent) versus excellent or very good.

⁴ General health rated as fair or poor (4 percent) versus excellent, very good or good.

Figure 13: Factors maintained as predictive for children’s outcomes in model selection restricted to currently collected data (without mother’s qualifications or whether there is an adult in the home in paid employment)

	FSP ¹	SDQ ²	Health ³	Health ⁴
Pre-birth demographic characteristics				
Mother’s age at child’s birth				*
Mother’s age at first birth	*	*	*	
Parents relationship – married/cohabiting/lone mother	*	*		
Number of children in the home	*		*	*
Child is first born				
Child is a twin or a triplet	*	*		
Mother’s feelings and behaviours in pregnancy				
Presentation for antenatal care	*		*	*
Smoking during pregnancy		*	*	*
Socioeconomic situation at 9 months post the birth				
Area deprivation (IMD 2004 score)	*	*	*	*

¹ Poorest 10 percent on Foundation Stage Profile total assessment of learning and development

² Highest 9 percent for total difficulties score from Strengths and Difficulties Questionnaire

³ General health rated as good, fair or poor (17 percent) versus excellent or very good.

⁴ General health rated as fair or poor (4 percent) versus excellent, very good or good.

Table 12a: Comparison of potential prediction of currently collected data to prediction from fully detailed MCS model for learning and development

Propensity strata ¹	Restricted to currently collected ^a		Restricted to currently collected ^b		Fully detailed model	
	Observed frequency (%)	Identification (cumulative %)	Observed frequency (%)	Identification (cumulative %)	Observed frequency (%)	Identification (cumulative %)
99-100	32.9	3.3	37.5	3.9	40.6	4.2
95-99	29.9	15.2	25.1	14.8	31.5	17.0
90-95	23.1	26.7	21.6	24.6	23.8	29.2
80-90	21.9	48.4	18.5	43.4	18.6	48.1
70-80	12.7	61.1	14.1	57.3	16.2	64.6
60-70	11.2	72.2	12.9	70.0	9.1	73.8
50-60	8.6	81.4	8.0	78.7	9.3	83.3
40-50	6.4	87.6	6.3	84.6	4.4	87.7
30-40	4.6	92.3	6.5	91.5	5.1	93.0
20-30	3.5	95.5	4.6	95.8	3.8	96.8
10-20	2.5	98.1	2.4	98.2	1.9	98.8
0-10	2.0	100.0	2.0	100.0	1.2	100.0

^aif information on mother's qualifications and household employment are available

^bif information on mother's qualifications is household employment are not available

¹propensity strata categorised from predicted odds of being in the lowest level (FSP total score 0-62, 10.2%).

Predictive factors for restricted model^a: mother's age at first birth, mother's qualifications, number of children in the home, child is a twin or a triplet, presentation for antenatal care, adult in employment in the household, and area deprivation. Child's birth month and year and gender also included as controls but not included in estimation of risk propensity. Model shown in Appendix 5.

Predictive factors for restricted model^b: mother's age at first birth, parent's relationship at birth, number of children in the home, child is a twin or a triplet, presentation for antenatal care, and area deprivation. Child's birth month and year and gender also included as controls but not included in estimation of risk propensity. Model shown in Appendix 9.

Predictive factors for fully detailed model: mother's age at first birth, mother's qualifications, mother never employed, language usually spoken in the home, number of children in the home, child is a twin or a triplet, mother's general health, mother's malaise score, poverty, housing tenure and area deprivation. Child's birth month and year and gender also included as controls but not included in estimation of risk propensity. Model shown in Table 5.

The analysis includes children with complete information for all predictive factors as listed.

Table 12b: Comparison of potential prediction of currently collected data to prediction from fully detailed MCS model for behavioural difficulties

Propensity strata ¹	Restricted to currently collected ^a		Restricted to currently collected ^b		Fully detailed model	
	Observed frequency (%)	Identification (cumulative %)	Observed frequency (%)	Identification (cumulative %)	Observed frequency (%)	Identification (cumulative %)
99-100	27.3	3.3			30.2	3.8
95-99	23.2	14.1			33.0	20.0
90-95	21.4	25.7	22.2*	25.1*	27.0	36.6
80-90	16.2	44.0	16.5	43.7	18.2	59.0
70-80	13.5	59.1	12.5	59.5	9.3	70.4
60-70	10.8	71.3	9.9	69.5	7.0	79.0
50-60	7.1	79.2	6.9	77.7	5.6	85.9
40-50	6.3	86.3	6.4	84.2	3.3	90.0
30-40	3.6	90.4	4.4	89.6	2.1	92.5
20-30	2.9	93.6	3.8	93.5	1.5	94.4
10-20	2.7	96.6	3.0	97.4	2.8	97.9
0-10	3.0	100.0	2.9	100.0	1.8	100.0

^a if information on mother's qualifications and household employment are available

^b if information on mother's qualifications is household employment are not available

¹ propensity strata categorised from predicted odds of being in the highest level (SDQ total score 14-40, 9.0%).

* the 99-100 and 95-99 strata could not be determined from the model due to the grouping of the observed risk propensity scores and potential cut points thus the first strata categorised includes all of the 10% highest risk children.

Predictive factors for restricted model^a: mother's age at first birth, mother's qualifications, parents' relationship at birth, child is first or later born, child is a twin or a triplet, smoking during pregnancy and area deprivation. Child's age at interview and gender also included as controls but not included in estimation of risk propensity. Model shown in Appendix 6.

Predictive factors for restricted model^b: mother's age at first birth, parents' relationship at birth, child is a twin or a triplet, smoking during pregnancy and area deprivation. Child's age at interview and gender also included as controls but not included in estimation of risk propensity. Model shown in Appendix 10.

Predictive factors for fully detailed model: mother's qualifications, parent's relationship at birth, language usually spoken in the home, child is first or later born, child is a twin or a triplet, feelings about pregnancy, smoking during pregnancy, mother's general health, mother's malaise score, mother's self efficacy, housing tenure, housing difficulties and area deprivation. Child's age at interview and gender also included as controls but not included in estimation of risk propensity. Model shown in Table 6.

The analysis includes children with complete information for all predictive factors as listed.

Table 12c: Comparison of potential prediction of currently collected data to prediction from fully detailed MCS model for children's health (unhealthy group)

Propensity strata ¹	Restricted to currently collected ^a		Restricted to currently collected ^b		Fully detailed model	
	Observed frequency (%)	Identification (cumulative %)	Observed frequency (%)	Identification (cumulative %)	Observed frequency (%)	Identification (cumulative %)
99-100	27.0	1.6	31.4	2.1	46.4	3.0
95-99	29.9	9.0	31.7	9.2	35.9	11.9
90-95	29.2	16.9	25.0	16.5	30.6	21.4
80-90	26.8	32.4	24.6	30.7	24.4	36.7
70-80	22.5	46.4	21.2	43.1	22.8	50.8
60-70	17.3	55.6	19.6	54.6	18.4	62.3
50-60	19.0	66.5	18.6	65.4	16.4	72.5
40-50	12.5	73.8	13.2	73.0	10.3	79.0
30-40	13.5	82.0	13.9	82.2	10.1	85.3
20-30	11.9	88.9	11.3	88.3	11.0	92.2
10-20	9.5	94.3	11.0	94.4	7.2	96.7
0-10	10.3	100.0	10.1	100.0	5.4	100.0

^a if information on mother's qualifications and household employment are available

^b if information on mother's qualifications is household employment are not available

¹ propensity strata categorised from predicted odds of good, fair or poor health (17.4%) as opposed to excellent or very good health.

Predictive factors for restricted model^a: mother's age at first birth, mother's qualifications, presentation for antenatal care, adult in employment in the household, and area deprivation. Child's age at interview and gender also included as controls but not included in estimation of risk propensity. Model shown in Appendix 7.

Predictive factors for restricted model^b: mother's age at first birth, number of children in the home, presentation for antenatal care, smoking during pregnancy, and area deprivation. Child's age at interview and gender also included as controls but not included in estimation of risk propensity. Model shown in Appendix 11.

Predictive factors for fully detailed model: mother's age at first birth, mother's qualifications, mother lived away from home prior to age 17, language usually spoken in the home, feelings about pregnancy, mother's general health, felt low or sad, mother's self efficacy, and household income. Child's age at interview and gender also included as controls but not included in estimation of risk propensity. Model shown in Table 7.

The analysis includes children with complete information for all predictive factors as listed.

Table 12d: Comparison of potential prediction of currently collected data to prediction from fully detailed MCS model for children's health (poor health)

Propensity strata ¹	Restricted to currently collected ^a		Restricted to currently collected ^b		Fully detailed model	
	Observed frequency (%)	Identification (cumulative %)	Observed frequency (%)	Identification (cumulative %)	Observed frequency (%)	Identification (cumulative %)
99-100	8.5	2.2	10.2	2.7	13.7	3.5
95-99	9.7	12.1	9.6	12.6	11.2	14.8
90-95	8.0	22.0	8.8	23.4	9.8	27.3
80-90	7.5	40.9	5.9	38.2	7.6	46.7
70-80	4.6	54.5	6.0	53.2	5.8	61.2
60-70	3.8	62.4	3.3	61.7	4.5	72.7
50-60	4.2	72.9	4.2	72.2	3.6	81.8
40-50	3.7	82.7	2.7	79.2	2.8	88.9
30-40	2.7	89.5	2.7	85.8	1.5	92.6
20-30	1.7	93.6	2.4	92.1	1.2	95.6
10-20	1.3	97.8	1.9	96.9	1.1	98.5
0-10	1.3	100.0	1.4	100.0	0.6	100.0

^a if information on mother's qualifications and household employment are available

^b if information on mother's qualifications is household employment are not available

¹ propensity strata categorised from predicted odds of fair or poor health (4.0%) as opposed to excellent, very good or good health.

Predictive factors for restricted model^a: mother's qualifications, presentation for antenatal care, smoking in pregnancy, adult in employment in the household, and area deprivation. Child's age at interview and gender also included as controls but not included in estimation of risk propensity. Model shown in Appendix 8.

Predictive factors for restricted model^b: mother's age at child's birth, number of children in the home, presentation for antenatal care, smoking in pregnancy, and area deprivation. Child's age at interview and gender also included as controls but not included in estimation of risk propensity. Model shown in Appendix 12.

Predictive factors for fully detailed model: separation of mother's parents, language usually spoken in the home, number of children in the home, time of presentation for antenatal care, smoking during pregnancy, mother's general health, mother's malaise score, felt low or sad and household income. Child's age at interview and gender also included as controls but not included in estimation of risk propensity. Model shown in Table 8.

The analysis includes children with complete information for all predictive factors as listed.

Illustrative Analysis of Vulnerable Groups

Another way in which the evidence from the MCS might inform the targeting of services is through the provision of evidence that poor outcomes for children are more likely to occur amongst specific groups of the population. Here we give an illustrative example in which mother's age at first birth, mother's qualifications and a group of other pre-birth 'risk' factors are combined such that we can differentiate groups of mothers and see how their children fare on the outcomes.

From Table 13a we see that poor learning and development was most common amongst the mothers who were under age 20 at first birth and had no qualifications or level 1 qualifications only, 23.6 per cent and 24.7 per cent respectively, and amongst the mothers who were aged 20-22 at first birth and had no qualifications, 24.8 per cent. These three groups of mothers represented 12.4 per cent of the population, and 30.1 per cent of the children who experienced poor learning and development were identified within these three groups. We see a similar pattern in Table 13b with respect to children's behavioural difficulties and see that 24.5 per cent of the children who experienced behavioural difficulties were also identified within these three groups. In Table 13c we see a similar patterning for children's health which is weaker than that seen for the other outcomes. A smaller proportion of children experiencing health difficulties were identified within these three groups, 19.8 per cent of those with fair or poor health, and 18.3 per cent of those with good health.

These types of models are akin to those described by Hall and Hall 2007 in their work on developing an instrument to identify mothers for the Family-Nurse Partnership Intervention. Our analysis could be viewed as extending their approach, in that they identified a specific group of families for whom the Family-Nurse Partnership Intervention might be applicable whereas our analysis of the MCS data allows the identification of a number of groups with differing levels of vulnerability. In each of Tables 13a to 13c we see a clear gradation of risk for children's outcomes across the groups illustrated. This might be helpful if the intention is to have progressive levels of intervention for different groups of families within the population as detailed in The Child Health Promotion Programme (Shribman and Billingham, 2008).

We have given this one illustrative example, but within this approach there is the flexibility to tailor the definition of the groups according to the intention of the interventions and to take into account evidence from other data sources as well as that from the MCS.

Table 13a: Illustration of levels of poor learning and development across vulnerable groups

Learning and development		Lowest level (total score 0-62, 10.2%)		2 nd level (total score 63-72, 9.6%)		OR Lowest level		OR Lowest or 2 nd level	
Group definition	Sample (%)	Observed frequency (%)	Identification (%)	Observed frequency (%)	Identification (%)	OR	95% CI	OR	95% CI
Age at first birth 13-19									
No qualifications	5.4	23.6	13.0	18.7	10.8	6.94***	(5.07, 9.51)	6.69***	(5.02, 8.90)
NVQ level 1	3.7	24.7	9.2	14.4	5.6	7.37***	(5.18, 10.47)	5.85***	(4.41, 7.78)
NVQ level 2 other risk ¹	6.5	14.8	10.0	13.4	9.5	3.91***	(2.88, 5.31)	3.59***	(2.85, 4.53)
NVQ level 2 no other risk	2.6	13.3	3.5	13.9	3.8	3.46***	(2.05, 5.85)	3.41***	(2.46, 4.73)
Age at first birth 20-22									
No qualifications	3.3	24.8	7.9	23.0	7.7	7.44***	(5.38, 10.30)	8.37***	(6.09, 11.50)
NVQ level 1	2.3	19.1	4.4	11.3	2.7	5.31***	(3.48, 8.12)	3.99***	(2.75, 5.81)
NVQ level 2 other risk ¹	5.9	12.4	7.5	13.4	8.5	3.19***	(2.25, 4.54)	3.18***	(2.46, 4.12)
NVQ level 2 no other risk	4.7	9.0	4.2	7.7	3.7	2.23***	(1.49, 3.32)	1.83***	(1.32, 2.52)
Age at first birth 23 or over									
No qualifications	3.6	19.0	6.8	17.5	6.6	5.28***	(3.68, 7.59)	5.25***	(3.84, 7.18)
NVQ level 1	5.3	12.0	6.2	9.4	5.1	3.06***	(2.12, 4.41)	2.48***	(1.87, 3.30)
NVQ level 2 other risk ¹	15.4	6.7	10.1	7.5	11.8	1.61**	(1.18, 2.20)	1.51***	(1.22, 1.87)
NVQ level 2 no other risk	41.4	4.3	17.3	5.6	24.0	(ref)		(ref)	

¹no experience of paid employment, lived away from home before age 17, not living with the natural father of the child, English not usually spoken in the home, 2 or more children in addition to expected child, expecting twins or triplets

†p<0.1, *p<0.05, ** p<0.01, ***p<0.001.

Table 13b: Illustration of levels of behavioural difficulties across vulnerable groups

Behavioural difficulties Group definition	Sample (%)	Highest level (total score 14-40, 9.0%)		2 nd level (total score 11-13, 10.3%)		OR Highest level		OR Highest or 2 nd level		
		Observed frequency (%)	Identification (%)	Observed frequency (%)	Identification (%)	OR	95% CI	OR	95% CI	
Age at first birth 13-19										
No qualifications	5.4	21.6	11.3	17.3	7.9	4.94***	(3.43, 7.13)	4.13***	(3.05, 5.60)	
NVQ level 1	3.7	21.3	7.3	15.3	4.6	5.38***	(3.41, 8.48)	3.85***	(2.83, 5.24)	
NVQ level 2 other risk ¹	6.5	13.9	10.1	12.6	7.9	3.23***	(2.24, 4.66)	2.39***	(1.79, 3.18)	
NVQ level 2 no other risk	2.6	10.3	3.2	10.9	3.0	2.29**	(1.32, 3.96)	1.85**	(1.24, 2.75)	
Age at first birth 20-22										
No qualifications	3.3	21.1	5.9	16.9	4.1	5.62***	(3.49, 9.06)	4.15***	(2.77, 6.23)	
NVQ level 1	2.3	14.8	3.1	13.5	2.4	3.68***	(2.20, 6.16)	2.88***	(1.92, 4.33)	
NVQ level 2 other risk ¹	5.9	11.2	7.3	14.0	7.9	2.33***	(1.57, 3.46)	2.23***	(1.69, 2.95)	
NVQ level 2 no other risk	4.7	7.0	3.6	9.8	4.4	1.60†	(0.96, 2.66)	1.24	(0.86, 1.79)	
Age at first birth 23 or over										
No qualifications	3.6	17.1	5.6	16.1	4.6	4.31***	(2.78, 6.68)	3.29***	(2.31, 4.69)	
NVQ level 1	5.3	10.3	5.4	12.1	5.5	2.16**	(1.38, 3.36)	1.92***	(1.37, 2.70)	
NVQ level 2 other risk ¹	15.4	7.2	13.0	7.7	12.1	1.59**	(1.16, 2.16)	1.18	(0.96, 1.46)	
NVQ level 2 no other risk	41.4	4.9	24.3	8.2	35.7	(ref)		(ref)		

¹no experience of paid employment, lived away from home before age 17, not living with the natural father of the child, English not usually spoken in the home, 2 or more children in addition to expected child, expecting twins or triplets

†p<0.1, *p<0.05, ** p<0.01, ***p<0.001.

Table 13c: Illustration of levels of poor health across vulnerable groups

General health Group definition	Sample (%)	Fair/poor (4.0%)		Good (13.4%)		OR Fair or poor		OR Good, fair or poor	
		Observed frequency (%)	Identification (%)	Observed frequency (%)	Identification (%)	OR	95% CI	OR	95% CI
Age at first birth 13-19									
No qualifications	5.4	6.8	9.2	17.7	7.1	2.27***	(1.76, 2.93)	3.04***	(1.94, 4.76)
NVQ level 1	3.7	5.1	4.6	20.8	5.7	2.40***	(1.76, 3.26)	2.25*	(1.06, 4.80)
NVQ level 2 other risk ¹	6.5	7.3	11.9	16.3	8.0	2.09***	(1.66, 2.62)	2.79***	(1.82, 4.29)
NVQ level 2 no other risk	2.6	4.8	3.1	11.5	2.2	1.44†	(0.97, 2.12)	2.11*	(1.01, 4.44)
Age at first birth 20-22									
No qualifications	3.3	7.5	6.0	22.8	5.5	3.05***	(2.22, 4.20)	3.53***	(1.96, 6.34)
NVQ level 1	2.3	5.7	3.2	19.0	3.2	2.24***	(1.51, 3.31)	1.83	(0.84, 4.00)
NVQ level 2 other risk ¹	5.9	5.6	8.3	15.6	7.0	2.00***	(1.53, 2.60)	2.78***	(1.73, 4.48)
NVQ level 2 no other risk	4.7	2.9	3.4	14.6	5.1	1.60**	(1.21, 2.10)	1.09	(0.55, 2.17)
Age at first birth 23 or over									
No qualifications	3.6	6.8	6.1	24.0	6.5	3.13***	(2.34, 4.20)	2.97***	(1.69, 5.23)
NVQ level 1	5.3	5.7	7.4	14.7	5.8	1.72***	(1.32, 2.23)	2.56***	(1.53, 4.28)
NVQ level 2 other risk ¹	15.4	3.8	14.7	12.0	13.9	1.38**	(1.15, 1.67)	1.79**	(1.21, 2.66)
NVQ level 2 no other risk	41.4	2.2	22.2	9.7	30.2	(ref)		(ref)	

¹no experience of paid employment, lived away from home before age 17, not living with the natural father of the child, English not usually spoken in the home, 2 or more children in addition to expected child, expecting twins or triplets

†p<0.1, *p<0.05, ** p<0.01, ***p<0.001.

Some Limitations and Reflections

Given the time and thought put into this analysis we thought it might be helpful to list some of our reflections and note some of the limitations and ways forward that occurred to us. But feel free to discount.

The indicators selected from the MCS were confined to those collected during pregnancy, relatively fixed attributes that existed prior to the pregnancy and information although collected at the 9 month old survey potentially could be collected at the antenatal interview. There was no interview with the MCS sample of mothers when they were pregnant, although this is proposed for the new 2012 cohort study (further details of this proposed study are provided at <http://www.longviewuk.com/>).

Undoubtedly the key indicators from the MCS analysis show important associations with the child outcomes and the propensity score exercise showed that these factors had some power for predicting outcomes.

Mediators and processes

As well as these early indicators there are a range of other factors that might well be implicated in tempering or enhancing poor child outcomes. These include breastfeeding practices, attachment, parenting practices, the level of support from fathers, other family members, the community and services to name but a few. Additionally, the persistence of impoverishment such as living in poverty or continuing depression may also be more influential than episodic occurrences. Many of these factors might mediate, or provide insight into the processes that lie behind the associations that we found.

Fathers

We are mindful that very little direct information on fathers has been included in our analyses but fathers are increasingly being recognised as being key players in a child's life. An exemplar of their importance was shown in a recent study of childhood obesity amongst 4 year olds in Australia. The most important factor in relation to whether a child was obese was the BMI's of their parents but the next most important factors were to do with the parenting behaviour of the father which was shown to be more important than the mother's parenting behaviour. Low paternal parenting control in particular was found to be strongly related to pre-school children being overweight or obese (Wake et al 2007).

The child outcomes

Also we note that different sets of factors were more or less influential depending on the child outcome under consideration. Socio-economic characteristics were strongly related to how well the child was doing on the foundation stage profile but maternal mental well-being and her assessment of her health generally were important in relation to her child's behaviour and health outcomes. This suggests that it may be more appropriate to take a more holistic approach to understanding how families influence their children's development and well-being.

One of our outcomes, performance on the Foundation Stage Profile is an administrative record collected by the DCSF for children in English State Schools. Our other outcomes are

not routinely collected although there has been a proposal that given the growth in mental health problems amongst children that the mental well-being of children should also be more routinely assessed (Layard and Dunn, 2009). The SDQ has now been validated across a range of ages and used in over 60 countries and thus might be a possible candidate. The Personal, Social and Emotional strand of the FSP does not capture emotional well-being in the same way as the SDQ. The PSE is a much broader construct covering three early learning goals relating to Disposition and Attitudes, Social development and Emotional development.

Some reflections on the key indicators

Level of education of the mother was a particularly important factor in relation to child outcomes. We note that currently this is collected as age at leaving education in the maternal and child record. But our analysis was based on qualifications attained and women who leave school at different ages may attain such qualification after leaving school. We also note that children of mothers with an NVQ level 1 are seemingly little better off than those with mothers with no qualifications. Collecting information on types of qualifications is more complicated than a simple question on age at leaving full-time education but it provides greater insights into the skill level achieved by the mother. If data collection is computer assisted then an algorithm should help the coding. Moreover, if the school leaving age is to be raised to age 18, as has been proposed, then age at leaving education will be less informative than hitherto.

Mothers age at first birth

It was clear that mother's age at first birth was a more important predictor of child outcomes than age at birth of the focal child. This is not surprising as there is a good deal of evidence that early motherhood is selective of women from disadvantaged backgrounds and who have accumulated the least human capital on the way to adulthood (Social Exclusion Unit, 1999) Moreover, it has been shown that it is not only teenage mothers who do not fare well but women who have children in their very early twenties also do not fare well (Hobcraft and Kiernan, 2001). Given this and specific interest from the Department of Health on this we included a finer breakdown of age at motherhood in our vulnerable groups analysis.

Children's Gender

For some purposes it is also important to distinguish between boys and girls and there are certainly identifiable differences between the two sexes on the outcomes. We have explored this in detail with respect to the FSP in Mensah and Kiernan (forthcoming). Child's gender may also be more influential in analyses which move from factors focused on the mother to more child specific attributes e.g. early measures of temperament.

Ethnicity

We commented earlier in some detail on issues surrounding ethnicity but note again that children from Pakistani families appear to be faring less well than children from other ethnic groups. Language spoken in the home was shown to be an important indicator which may reflect how recently the parents had arrived in the country. An additional factor that might be worth considering would be whether the mother was born in this country and length of time

in the country. Length of time in the country was collected for the MCS children at the age 3 survey. With hindsight it might have been useful for us to have included information on country of birth or duration of residence in the UK in our analysis. At the present time there is a good deal of development work underway on questions to include in the Ethnic boost sample in Understanding Society (the new UK Longitudinal Household Panel Survey) and it may be helpful to have information on their work as it progresses. The link to this study is - <http://www.iser.essex.ac.uk/survey/understanding-society>.

MCS findings and policy fit

And finally a few comments on the MCS findings and policy. Our findings from the analysis of the MCS data chime with the recommendations put forward by Barlow et al 2008 in their review 'Health-led Parenting Interventions in Pregnancy and Early years'. From our study it was clear that there were "demographically at risk mothers" as described in this review. For example those who begin child bearing at an early age, have low or no qualifications, or are living in deprived areas, and we showed the strong associations which these factors hold with children's outcomes which point to the importance of early interventions for these groups of families. Our study however was not able to study some of the other women at risk, particularly those experiencing domestic abuse, alcohol addiction or drug addiction, as the data which could clearly identify such women were not available.

Antenatal smoking cessation programs are recommended as a strategy for prevention of low infant birth weight, premature birth and neonatal mortality. Our study also showed the continued influences of antenatal smoking for longer term child health and behavioural difficulties.

Maternal depression is an important influence on child outcomes in the MCS sample and thus would lend support to their recommendations for interventions promoting mother's mental health both in the ante-natal and post-natal period. Our study goes further in showing the importance of mother's general health suggesting that other aspects of health promotion for mothers may also have the potential to benefit children's outcomes.

Acknowledgements

We would like to thank the ESRC Data Archive for supplying the Millennium Cohort data and Jonathan Bradshaw and John Holmes for providing the data on poverty.

References

- Barlow J, Schrader McMillan A, Kirkpatrick S, Ghate D, Smith M & Barnes J. (2008) *Health-led Parenting Interventions in Pregnancy and Early Years*. Research Report DCSF-RW070. Department for Children, Schools and Families
- Case A, Lubotsky D & Paxson C. (2002) Socioeconomic status and health in childhood: the origins of the gradient. *American Economic Review* 92 (5), 1308-1334
- Dex S & Joshi H (2005) *Children of the 21st century: From birth to nine months* (Bristol, The Policy Press).
- Feinstein L, Duckworth K & Sabates R. (2008) *Education and the family : passing success across the generations* (London, Routledge).
- Goodman R. (1997) The Strengths and Difficulties Questionnaire: A Research Note. *Journal of Child Psychology and Psychiatry*, 38, 581-586.
- Goodman R. (2001) Psychometric properties of the Strengths and Difficulties Questionnaire (SDQ). *Journal of the American Academy of Child and Adolescent Psychiatry*, 40, 1337-1345.
- Hall D & Hall S (2007) *The "Family-Nurse Partnership": developing an instrument for identification, assessment and recruitment of clients*. Research Report DCSF-RW022. Department for Children, Schools and Families
- Hansen K (2008) *Millennium Cohort Study first, second and third surveys: a guide to the datasets (third edition)* (London, Centre for Longitudinal Studies, Institute of Education).
- Hansen K & Jones EM (2008) Foundation Stage Profile and Devolved Administration Teacher Survey, in Hansen K & Joshi H. *Millennium Cohort Study, Third Survey: A User's Guide to Initial Findings* (Centre for Longitudinal Studies, Institute of Education, London).
- HM Government (2007) *Safe. Sensible. Sociable. The Next Steps in the National Alcohol Strategy*. London, Crown Copyright
- Hobcraft JN & Kiernan KE. (2001) Childhood poverty, early motherhood and adult social exclusion, *British Journal of Sociology*, 52(3), 495-517.
- Kelly Y, Bartley M, Schoon I & Hope S. (2004) Parent's Health, in Dex S & Joshi H. *Millennium Cohort Study First Survey: A User's Guide to the Initial Findings* (London: Centre for Longitudinal Studies, Institute of Education)
- Kelly Y, Panico L, Bartley M, Marmot M, Nazroo J & Sacker A. (2009) Why does birthweight vary among ethnic groups in the UK? Findings from the Millennium Cohort Study. *Journal of Public Health* 31:131-137
- Kelly Y, Sacker A, Gray R, Kelly J, Wolke D & Quigley MA. (2009) Light drinking in pregnancy, a risk for behavioural problems and cognitive deficits at 3 years of age? *International Journal of Epidemiology* 38:129-140
- Ketende S. (2008) *Millennium Cohort Study: Technical Report on Response, 2nd edition* (London: Centre for Longitudinal Studies, Institute of Education).
- Kiernan KE & Huerta MC. (2008) Economic deprivation, maternal depression, parenting and children's cognitive and emotional development in early childhood, *British Journal of Sociology*, 59(4), 783-806.

- Kiernan KE & Mensah FK. (2009) Poverty, Maternal Depression, Family Status and Children's Cognitive and Behavioural Development in Early Childhood: a Longitudinal Study, *Journal of Social Policy*, In Press.
- Layard R & Dunn J. (2009) *A Good Childhood. Searching for Values in a Competitive Age. The Landmark Report for the Children's Society*. (London: Penguin Books)
- Mensah FK & Kiernan KE. (forthcoming) Gender differences in educational attainment: influences of the family environment. *British Journal of Educational Research*, In Press
- Mullick MSI. & Goodman R. (2001) Questionnaire screening for mental health problems in Bangladeshi children: a preliminary study. *Social Psychiatry and Psychiatric Epidemiology* 36: 94-99
- Office for National Statistics. (2003). *Ethnic group statistics: A guide for the collection and classification of ethnicity data* (London: HMSO).
- Office of the Deputy Prime Minister (2004) *The English Indices of Deprivation (revised)*. (London: ODPM)
- Ong KK, Preece MA, Emmett PM, Ahmed ML, Dunger DB (2002) Size at birth and early childhood growth in relation to maternal smoking, parity and infant breast-feeding: longitudinal birth cohort study and analysis. *Pediatric Research* 52:863-867
- Plewis I. (2007) Non-Response in a Birth Cohort Study: The Case of the Millennium Cohort Study, *International Journal of Social Research Methodology*, 10(5), 325-334.
- Qualifications and Curriculum Authority. (2003) *Foundation Stage Profile Handbook* (London, Department for Education and Skills).
- Shribman S, Billingham K (2008) *The Child Health Promotion Programme. Pregnancy and the first five years of life*. Department for Children, Schools and Families. Department of Health
- Social Exclusion Unit (1999) *Teenage Pregnancy*.
- StataCorp LP (2007) Predict – Obtain predictions, residuals, etc., after estimation. In *Stata base reference manual, Volume 2, release 10*. (Texas)
- Subramanian SV, Ertel K. (2008) Is the use of self-rated health measures to assess health functioning misleading? *International Journal of Epidemiology*, 37:1436–37.
- UCLA Academic Technology Services. (2008) *Regression with Stata: Chapter 3 – Regression with Categorical Predictors*. Available online at: <http://www.ats.ucla.edu/stat/stata/webbooks/reg/chapter3/statareg3.htm> (accessed 2nd December 2008)
- Wake M, Nicholson JM, Hardy P, Smith K (2007) Preschooler obesity and parenting styles of mothers and fathers: Australian national population study. *Pediatrics* 120:e1520-1527

Appendix 1: Logistic regression models used in calculating propensity scores for children's learning and development (shown in Table 11a)

Learning and development (FSP total score 0-62, 10.2%)		Adjusted estimates		
		OR	95% CI	p
Child's gender	Female	(ref)		
	Male	1.96	(1.67, 2.31)	0.000
Child's birth month within intake ¹ (relative to Sept 2000)		1.16	(1.13, 1.19)	0.000
Child's birth weight	3.5kg or more	(ref)		
	3 to 3.5kg	0.99	(0.81, 1.21)	0.946
	2.5 to 3kg	1.34	(1.06, 1.70)	0.015
	Less than 2.5kg	1.89	(1.38, 2.59)	0.000
Mother's age at 1 st birth	13-19	1.54	(0.87, 2.73)	0.136
	20-24	1.40	(0.82, 2.38)	0.217
	25-29	1.10	(0.64, 1.90)	0.725
	30-34	0.97	(0.57, 1.66)	0.909
	35+	(ref)		
Mother's qualifications	NVQ level 4/5	(ref)		
	NVQ level 3	1.12	(0.76, 1.65)	0.580
	NVQ level 2	1.57	(1.19, 2.07)	0.002
	NVQ level 1	2.30	(1.66, 3.18)	0.000
	No qualifications	2.06	(1.51, 2.80)	0.000
Mother ever worked	Yes	(ref)		
	No	1.33	(1.08, 1.65)	0.008
Language usually spoken in home	English	(ref)		
	English and other	1.29	(0.94, 1.78)	0.114
	Other language only	1.18	(0.84, 1.64)	0.336
Children in home	1 child	(ref)		
	2 children	1.14	(0.95, 1.35)	0.155
	3 children	1.51	(1.18, 1.92)	0.001
	4+ children	1.62	(1.19, 2.22)	0.003
Child twin/triplet	Single birth	(ref)		
	Twin or triplet	1.22	(0.69, 2.19)	0.492
General health	Excellent	(ref)		
	Good	1.16	(0.95, 1.42)	0.142
	Fair	1.40	(1.09, 1.81)	0.009
	Poor	1.68	(1.09, 2.57)	0.018
Malaise score (psychological distress)	0 to 3	(ref)		
	4 to 9 (high)	1.29	(0.99, 1.68)	0.057
Income poverty (<60% UK median)	No	(ref)		
	Yes	1.34	(1.11, 1.61)	0.003
Housing tenure	Owner occupier	(ref)		
	Private rented	1.66	(1.24, 2.23)	0.001
	Social housing	1.65	(1.30, 2.11)	0.000
	Other	1.80	(1.22, 2.64)	0.003
Area index of multiple Deprivation (IMD)	Highest quintile	(ref)		
	60 - < 80	1.07	(0.65, 1.77)	0.788
	40 - < 60	1.78	(1.16, 2.74)	0.009
	20 - < 40	1.84	(1.18, 2.86)	0.007
	Lowest quintile	2.07	(1.33, 3.22)	0.001

¹Note children's month and year of birth included as a control but not used in estimation of risk propensity score

Appendix 2: Logistic regression models used in calculating propensity scores for children's behavioural difficulties (shown in Table 11b)

Behavioural difficulties (SDQ total difficulties score 14-40, 9.0%)		Adjusted estimates		
		OR	95% CI	p
Child's gender	Female	(ref)		
	Male	1.89	(1.58, 2.25)	0.000
Child's age at interview (years) ¹ (relative to age 5)		1.00	(0.67, 1.49)	0.988
Child's birth weight	3.5kg or more	(ref)		
	3 to 3.5kg	1.00	(0.79, 1.25)	0.983
	2.5 to 3kg	0.98	(0.74, 1.29)	0.860
	Less than 2.5kg	1.27	(0.90, 1.78)	0.179
Mother's qualifications	NVQ level 4/5	(ref)		
	NVQ level 3	1.26	(0.90, 1.77)	0.185
	NVQ level 2	1.44	(1.10, 1.89)	0.008
	NVQ level 1	1.75	(1.26, 2.43)	0.001
	No qualifications	1.98	(1.40, 2.80)	0.000
Relationship with child's father at birth	Married	(ref)		
	Cohabiting	1.26	(1.01, 1.58)	0.038
	Not living together	1.24	(0.91, 1.70)	0.165
Language usually spoken in home	English	(ref)		
	English and other	1.11	(0.78, 1.57)	0.561
	Other language only	1.64	(0.95, 2.84)	0.074
Child first born	First birth	(ref)		
	Second or later birth	0.77	(0.62, 0.94)	0.011
Child twin/triplet	Single birth	(ref)		
	Twin or triplet	1.50	(0.86, 2.63)	0.150
Feelings about pregnancy	Very happy	(ref)		
	Happy	1.19	(0.95, 1.48)	0.124
	Not bothered / unhappy	1.34	(1.04, 1.73)	0.023
Smoking in pregnancy	Non smoker	(ref)		
	Gave up	0.98	(0.74, 1.31)	0.908
	Continued	1.45	(1.13, 1.88)	0.004
General health	Excellent	(ref)		
	Good	1.17	(0.95, 1.44)	0.134
	Fair	1.46	(1.10, 1.94)	0.008
	Poor	2.00	(1.25, 3.19)	0.004
Malaise score (psychological distress)	0 to 3	(ref)		
	4 to 9 (high)	1.88	(1.47, 2.42)	0.000
Self efficacy	No negative indication	(ref)		
	Any negative indication	2.09	(1.66, 2.63)	0.000
Housing tenure	Owner occupier	(ref)		
	Private rented	1.68	(1.17, 2.42)	0.005
	Social housing	1.31	(0.99, 1.74)	0.059
	Other	1.17	(0.76, 1.80)	0.461
Housing difficulties	No	(ref)		
	Yes	1.52	(0.96, 2.41)	0.071
Area index of multiple Deprivation (IMD)	Highest quintile	(ref)		
	60 - < 80	1.10	(0.72, 1.67)	0.661
	40 - < 60	1.35	(0.90, 2.03)	0.151
	20 - < 40	1.38	(0.94, 2.04)	0.100
	Lowest quintile	1.73	(1.19, 2.50)	0.004

¹Note children's age at interview included as a control but not used in estimation of risk propensity score

Appendix 3: Logistic regression models used in calculating propensity scores for children's health (unhealthy group) (shown in Table 11c)

General health (good/fair/poor 17.4%)		Adjusted estimates		p
		OR	95% CI	
Child's gender	Female	(ref)		0.000
	Male	1.26	(1.12, 1.42)	
Child's age at interview (years) ¹ (relative to age 5)		0.74	(0.56, 0.97)	0.030
Child's birth weight	3.5kg or more	(ref)		0.038
	3 to 3.5kg	1.16	(1.01, 1.34)	
	2.5 to 3kg	1.15	(0.96, 1.37)	
	Less than 2.5kg	1.78	(1.45, 2.20)	
Mother's age at 1 st birth	13-19	1.21	(0.90, 1.64)	0.200
	20-24	1.37	(1.04, 1.82)	0.028
	25-29	1.02	(0.78, 1.34)	0.859
	30-34	0.95	(0.70, 1.28)	0.730
	35+	(ref)		
Mother's qualifications	NVQ level 4/5	(ref)		0.912
	NVQ level 3	0.99	(0.81, 1.20)	
	NVQ level 2	1.16	(0.97, 1.38)	
	NVQ level 1	1.36	(1.11, 1.67)	
	No qualifications	1.41	(1.12, 1.77)	
Mother lived away from home before 17	No	(ref)		0.026
	Yes	1.20	(1.02, 1.42)	
Language usually spoken in home	English	(ref)		0.000
	English and other	1.81	(1.53, 2.14)	
	Other language only	1.40	(1.00, 1.95)	
Feelings about pregnancy	Very happy	(ref)		0.415
	Happy	1.06	(0.92, 1.21)	
	Not bothered / unhappy	1.18	(1.00, 1.39)	
General health	Excellent	(ref)		0.000
	Good	1.48	(1.26, 1.74)	
	Fair	2.29	(1.84, 2.86)	
	Poor	1.98	(1.39, 2.81)	
Felt low or sad (for at least 2 weeks)	No	(ref)		0.000
	Yes	1.27	(1.12, 1.44)	
Self efficacy	No negative indication	(ref)		0.027
	Any negative indication	1.22	(1.02, 1.44)	
Net household income	£31,200+	(ref)		0.694
	£20,800-£31,200	1.05	(0.84, 1.31)	
	£10,400-£20,800	1.15	(0.93, 1.42)	
	£0-£10,400	1.27	(1.02, 1.58)	

¹Note children's age at interview included as a control but not used in estimation of risk propensity score

Appendix 4: Logistic regression models used in calculating propensity scores for children's health (poor health) (shown in Table 11d)

General health (fair/poor 4.0%)		Adjusted estimates		
		OR	95% CI	p
Child's gender	Female	(ref)		
	Male	1.29	(1.05, 1.58)	0.017
Child's age at interview (years) ¹ (relative to age 5)		0.74	(0.48, 1.16)	0.188
Child's birth weight	3.5kg or more	(ref)		
	3 to 3.5kg	1.27	(0.97, 1.65)	0.084
	2.5 to 3kg	1.34	(0.96, 1.89)	0.087
	Less than 2.5kg	2.27	(1.68, 3.08)	0.000
Mother's parents separated before age 17	No	(ref)		
	Yes	1.32	(1.00, 1.72)	0.047
Language usually spoken in home	English	(ref)		
	English and other	1.44	(1.04, 2.00)	0.030
	Other language only	1.34	(0.70, 2.56)	0.368
Children in home	1 child	(ref)		
	2 children	0.93	(0.69, 1.24)	0.604
	3 children	1.28	(0.93, 1.77)	0.124
	4+ children	1.45	(1.00, 2.10)	0.051
First antenatal care	12 weeks or earlier	(ref)		
	13-16 weeks	1.13	(0.80, 1.59)	0.497
	17-20 weeks	1.22	(0.76, 1.96)	0.413
	After 20 weeks	1.82	(0.95, 3.46)	0.069
	No antenatal care	1.67	(1.02, 2.74)	0.040
Smoking in pregnancy	Non smoker	(ref)		
	Gave up	1.02	(0.72, 1.45)	0.903
	Continued	1.34	(1.02, 1.77)	0.039
General health	Excellent	(ref)		
	Good	1.30	(0.96, 1.76)	0.087
	Fair	2.17	(1.53, 3.08)	0.000
	Poor	2.70	(1.64, 4.44)	0.000
Malaise score (psychological distress)	0 to 3	(ref)		
	4 to 9 (high)	1.32	(0.99, 1.78)	0.061
Felt low or sad (for at least 2 weeks)	No	(ref)		
	Yes	1.37	(1.08, 1.75)	0.011
Net household income	£31,200+	(ref)		
	£20,800-£31,200	1.25	(0.81, 1.92)	0.309
	£10,400-£20,800	1.83	(1.21, 2.77)	0.005
	£0-£10,400	2.39	(1.53, 3.74)	0.000

¹Note children's age at interview included as a control but not used in estimation of risk propensity score

Appendix 5: Logistic regression models used in calculating propensity scores (currently collected data only) for children’s learning and development (shown in Table 12a)

Learning and development (FSP total score 0-62, 10.2%)		Adjusted estimates			Notes: reason selected
		OR	95% CI	p	
Child’s gender ¹	Female	(ref)			
	Male	1.90	(1.62, 2.22)	0.000	[Control]
Child’s birth month within intake ¹ (relative to Sept 2000)		1.16	(1.13, 1.19)	0.000	[Control]
Mother’s age at 1 st birth	13-19	1.95	(1.12, 3.40)	0.018	
	20-24	1.67	(0.99, 2.81)	0.055	
	25-29	1.15	(0.67, 1.97)	0.604	
	30-34	0.94	(0.56, 1.61)	0.831	
	35+	(ref)			Combined Wald test: p=0.000
Mother’s qualifications	NVQ level 4/5	(ref)			
	NVQ level 3	1.19	(0.82, 1.72)	0.363	
	NVQ level 2	1.66	(1.27, 2.17)	0.000	
	NVQ level 1	2.67	(1.94, 3.69)	0.000	
	No qualifications	2.57	(1.86, 3.53)	0.000	Combined Wald test: p=0.000
Children in home	1 child	(ref)			
	2 children	1.08	(0.90, 1.30)	0.385	
	3 children	1.49	(1.18, 1.89)	0.001	
	4+ children	1.54	(1.15, 2.07)	0.004	Combined Wald test: p=0.002
Child twin/triplet	Single birth	(ref)			
	Twin or triplet	1.70	(1.04, 2.79)	0.035	Wald test: p=0.035
First antenatal care	12 weeks or earlier	(ref)			
	13-16 weeks	1.09	(0.85, 1.41)	0.493	
	17 weeks or later	1.37	(1.01, 1.86)	0.040	Combined Wald test: p=0.197
	No antenatal care	1.31	(0.85, 2.03)	0.226	But: Individual effect for 17 weeks or later: p=0.040
Adult in employment	1 or more	(ref)			
	None	1.55	(1.29, 1.86)	0.000	Wald test: p=0.000
Area index of multiple Deprivation (IMD)	Highest quintile	(ref)			
	60 - < 80	1.09	(0.67, 1.77)	0.728	
	40 - < 60	1.88	(1.24, 2.85)	0.003	
	20 - < 40	2.10	(1.38, 3.22)	0.001	
	Lowest quintile	2.58	(1.67, 3.98)	0.000	Combined Wald test: p=0.000

¹Note children’s gender and month and year of birth included as controls but not used in estimation of risk propensity score

Appendix 6: Logistic regression models used in calculating propensity scores (currently collected data only) for children’s behaviour (shown in Table 12b)

Behavioural difficulties (SDQ total difficulties score 14-40, 9.0%)		Adjusted estimates			Notes: reason selected
		OR	95% CI	p	
Child’s gender ¹	Female	(ref)			
	Male	1.80	(1.52, 2.14)	0.000	[Control]
Child’s age at interview (years) ¹ (relative to age 5)		1.06	(0.71, 1.57)	0.778	[Control]
Mother’s age at 1 st birth	13-19	1.98	(1.05, 3.76)	0.036	Combined Wald test: p=0.172 But: Individual effect for 13-19: p=0.036 and marginal effect for 20-24: p=0.056
	20-24	1.82	(0.98, 3.37)	0.056	
	25-29	1.46	(0.82, 2.60)	0.197	
	30-34	1.47	(0.79, 2.72)	0.218	
	35+	(ref)			
Mother’s qualifications	NVQ level 4/5	(ref)			Combined Wald test: p=0.000
	NVQ level 3	1.33	(0.96, 1.85)	0.091	
	NVQ level 2	1.58	(1.21, 2.05)	0.001	
	NVQ level 1	2.03	(1.48, 2.78)	0.000	
	No qualifications	2.48	(1.80, 3.40)	0.000	
Relationship with child’s father at birth	Married	(ref)			Combined Wald test: p=0.002
	Cohabiting	1.35	(1.09, 1.66)	0.005	
	Not living together	1.60	(1.21, 2.12)	0.001	
Child first born	First birth	(ref)			Marginal Wald test: p=0.072
	Second or later birth	0.82	(0.67, 1.02)	0.072	
Child twin/triplet	Single birth	(ref)			Marginal Wald test: p=0.099
	Twin or triplet	1.60	(0.91, 2.82)	0.099	
Smoking in pregnancy	Non smoker	(ref)			Combined Wald test: p=0.000
	Gave up	1.07	(0.81, 1.43)	0.624	
	Continued	1.63	(1.29, 2.06)	0.000	
Area index of multiple Deprivation (IMD)	Highest quintile	(ref)			Combined Wald test: p=0.000
	60 - < 80	1.08	(0.72, 1.63)	0.694	
	40 - < 60	1.38	(0.91, 2.10)	0.126	
	20 - < 40	1.58	(1.08, 2.30)	0.018	
	Lowest quintile	2.07	(1.44, 2.98)	0.000	

¹Note children’s gender and age at interview included as controls but not used in estimation of risk propensity score

Appendix 7: Logistic regression models used in calculating propensity scores (currently collected data only) for children’s health (unhealthy group) (shown in Table 12c)

General health (good/fair/poor 17.4%)		Adjusted estimates			Notes: reason selected
		OR	95% CI	p	
Child’s gender ¹	Female	(ref)			
	Male	1.23	(1.10, 1.38)	0.000	[Control]
Child’s age at interview (years) ¹ (relative to age 5)		0.74	(0.56, 0.97)	0.029	[Control]
Mother’s age at 1 st birth	13-19	1.27	(0.94, 1.72)	0.116	
	20-24	1.47	(1.11, 1.96)	0.008	
	25-29	1.01	(0.77, 1.31)	0.958	
	30-34	0.89	(0.66, 1.19)	0.430	
	35+	(ref)			Combined Wald test: p=0.000
Mother’s qualifications	NVQ level 4/5	(ref)			
	NVQ level 3	1.03	(0.85, 1.24)	0.793	
	NVQ level 2	1.25	(1.04, 1.49)	0.015	
	NVQ level 1	1.58	(1.29, 1.92)	0.000	
	No qualifications	1.73	(1.35, 2.22)	0.000	Combined Wald test: p=0.000
First antenatal care	12 weeks or earlier	(ref)			
	13-16 weeks	0.99	(0.83, 1.18)	0.930	
	17 weeks or later	1.12	(0.90, 1.40)	0.311	Combined Wald test: p=0.2507
	No antenatal care	1.40	(1.00, 1.95)	0.051	But marginal effect no antenatal care: p=0.051
Adult in employment	1 or more	(ref)			
	None	1.26	(1.07, 1.49)	0.007	Wald test: p=0.008
Area index of multiple Deprivation (IMD)	Highest quintile	(ref)			
	60 - < 80	1.21	(0.97, 1.51)	0.096	Marginal combined Wald test: p=0.060
	40 - < 60	1.19	(0.94, 1.50)	0.142	Marginal individual effect 60-<80: p=0.096
	20 - < 40	1.37	(1.09, 1.72)	0.007	Individual effect 40-<60: p=0.007
	Lowest quintile	1.38	(1.09, 1.75)	0.009	Individual effect lowest quintile: p=0.009

Note smoking maintained in model with marginal effect – protective effect for quitting smoking in pregnancy odds ratio 0.84, p=0.08 – chosen to remove as not ‘risk factors’ as such.

¹Note children’s gender and age at interview included as controls but not used in estimation of risk propensity score

Appendix 8: Logistic regression models used in calculating propensity scores (currently collected data only) for children’s health (poor health) (shown in Table 12d)

General health (fair/poor 4.0%)		Adjusted estimates			Notes: reason selected
		OR	95% CI	p	
Child’s gender ¹	Female	(ref)			
	Male	1.26	(1.03, 1.53)	0.023	[Control]
Child’s age at interview (years) ₁ (relative to age 5)		0.75	(0.48, 1.16)	0.197	[Control]
Mother’s qualifications	NVQ level 4/5	(ref)			
	NVQ level 3	1.37	(0.97, 1.94)	0.072	
	NVQ level 2	1.66	(1.19, 2.31)	0.003	
	NVQ level 1	1.65	(1.06, 2.56)	0.027	
	No qualifications	1.80	(1.13, 2.88)	0.013	Combined Wald test: p=0.050
First antenatal care	12 weeks or earlier	(ref)			
	13-16 weeks	1.14	(0.82, 1.59)	0.441	Combined Wald test: p=0.117
	17 weeks or later	1.41	(0.94, 2.10)	0.093	But: marginal effect for 17 weeks or later: p=0.093
	No antenatal care	1.66	(1.03, 2.68)	0.039	and individual effect for no antenatal care: p=0.039
Smoking in pregnancy	Non smoker	(ref)			
	Gave up	1.03	(0.72, 1.49)	0.863	
	Continued	1.52	(1.15, 2.00)	0.003	Combined Wald test: p=0.010
Adult in employment	1 or more	(ref)			
	None	1.55	(1.16, 2.06)	0.003	Wald test: p=0.003
Area index of multiple Deprivation (IMD)	Highest quintile	(ref)			
	60 - < 80	1.04	(0.61, 1.77)	0.894	
	40 - < 60	1.00	(0.60, 1.66)	0.994	
	20 - < 40	1.64	(1.01, 2.66)	0.045	
	Lowest quintile	1.53	(0.92, 2.55)	0.105	Combined Wald test: p=0.024

¹Note children’s gender and age at interview included as controls but not used in estimation of risk propensity score

Appendix 9: Logistic regression models used in calculating propensity scores for children’s learning and development (currently collected data only without mother’s qualifications or whether there is an adult in the home in paid employment) (shown in Table 12a)

Learning and development (FSP total score 0-62, 10.2%)		Adjusted estimates			Notes: reason selected
		OR	95% CI	p	
Child’s gender ¹	Female	(ref)			
	Male	1.90	(1.63, 2.23)	0.000	[Control]
Child’s birth month within intake ¹ (relative to Sept 2000)		1.16	(1.13, 1.19)	0.000	[Control]
Mother’s age at 1 st birth	13-19	2.95	(1.70, 5.12)	0.000	
	20-24	2.16	(1.28, 3.64)	0.004	
	25-29	1.31	(0.77, 2.24)	0.319	
	30-34	0.97	(0.57, 1.64)	0.896	
	35+	(ref)			Combined Wald test: p=0.000
Relationship with child’s father at birth	Married	(ref)			
	Cohabiting	1.04	(0.85, 1.28)	0.694	
	Not living together	1.29	(1.04, 1.60)	0.022	Combined Wald test: p=0.050
Children in home	1 child	(ref)			
	2 children	1.14	(0.94, 1.37)	0.174	
	3 children	1.61	(1.27, 2.06)	0.000	
	4+ children	1.85	(1.41, 2.43)	0.000	Combined Wald test: p=0.000
Child twin/triplet	Single birth	(ref)			
	Twin or triplet	1.75	(1.10, 2.80)	0.019	Wald test: p=0.019
First antenatal care	12 weeks or earlier	(ref)			
	13-16 weeks	1.10	(0.85, 1.41)	0.475	
	17 weeks or later	1.44	(1.06, 1.95)	0.020	
	No antenatal care	1.60	(1.05, 2.44)	0.029	Combined Wald test: p=0.048
Area index of multiple Deprivation (IMD)	Highest quintile	(ref)			
	60 - < 80	1.12	(0.70, 1.80)	0.640	
	40 - < 60	2.06	(1.38, 3.08)	0.000	
	20 - < 40	2.44	(1.62, 3.69)	0.000	
	Lowest quintile	3.39	(2.23, 5.15)	0.000	Combined Wald test: p=0.000

¹Note children’s gender and month and year of birth included as controls but not used in estimation of risk propensity score

Appendix 10: Logistic regression models used in calculating propensity scores for children's behaviour (currently collected data only without mother's qualifications or whether there is an adult in the home in paid employment) (shown in Table 12b)

Behavioural difficulties (SDQ total difficulties score 14-40, 9.0%)		Adjusted estimates			Notes: reason selected
		OR	95% CI	p	
Child's gender ¹	Female	(ref)			
	Male	1.80	(1.52, 2.14)	0.000	[Control]
Child's age at interview (years) ¹ (relative to age 5)		1.05	(0.71, 1.55)	0.807	[Control]
Mother's age at 1 st birth	13-19	2.35	(1.24, 4.45)	0.009	
	20-24	1.98	(1.09, 3.61)	0.026	
	25-29	1.48	(0.83, 2.65)	0.182	
	30-34	1.44	(0.78, 2.67)	0.245	
	35+	(ref)			Combined Wald test: p=0.012
Relationship with child's father at birth	Married	(ref)			
	Cohabiting	1.41	(1.15, 1.72)	0.001	
	Not living together	1.80	(1.38, 2.34)	0.000	Combined Wald test: p=0.000
Child twin/triplet	Single birth	(ref)			
	Twin or triplet	1.73	(0.99, 3.04)	0.055	Wald test: p=0.055
Smoking in pregnancy	Non smoker	(ref)			
	Gave up	1.10	(0.83, 1.46)	0.513	
	Continued	1.77	(1.41, 2.22)	0.000	Combined Wald test: p=0.000
Area index of multiple Deprivation (IMD)	Highest quintile	(ref)			
	60 - < 80	1.13	(0.76, 1.67)	0.554	
	40 - < 60	1.51	(1.01, 2.27)	0.045	
	20 - < 40	1.75	(1.21, 2.51)	0.003	
	Lowest quintile	2.45	(1.73, 3.48)	0.000	Combined Wald test: p=0.000

¹Note children's gender and age at interview included as controls but not used in estimation of risk propensity score

Appendix 11: Logistic regression models used in calculating propensity scores for children's health (unhealthy group) (currently collected data only without mother's qualifications or whether there is an adult in the home in paid employment) (shown in Table 12c)

General health (good/fair/poor 17.4%)		Adjusted estimates			Notes: reason selected
		OR	95% CI	p	
Child's gender ¹	Female	(ref)			
	Male	1.23	(1.10, 1.38)	0.000	[Control]
Child's age at interview (years) ¹ (relative to age 5)		0.74	(0.56, 0.98)	0.039	[Control]
Mother's age at 1 st birth	13-19	1.46	(1.08, 1.99)	0.015	
	20-24	1.54	(1.14, 2.07)	0.005	
	25-29	1.02	(0.78, 1.34)	0.894	
	30-34	0.88	(0.66, 1.18)	0.399	
	35+	(ref)			Combined Wald test: p=0.000
Children in home	1 child	(ref)			
	2 children	1.08	(0.93, 1.24)	0.322	
	3 children	1.17	(0.97, 1.41)	0.099	
	4+ children	1.42	(1.16, 1.72)	0.001	Combined Wald test: p=0.006
First antenatal care	12 weeks or earlier	(ref)			
	13-16 weeks	0.99	(0.83, 1.19)	0.955	
	17 weeks or later	1.17	(0.94, 1.46)	0.157	
	No antenatal care	1.53	(1.10, 2.13)	0.013	Combined Wald test: p=0.053
Smoking in pregnancy	Non smoker	(ref)			
	Gave up	0.87	(0.72, 1.07)	0.187	
	Continued	1.22	(1.04, 1.42)	0.012	Combined Wald test: p=0.003
Area index of multiple Deprivation (IMD)	Highest quintile	(ref)			
	60 - < 80	1.24	(0.99, 1.55)	0.064	
	40 - < 60	1.26	(1.00, 1.59)	0.052	
	20 - < 40	1.52	(1.21, 1.91)	0.000	
	Lowest quintile	1.62	(1.29, 2.04)	0.000	Combined Wald test: p=0.001

¹Note children's gender and age at interview included as controls but not used in estimation of risk propensity score

Appendix 12: Logistic regression models used in calculating propensity scores for children's health (poor health) (currently collected data only without mother's qualifications or whether there is an adult in the home in paid employment) (shown in Table 12d)

General health (fair/poor 4.0%)		Adjusted estimates			Notes: reason selected
		OR	95% CI	p	
Child's gender ¹	Female	(ref)			
	Male	1.26	(1.03, 1.54)	0.025	[Control]
Child's age at interview (years) ¹ (relative to age 5)		0.76	(0.48, 1.18)	0.215	[Control]
Mother's age at child's birth	13-19	2.04	(1.25, 3.34)	0.005	Marginal combined Wald test: p=0.059 Individual effect for 13-19: p=0.005
	20-24	1.13	(0.76, 1.67)	0.538	
	25-29	1.19	(0.83, 1.70)	0.340	
	30-34	1.07	(0.76, 1.51)	0.679	
	35+	(ref)			
Children in home	1 child	(ref)			Combined Wald test: p=0.003
	2 children	1.05	(0.79, 1.41)	0.727	
	3 children	1.61	(1.15, 2.25)	0.006	
	4+ children	1.82	(1.23, 2.70)	0.003	
First antenatal care	12 weeks or earlier	(ref)			Combined Wald test: p=0.045
	13-16 weeks	1.14	(0.81, 1.60)	0.442	
	17 weeks or later	1.44	(0.97, 2.15)	0.073	
	No antenatal care	1.82	(1.14, 2.91)	0.012	
Smoking in pregnancy	Non smoker	(ref)			Combined Wald test: p=0.000
	Gave up	1.08	(0.75, 1.57)	0.666	
	Continued	1.69	(1.30, 2.21)	0.000	
Area index of multiple Deprivation (IMD)	Highest quintile	(ref)			Combined Wald test: p=0.003
	60 - < 80	1.05	(0.62, 1.80)	0.847	
	40 - < 60	1.07	(0.64, 1.80)	0.783	
	20 - < 40	1.85	(1.14, 3.01)	0.014	
	Lowest quintile	1.81	(1.09, 3.00)	0.023	

¹Note children's gender and age at interview included as controls but not used in estimation of risk propensity score