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Health Supplier Quality and the Distribution of Child Health

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and the ALSPAC Study Team

June 2005

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Contents

Editorial Note

Carol Propper and Simon Burgess are both Professors of Economics in the Department of Economics and the Centre for Market and Public Organisation (CMPO), where Burgess is the Director. Burgess is a Research Associate and Propper is a Co-Director at the ESRC Research Centre for Analysis of Social Exclusion (CASE), London School of Economics. John Rigg is a Research Officer at CASE.

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Abstract

There is emerging evidence to suggest that initial differentials between the health of poor and more affluent children in the UK do not widen over early childhood. One reason may be that through the universal public funded health care system all children have access to equally effective primary care providers. This paper examines this explanation. The analysis has two components. It first examines whether children from poorer families have access to general practitioners of a similar quality to children from richer families. It then examines whether the quality of primary care to which a child has access has an impact on their health at birth and on their health during early childhood. The results suggest that children from poor families do not have access to markedly worse quality primary care, and further, that the quality of primary care does not appear to have a large effect on differentials in child health in early childhood.

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1. Introduction

There is an emerging literature that shows that children from poor backgrounds in developed countries are less healthy than children from more affluent homes. From the USA and Canada, there is evidence that this gradient steepens as children age: the difference between children from poor and rich households increases during childhood (Case *et al*, 2002; Currie and Stabile, 2003). In contrast, in the UK, while a gradient exists, it appears that it does not increase during childhood, but if anything diminishes (West, 1997; Burgess *et al*, 2004; Currie *et al*, 2004). One possible explanation for this lack of deepening of the gradient is the universal health care system in the UK, the publicly funded National Health Service (NHS). Health capital is a stock and is maintained through inputs by individuals and households and from health care institutions. It would be expected that prolonged exposure to higher or lower quality health care institutions would lead to a divergence in health outcomes over time. Therefore one reason for the lack of increase in the health care gradient in UK children might be that universal provision ensures that differences across UK children in the quality of the health care institutions they access are not large.

A key part of the NHS is the well developed network of local general medical physicians, known as general practitioners (GPs). These physicians provide primary care and act as the first point of call for all medical care, referring patients on to secondary care if they deem it to be required. Generally, it has been argued that health care systems with better primary care services have better health: Shi *et al* (2002), for example, state that "numerous studies at both individual and ecological levels have established the salutary effect of primary care and shown its positive association with health outcomes". In recognition of the important role played by GPs in the UK system, central government allocates resources to general practices in a way that is intended to compensate practices located in areas with less healthy practice populations for the greater costs of treating such patients and also acts to ensure a fair distribution of GPs across areas.

Primary care providers are likely to be particularly important for children, as most of the care received by children is in the general practice setting rather than at a hospital level. So one reason why the health of poor children in the UK does not deteriorate relative to that of richer children as they age may be that all children have access to equally effective primary care providers. This paper examines this explanation. Our analysis has two components. We first examine whether children from poorer families have access to general practitioners of a similar quality to children from richer families. We then examine whether the quality of primary care to which a child has access has an impact on their health

at birth and on their health during early childhood. As the quality of GP care has several dimensions, our analysis examines the association of the income of the child's family and their health with several measures of quality, which map onto the dimensions of care that have been identified as being important (Institute of Medicine, 1994; Marshall *et al*, 2002).

We undertake our analyses using data on a large cohort of children born in one region of the UK in the early 1990s. The cohort is the Avon Longitudinal Study of Parents and Children (ALSPAC). The advantages of the ALSPAC data are twofold. First, the data set contains detailed information on parental and child health. This allows us to examine health outcomes at both birth and seven years later and to control for attributes of the child, their household and parents that may affect a child's health over and above the quality of care to which they have access. Second, the fact that the cohort are all born in a single region means that administrative data on the quality of the GP practice with which each child was registered at birth can be matched to the children in the cohort.

The paper uses administrative data on the quality of GP care. In using such data, it is necessary to take into account the fact that some of these measures may reflect factors that are not due to GP quality but are beyond a GP's control. For example, measures derived from administrative data relating to GP performance for childhood immunisation or referrals of individual to hospital for the treatment of chronic condition may be functions of local need as well as the performance of the GP practice (Giuffrida *et al*, 1999). In other words, the measures of quality reflect not only GP effort but also the local conditions of the small area in which they work.[1] To deal with this, we present estimates of the relationship between child income, health and GP quality, before and after controlling for the impact of local population health on the measured quality of the GP. To do this, we match administrative data on GP quality with small area data on population income and health. These small area data are derived from national and local sources and from the ALSPAC cohort.

We find that whether poorer children have access to GPs care of lower quality depends on which measure of quality is examined and on whether measures of quality are adjusted for the health of the population that the GP serves. Even before adjustment for population health, children from poorer families do not have GPs who are of uniformly poorer quality. Instead, we find that children from poorer families have GPs who on some dimensions of care are of lower quality, on other dimensions are no different from those of children in more affluent households, and on some dimensions are of higher quality. Once we

[1] This is the same issue that arises when performance measures are used to reward good performance of public sector providers (Propper and Wilson, 2003).

allow for the population health of the practice, there is little relationship between GP quality and the income of the child's family. In other words, once we have allowed for the fact that poor children live in areas where GPs have populations with high medical care need, there is little association between the family income of the child and the quality to which they have access.

In terms of the second part of the explanation for the lack of gradient, we do not find strong evidence that the quality of the GP to which a child has access affects health outcomes in early childhood. There is some evidence that initial child health, as measured by birthweight, is positively associated with the amount of preventative care provided by the practice, but it is also negatively associated with the extent of access provided by the practice. Poor child health at age 7 is not associated with poorer quality. There is also no evidence that the health of lower income children is more negatively affected by the quality of the GP to which they have access than the health of more affluent children. These results hold whether or not adjustment is made for the population of the practice. From this, it is hard to conclude that differences in the quality of primary care have a role in explaining the gap between rich and poor children's health in the UK. Even if there is some gap in the quality of the service provided to rich and poor children, the fact that quality has little impact on health outcomes means that differences in the quality of service to which poor children have access cannot explain lower levels of health in poor children. Put another way, the lack of increase in the gap of rich and poor children's health during childhood in the UK could be because they all have access to primary care inputs of similar quality or because these inputs have little marginal impact on health in early childhood.

The organisation of the paper is as follows. In section 2 we discuss related literature, in section 3 methodology, in section 4 data, in section 5 results and in section 6, our conclusions.

2. Related literature

2.1 The impact of primary care on health outcomes

Recent literature on health care systems has argued strongly that systems with better primary care services have better health (e.g. Macinko *et al*, 2003). Shi *et al* (2002) state that "numerous studies at both individual and ecological levels have established the salutary effect of primary care and shown its positive association with health outcomes". Most of the studies from which these conclusions are drawn examine the relationship between health outcomes and primary care at an aggregate level. Starfield and Shi (2002) use cross sectional data on 13 countries and find that a measure of the strength of primary care

infrastructure had negative bivariate correlations with health care costs and positive bivariate correlations with health indicators. Macinko *et al* (2003) use a panel of 18 OECD countries between 1970 and 1998 and find that the strength of a country's primary care system is negatively associated with mortality. Several studies are at area level, primarily for the United States (Shi *et al*, 1999; Shi and Starfield (2001), but there are two area studies for the UK. Jarman *et al* (1999) used data on 183 hospitals and examined inpatient mortality rates only, finding that that inpatient mortality rates were lower in hospitals with, interalia, higher number of GPs per capita. Guilford (2002) used data from 99 English Health Authorities (HAs) for 1999 and found that HAs with more GPs per capita had lower all cause and specific mortality, lower hospital admissions and lower conceptions for women under 18, allowing for some characteristics of the local population. In addition to being at area (or higher) level, these studies examine the impact of primary care supply, as distinct from quality.

There are fewer studies at individual level. Some of these examine the impact of the quantity – the supply – of primary care. Most are small scale, but there are two recent exceptions. Using data on 58,000 individuals clustered in 60 health care markets in the US, Shi and Starfield (2000) found that individuals were more likely to report good health if they lived in states with more primary care doctors per capita, after controlling for socio-demographic characteristics. Morris *et al* (2004) examine the whether the supply of GPs has an effect on self-assessed health of individuals in England. The analysis is based individual level data from the Health Survey of England and contains around 65,000 observations for the years 1997-2000. Individual level health variables from the HSE (self assessed health, acute ill health in the last 2 weeks, specific longstanding illnesses, having a limiting long standing illnesses, mental health (GHQ12 scores) and economic activity due to ill health) are used to construct measures of health. GP supply is measured at area level (the electoral ward) in which the respondent lives.[2,3] The authors examine whether there is an association between GP supply and individual health, controlling for standard socio-demographic characteristics and some measures of the accessibility of hospital care. They find that single equation models that do not control for endogeneity of supply yield insignificant estimates of the impact of GP supply on health. After using instrumental variable methods, they find a positive and significant association between GP supply and health status.

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[2] GP supply is measured in a number of ways – as a weighted average of practice list size, as a weighted average of ward list size and at local authority level (a higher level than ward: there are 354 LAs).

[3] An electoral ward is around 5000 people.

A very limited number of studies examine the relationship between the quality of primary care and health outcomes. Shi *et al* (2002) use the same data on 58,000 respondents in Shi and Starfield (2000) to examine the association between measures of adult self-reported health and a number of measures of three dimensions of care – access, interpersonal relationships and continuity in primary care. These were appointment time, waiting time and travel time to measure access; thoroughness of care, doctor's listening, doctor's explanation and choice of doctor to measure interpersonal relationships; choice of doctor to measure continuity of care. The results showed that good primary care experience, in particular, good accessibility and continuity, was associated with better general and mental self reported health. Dusheiko *et al* (2003) examine the relationship between individual level health and practice characteristics for a sample of 2500 individuals clustered in 60 practices in 6 Health Authorities in 1998. They found female patients in practices had better health the greater the proportion of female GPs, and practices with characteristics indicating higher quality had healthier patients, but found no impact of GP supply, as measured by number of patients in the practice per GP. None of these studies focus specifically on outcomes for children.[4]

2.2 Measuring GP quality

Quality of care is a multidimensional concept and there is no single accepted common set of indicator measures of this quality. Important dimensions include access, clinical effectiveness and interpersonal effectiveness (Institute of Medicine, 1994; Shi *et al*, 2002; Marshall *et al*, 2002). While the UK government has been concerned to measure the quality of care in primary settings, in practice the study of quality is its infancy, the government publishing a set of quality indicators for primary care for the first time in 2002.[5] Using UK data, Campbell *et al* (2001) examined the relationship between measures of quality of clinical care and four measures of quality intended to capture access and effectiveness in 60 GP practices in the UK. These were practice size (whole time equivalent general practitioners), booking times for routine consultations, socio-economic deprivation of the practice and team climate (based on questionnaires sent to staff). Quality of clinical care was measured on several dimensions: disease management (relating to the

4 Children's outcomes are included in the country studies which use all cause mortality or the area studies that examine hospital admission rates, but are not separately examined. Neither of the two individual level studies based on household or individual surveys (Shi *et al,* 2002 and Morris *et al,* 2004) appear to use data on children, though it is collected for children aged 2 and above in the HSE survey used by Morris *et al* (2004).

5 There has been a focus on the use of measures that are easily collected and also have practitioner approval.

management of angina, asthma, diabetes); preventative care (uptake of screening for cervical cytology, primary childhood immunisation, MMR immunisation and preschool vaccination), access, continuity and interpersonal care (the last three measured by questionnaires sent to patients). The authors found considerable variation in the quality of care, with only moderate correlation between different aspects of care. They conclude that their four measures of access and effectiveness were predictors of the clinical quality of care, but none of them were consistently associated with all measures of quality of care.[6]

One potential problem of measures of care is the extent to which they reflect not GP quality or effort, but the nature of the practice population. Giuffrida *et al* (1999) raise concerns over the use of admissions for chronic conditions as measures of access. They examined the extent to which admission rates for asthma, epilepsy and diabetes[7] at area (English health authority) level were associated with two factors beyond the control of primary care providers: socio-economic characteristics of the area (as measured by data on health at small area level from the 1991 Census) and the supply of secondary care services (number of hospital staff in general medicine per 10,000 population, beds per head of population weighted for distance). They found considerable variation both within and between health authorities in admission rates. They also found that a high proportion of the variance (around 50 percent) in age and sex standardised admission rates was explained by socio-economic factors and the supply of secondary care. Studies for the UK have also found considerable fluctuation in admission rates for these conditions from year to year for any practice (e.g. Macleod *et al* 2004).

In summary, currently there is no single accepted set of measures of quality in primary care and measures taken from administrative data may need to be adjusted so that they reflect the quality of care provided rather than the health of the patient population.

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6 The largest effect was the relationship between the time available for routine consultations and the quality of management of chronic disease. Size of practice was associated negatively with measures of access, but positively with care for diabetes. Deprivation of the population was significantly associated with lower uptake of preventative care. Team climate was associated with quality of care for diabetes, access to care and overall satisfaction, but cannot be routinely measured.

7 These are conditions for which timely and effective primary care could be expected to reduce the risk of admission to hospital by preventing the onset of illness, controlling an acute episode of illness, or better long term management.

3. Our approach

We study two issues. First, do children from poorer families have GPs who are of lower quality? Second, to what extent does GP quality affect child health and does this differ by income group? To answer the second question, we examine the extent to which child health, at birth and at age 7, are correlated with the quality of the GP that the mother of the child is registered with at the child's birth, after controlling for a large set of family and household characteristics that may affect child health. As measures of quality based on practice activity may reflect both GP effort and the characteristics of the population served by the practice, administrative measures of quality need to be adjusted for the effect of the health of the population the GP serves.

To illustrate ideas, we model child health as a function of family characteristics, X_i, and the true quality of the GP care available to the child, Q_{gi}.

(1) $h_i = a_1 + a_2 X_i + a_3 Q_{gi} + w_i$

However, true quality Q_g is unobserved. Instead measured quality, q_g, will be a function of health of the population served by the GP, P_g, and true quality, Q_g.

(2) $q_g = b_1 + b_2 P_g + b_3 Q_g + v_g$

Our approach is to use a wide set of measures of P_g to purge q_g of correlation with P_g by regressing q_g on P_g. We then estimate (1) replacing Q_{gi} with residual from (2), allowing for clustering within GP.[8] The residual from (2) captures the component of Q_g that is orthogonal to P_g, other measurement error and noise.

The assumptions made in this approach are:

(i) $corr(v_g, w_i) = 0$
(ii) $corr(P_g, v_g) = 0$

Assumption (i) implies that unobserved factors that affect child health are not correlated with unobserved factors that affect (measured) GP quality. In the data we use here this seems quite plausible, partly because of the rich set of controls we have in the ALSPAC data, but mainly because choice of GP in the UK in the early 1990s was very limited and any choice made in an almost information-free environment. Individuals in the UK in the early 1990s were restricted to choosing a GP practice near their home locations, and a high proportion choose

[8] Each GP practice contains several children in the data set.

the nearest GP practice. Little data was available even on the services offered by practices (by 1994 GPs published data on opening hours and particular clinics they ran), and no validated data on quality was available until 2002. Individuals wishing to change practice had to go through a bureaucratic procedure. The real element of choice was choice of GP within practice, as most GP practices contain a number of GPs. Our practice quality data are at practice level.

If assumption (ii) is not met, then our approach may over- or under-adjust the measured quality. For example, if high quality GPs locate in areas in which populations were less healthy and so more difficult to treat, our approach would under-estimate the true quality of these GP and over-estimate the quality of low quality GPs. On the other hand, if conditional on location good GPs exert extra effort to overcome the handicap of poor population health, our method will over-adjust.

While GPs choose locations, the factors that drive GP location choice in the UK probably mean that the correlation between unobserved GP quality and population may be either positive or negative. On one hand, GPs may wish to locate in areas with easier to treat populations as these are more attractive residential areas. This would mean a positive correlation between GP quantity – i.e. supply – and population health, though not necessarily a correlation between GP quality and population health. On the other hand, the UK government uses incentive payments to attract doctors to areas of worse population health and also restricts entry into areas with high ratios of doctors to population. A positive response by doctors to these payments would mean a negative correlation between GP supply and population health (Morris *et al*, 2004). But again direction of the correlation between GP quality and population health is not clear.

Finally, if the variance of v_g in (2) is very large relative to $b_3 Q_g$ this will attenuate the coefficient on q_g. This is a standard measurement error problem: we seek to overcome it by using a large set of measures of P_g.

Given these issues, our approach is to present estimates of (1) with both unadjusted and adjusted quality measures (details of the adjustments are below) and present both the raw correlations between GP quality and health outcomes and then the correlations after controlling for a wide set of family characteristics that have been shown to affect child health (Case *et al*, 2002; Burgess *et al*, 2004).

4. The data

Child health

The ALSPAC data are a cohort of children born in one region of the UK in the early 1990s. ALSPAC enrolled pregnant women resident in the former Avon Health Authority whose estimated date of delivery was between the 1st of April 1991 and the 31st of December 1992 (Golding *et al*, 2001). Approximately 85% of eligible mothers enrolled, resulting in a cohort of 14,893 pregnancies.[9] Respondents were interviewed at high frequency compared to other UK cohort studies.[10] We use data from several mother- and child-based questionnaires covering the dates between 8 weeks gestation and the 81st month of the child. We construct six indicators of poor child health, two based on outcomes at birth; the others on outcomes when the child is aged approximately seven years of age. The age at birth measures are from medical records, one of the age 7 measures is for a condition that would be diagnosed by a medical practitioner, one is from medical readings and the other two are from mothers' responses. So if there is mother reported bias, the use of the measures based on medical records should show this.

For estimation purposes we use these data as binary variables, with one denoting poor child health. These poor health indicators are:

(i) Lowest 10% and 5% of log birth weight

Data on birth weights are obtained from hospital birth records. We define two cut offs, the first being in the lowest decile of the log birth-weight distribution,[11] which equates to 2720 grams, the second being in the lowest 20th of the sex-specific birth-weight distribution, which equates to 2465 grams. These weights are respectively just above and between international definitions of low (2500g) and very low birth weight (2000g).[12]

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9 Our estimation samples are somewhat smaller than this, representing late miscarriages, stillbirths and post-birth sample attrition and non-response to questionnaire items. The cross-sectional representation of the ALSPAC sample was compared with the 1991 National Census data of mothers with infants under one year of age who were resident in the county of Avon. The ALSPAC compared reasonably well. Mothers who were married or cohabiting, owned their own home, did not belong to any ethnic minority and lived in a car-owning household were slightly over-represented (Golding *et al*, 2001).

10 For example, the UK National Child Development Study (NCDS) interviewed at birth and then again at 7. The UK Birth Cohort Study (BCS70, first wave was in 1970) has a similar gap.

11 Distributions are based on the ALSPAC cohort.

12 53% (72%) of those defined as low (very low) birth weight are pre-term (under 38 weeks gestation).

(ii) Eight or more symptoms of poor child health at 81 months

When the ALSPAC children were aged 81 months, mothers were asked to state whether their child had recently experienced any of a list of 21 symptoms of poor health. The symptoms are wide ranging, both in the dimensions of health they capture as well as their prevalence. For instance, scarcely any children stop breathing (experienced by just 0.21 per cent of the sample), whereas it was rare for children not to have experienced a cold (87.1 per cent of children had a cold in the previous year). The total count of symptoms is approximately normally distributed; the modal number of symptoms is 5. We define ill health as having eight or more symptoms of poor health.

(iii) Mother-reported poor child health

This measure is based on mothers' assessment of their child's health in the past year. A similar question is asked in most household surveys which include questions on health. Mothers were asked to classify their child health into either "very healthy, no problems", "healthy, but a few minor problems", "sometimes quite ill" or "almost always unwell". From these responses, we compute a binary indicator, labelled mother-reported poor child health. This is equal to one if children are rated as anything but very healthy.[13]

(iv) Highest decile of body mass index (BMI)

The body mass index (BMI) is constructed from clinic-based measures of the child's height and weight at 7 years of age.[14] We construct an indicator variable with value 1 if the child is in the top 10 percent of the survey sex-specific BMI distribution.

(v) Mother-reported asthma

This outcome is derived from the same checklist of symptoms at 81 months as the count of symptoms measure. It takes the value 1 if the mother answers the child has asthma, and has the advantage of being for one condition only, which would have been diagnosed by a health care professional.

Details of the distribution of these variables are in Table 1.

4.2 Indicators of practice quality

As the quality of primary care has several dimensions, practices may perform well in some dimensions of primary care, but less well in others (Marshall *et al*, 2002). For this reason we use 12 indicators of practice quality, which cover four domains of practice performance that have been identified as being important

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13 A poor health measure based on the two categories of "sometimes quite ill" and "almost always unwell" would yield insufficient cases for analytical purposes.

14 BMI is weight in kilograms divided by height in metres squared.

components of the quality of care in the UK as well as the US (for example, Houghton and Rouse, 2004; Shi *et al*, 2002). These are preventative care, chronic disease management, access and interpersonal effectiveness.

Houghton and Rouse (2004) examined the performance indicators used by the Department of Health to monitor the performance of primary care organisations (PCOs) to examine whether it was possible to identify a subgroup of the 20 indicators that GPs would consider valid indicators of their performance. They found that seven indicators comprised 73% of the indicators chosen and these were chosen by 75% of the 25 GPs who participated. These indicators were percentage of patients receiving cervical screening, percentage of generic prescribing, percentage of patients receiving childhood immunisations, percentage of eligible patients receiving influenza vaccinations, ability to see GP within 48 hours, percentage prescribing antibacterial drugs and primary care management of diabetes and asthma. We use several of these and augment the list with aspects of care that may be particularly important to women and children.

Individuals registered with group practices generally see a range of the GPs at the practice, so our practice quality measures are at practice level. They are from administrative records collected by the local health authority and matched to the ALSPAC study child via the child's GP at birth.[15,16] Three issues arise in the use of these data. First, the data are available for 1994/5 to 2001/2, which is after the birth of the children in the ALSPAC sample. However, as the year-on-year correlations of the practice quality indicators are generally high, we use the mean of the data for the two earliest years for which it is available; 1994/5 and 1995/6. These data therefore actually cover the period midway between birth and age 7. We are interested in outcomes at birth and at age 7. We therefore treat these as time invariant practice measures and make the assumption that these measures reflect practice quality both at birth and during early childhood. This makes our measures somewhat noisy. Second, some children may move between practices and therefore the practice at birth will not be the same as that at age 7. If moves are exogenous to quality of GP, this will not introduce bias, but will again introduce noise. We explore the robustness of our results to this below. Third, some of the measures are used to trigger incentive payments to GPs (for example, hitting cervical smear levels), which may induce gaming and threshold effects. There may also be some element of 'what gets measured gets

15 This was Avon health authority.

16 The data provided contains measures of 121 practice characteristics for 125 practices from 1994/5 to 2000/1. Only a relatively small selection of these characteristics are used in the analysis since many were considered to be either unreliable indicators of practice quality or missing for an unacceptably large number of practices.

done' in these indicators (Propper and Wilson 2003). However, while we cannot adjust measures for this potential bias, we assume that all GPs react in the same way to these incentives. In addition, our use of a range of measures, several of which are not related to incentive payments, may alleviate this problem.

The measures are:

(i) Measures of preventative care

We use three measures of this aspect of care: the percentage of at risk women who received cervical smears; the percentage children vaccinated/immunised; the percentage of children receiving pre-school booster.

(ii) Measures of chronic disease management

We use three indicators of chronic disease management: per cent of diabetic patients reviewed, per cent diabetic patients admitted to hospital and per cent patients with asthma admitted to hospital. Preliminary analysis indicated a high correlation between these so in the analyses below we reduce these to one measure, a single, composite, index based on factor analysis of three indicators of chronic disease management.

(iii) Measures of access/quantity of staff

We use the number of patients per whole time equivalent GP; the number of patients per whole time equivalent nurse: number of health visitor hours per 100 population aged 0 to 4 years; the number of night visits made per 100 population.

(iv) Measures of the quality of interpersonal care

We use the ALSPAC data to construct two measure of satisfaction of mothers of care provided at their GP practice. The first records satisfaction with the GP, the second satisfaction with health visitors. These are practice level averages of responses to a set of questions asked to mothers registered with the practice when the study child was 21 months old.[17] We also derive two indicator

[17] For the GP satisfaction indicator, mothers were asked: "How would you describe the attitude of your current doctor/GP". Mothers responded either "always", "usually", "sometimes" or "never" to six separate statements on whether their GP was "supportive", sympathetic", "interested", "helpful" "easy to talk to" and "prepared to give you time". The responses were coded from 1 to 4, with 4 equating to greatest satisfaction ("always"). The responses were summed for each mother to form an aggregate (individual-level) GP satisfaction score ranging from 6 to 24. For the health visitor indicator, mothers were asked to indicate the extent to which they agreed with the statement that "the health visitor gives very helpful advise". The possible responses were "this is exactly how I feel", "this is often how I feel", "this is

variables from data on practice staffing that have been argued to be relevant for the quality of the relationship between patients and GPs: the number of female GPs and the size of the practice.

Correlation coefficients for the practice quality indicators are reported in Table A1. These show a high correlation of the measures within the preventative care domain, no correlation across preventative care and chronic disease management, a correlation within the staffing measures, and some correlation within the interpersonal care domain. One strategy would be to reduce these measures to one indicator of each of the four aspects of care. However, we do not adopt this approach initially for the following reasons. First, many of the within domain correlations are not high; second, there is some correlation across domains; and third, it might be the case that one measure is particularly important and fourth, as this is the first large scale study of the effect of quality of care on children's health in the UK, we do not wish to reduce the amount of information used in the analysis. However, we do adopt this approach after examining the impact of all twelve measures separately.

The measures show considerable variation across practices within the sample. Table A2 presents the 90:10 decile ratios for the measures at practice level. This shows variation in the decile ratio, with lower variation in the measures of preventative care and chronic disease management, and the highest variation being in staffing levels, for which the 90:10 ratio is generally above 2. This shows that practices in our sample have considerable discretion in their behaviour.

4.3 Adjusting the GP quality measures for the health status of the practice population

GP practice performance on these measures may be affected by the nature of the practice population, over which GPs have relatively little control. For example, a practice located in a socio-economically deprived area is likely to experience greater difficulty in achieving high rates of cervical smears and rates of childhood immunisation than practices in less deprived areas containing a more 'compliant', better-educated and informed population. Staffing patterns are the outcome of GP staff deployment decisions and are thus also conditional on the practice population. For example, practices may have a higher number of night visits because they have a poorer population. So on this indicator a practice with a poor population may appear to perform better, but adjusted for population need, this is not the case.

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sometimes how I feel" and "I never feel this way". These responses were coded from 4 to1 respectively.

Three sets of data were used to measure the population health of the practice and to adjust the quality measures for practice population health. The first is data collected at local area (ward) level that measures the deprivation of the local area in which the GP practice is located. These data, most of which refer to the mid 1990s, measure six separate domains of deprivation (income, health, employment, education, geographical access to services, child poverty) at ward level (DETR 2000).[18] From the 1991 census data the Department of Health also calculate a measure of deprivation of the ward in which the practice is located:[19] this measure is part of the set of measures at local area level.

The second set measures the demographic structure of the practice population. The data are from the same administrative data sets as the practice quality indicators.[20] The third set is derived from the ALSPAC sample. We use the large set of measures of physical and mental health, housing and socio-economics status (SES) of the mothers of the ALSPAC children to construct a measure of the health and SES of the younger female population of the practice. Most of these measures are taken early during pregnancy and refer to the health, housing and SES of the mother prior to the birth of the ALSPAC child. Sample descriptives for all the variables, at practice level, are in Table A3.

Table 2 presents summary statistics from the regressions of practice quality against practice population measures of health and income: the adjusted R^2 and F-tests for each of the three sets of variables (entered simultaneously) used to measure population health. The total amount of variation in quality accounted for by the regressions varies: the smallest amount of variation explained is for satisfaction with health visitors, the largest amount of variation explained is for number of night visits. The adjusted R^2s are low for preventative care, satisfaction with the practice and some aspects of staffing, but higher for preventative care and other aspects of staffing. However, for all of the practice quality indicators except the number of patients per whole time equivalent nurse and the health visitor satisfaction, at least one of the sets of measures of local

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18 These are based on 33 indicators, measured at ward level, taken from a variety of sources (details in DETR 2000). Many are based on claims of state benefits in the ward. A ward is around 5000 people. As a GP practice may draw their populations from different wards a score for each practice was derived from the modal ward score of the mothers in ALSPAC registered with the practice.

19 Known as the Townsend score.

20 The proportion of the practice population aged over 65, the number of patients who are age 65 per whole time equivalent GP and the number of patients aged 0-4 per whole time equivalent GP.

area need are statistically significant. In many cases two or three sets are jointly significant.

As the three sets of measures of population need (especially ward SES and the SES/health of the ALSPAC parents registered with the practice) are themselves correlated, the association between the sets of need measures and the practice characteristics were tested entering each set of measures separately (available from the authors). This showed that ward SES measures were strongly associated with prevention practice quality indicators, the various staff to patient ratios and night visits. The demographic characteristics of the practice explain a significant amount of the variation GP staffing of the practice and the number of night visits, but not of other measures of practice quality.[21] The population health measures derived from the health of the ALSPAC mothers were significantly associated with preventative care, and most of the staff to patient ratios and night visits, so show similar patterns to the ward SES measures. In summary, the practice quality indicators are relatively highly correlated with measures of population need, the measures of ward and practice SES and health being most correlated with the practice achieving preventative care targets and staff to patient ratios, and the demographic structure of the practice being most correlated with the number of WTE GPs and number of night visits made.

As there is no benchmark for normal levels of activities on the quality measures, we define a practice to be of poor quality on any measure if the quality measure of the practice is the lowest quartile of the practice quality distribution. Both the unadjusted and the adjusted quality measures are analysed this way: the adjusted quality indicators are equal to 1 if the practice is in the lowest quartile of the distribution of the residuals from the estimates of Table 2.

4.4 Background controls

To control for factors that affect child health other than the quality of the GP practice, we use controls for age of gestation at delivery, gender, singleton (non-twin) status, birth order and ethnicity of the child; for household composition; for mother's age at birth, her education and work status during pregnancy, maternal mental health prior to the pregnancy, number of cigarettes smoked

21 This result accords with Morris et al (2004) who found that *quantity* of GP services at small areas level was explained by measures of demographic structure at the same small area level.

during pregnancy, and for low-income status early in pregnancy.[22] Descriptive statistics for all variables used in the analysis are in table 1.

5. Results

5.1 Do poor children have low quality GPs?

We begin by examining whether poor children are registered with poor quality practices. Evidence is presented in Table 3. We report results for two indicators of low household income, derived from averaging responses collected from the mother over the period from when the study child was 32 weeks of gestation to 85 months old. The first is derived from questions to the mother about whether her household is in financial hardship, the second based on categories of unequivalised net family income. A higher value for the practice quality indicators is indication of better quality on that dimension, so a negative (positive) correlation coefficient for financial hardship (income) indicates that poorer children have practices that are of lower quality.

The table presents the association with income for unadjusted quality indicators on the left hand side. There is a clear pattern in the unadjusted measures. Children from better off households are registered with practices that perform better in terms of preventative care and chronic disease management, have more staff per patient, more female GPs, more GPs in total, and with GPs who score more highly in terms of patient satisfaction. On the other hand, these children are registered with practices that do less night visits and have fewer health visitors. So in terms of raw measures of quality, on balance children from poorer families have lower quality GP practices, except that these practices do appear to compensate for lower performance on some dimensions with more health visitors and more night visits.

The second part of the table presents the association between practice quality and household income after adjustment of the indicators for the health needs of the small area in which the practice is located.[23] This shows that, after controlling for the SES, demographic structure and health of the practice population/small area in which the practice is located, the association between poor children and poor quality GPs is much weaker. Children from poorer households still have GPs who are of poorer quality as measured by

22 All these variables have been shown to be associated with child health in this data set: see Burgess et al (2004). This paper also provides further details on these ALSAPC data.

23 Similar results are obtained from regressing practice quality measures on household income and the three sets of adjustment for small area need.

performance in terms of chronic disease management, and have fewer GPs, fewer female GPs and are in practices where there are more patients per GPs. But the association with measures of preventative care, many of the access measures and the measures of interpersonal care is essentially zero.

What can be concluded from this about the distribution of GP quality across households? There is a clear association between low income and poor practice quality in the raw scores of the practices on the four dimensions, in perhaps the anticipated direction – that poorer children have poorer quality GPs. But the results of table 2 shows that the raw measures of GP quality are in the most part correlated with population characteristics of the small area in which the practice is located. The preventative care and access dimensions are particularly associated with ward and practice population SES and health, and the GP staffing with practice demographic structure. Once we take into account these associations (which is what the adjustment does), the association between household income and GP quality falls considerably. The correlations that remain are those where the adjustment has little statistical power (the chronic disease management index) or in some aspects of staffing. Put another way, there is a correlation at area level between practice quality and area SES/health; once this small area level association is allowed for, there is much less association between individual income and practice quality. This is because low income households are clustered spatially: poor people tend to live in areas with other poor people, so that there is a correlation between small area SES and household income.[24]

This then raises the question of how to interpret the quality measures. Are the levels of measured quality simply due to area characteristics so that areas where people are in poor health/greater need impinge negatively on measured quality but the true quality is not lower, or do they reflect true lower quality for poorer families? The adjusted measures suggest the first, while the unadjusted measures show the second. As individuals are clustered by income in where they live, we do not have the data to distinguish between these two competing explanations – we cannot break the correlation between population health and individual income. So in our examination of the impact of quality on child health we present results for both the unadjusted and the adjusted measures. These can be thought of as upper and lower bounds on the effect of quality on children's health: the unadjusted upper bound not allowing for the fact that measured quality is correlated with area health needs, the adjusted lower bound taking out this need correlation but possibly removing part of the effort made by

[24] While there are differences across practices in the income of the ALSPAC cohort, the 90:10 ratio of mean household income at the practice level is 1.4, indicating that that income differences within practice exist.

GPs to respond to the needs of their poorer populations (for example, by increasing night visits).

5.2 Poor practice quality and poor child health

We first present estimates of the relationship between each measure of practice quality and child health, where each quality indicator is a dummy variable with value 1 if the practice is in the lowest quartile of the distribution of the measure. Table 4 presents the association between child health and unadjusted practice quality measures. For each outcome, the table reports the association without and with the full set of controls for child gender and ethnicity, child birth order, household demographic structure, mother health and mother SES.

The first four columns show results for health at birth. These show that low birth weight is significantly associated with a GP practice which has poorer measured preventative care. For example, a child with a GP in the bottom quartile of quality, as measured by the rate of smear indicator, is 2.6 percent more likely to be born in the bottom 10% of the log birthweight distribution. The raw association between poor quality and poor birth outcomes is reduced by about half by the inclusion of household controls. After allowing for these controls, a child with a GP in the bottom quartile of the cervical smear quality measure is approximately 1 percentage points more likely to be in the bottom decile of the log birthweight distribution (i.e. has an 11 percent probability compared to a mean of 10 percent). The effect on having a very low birth weight is similar (a rise from 5% at the mean to just under 6%). There is very little association with the other attributes of quality – chronic disease management, access/staffing, and interpersonal care – and health at birth.

The next eight columns present the association of measured GP practice quality with outcomes at age 7. In the main, there are relatively few significant associations. Having a large number of symptoms is, if anything, associated with better GP quality, though only the association between the chronic disease management dimension of care and having more than 8 outcomes at age 7 is statistically significant. Children in practices with many patients per GP appear to have worse health as defined by more symptoms. The next 4 columns indicate that neither being assessed as in poor health nor having a high body mass index appear associated with poor GP quality and in fact, being rated as in worse health is negatively associated with practices which have higher patient to GP ratios. The final two columns present the results for whether the child has asthma. Children who have GPs who have poor scores for preventative care appear more likely to have asthma, so on this dimension of care, the relationship between outcomes and child health is similar to that for birth weight (and the coefficients are of similar magnitude). But children with GPs who perform worse in terms of care for chronic diseases (including asthma) are less likely to

have asthma. For asthma, as for two of the other outcomes at age 7, lower satisfaction with a GP is associated with better child health.

The overall picture is of some association with the unadjusted measures, such that children whose mothers are registered with GPs who perform less well in terms of preventative care have a higher probability of low birthweight. But there is less association of poor GP quality with outcomes at age 7. Further, for these later outcomes, there are a small number of counterintuitive significant associations of child health with measures of quality.

Table 5 present the results after adjustment of the practice quality measures for the health of the practice populations. The first four columns show that the association of poor practice quality, as measured by performance on preventative care measures, and low birth weight is weaker than in Table 2. After controlling for both practice population characteristics through the use of adjusted indicators and household characteristics, only one of the preventive care measures remains significantly associated with one of the poor outcomes at birth. There is also some indication that better quality GPs are associated with poorer birthweight outcomes: fewer patients per GP, lower satisfaction with health visitors and more female GPs are associated with lower birthweight. The already weak pattern of association of outcomes at age 7 with unadjusted practice quality in table 2 remains after adjusting the quality measures for the practice population. There is no significant association between quality and child health as measured by the child having asthma. There are a small number of significant associations with poor practice quality and the child being in the highest decile of BMI, but these associations are only significant at the 10 percent level. There is one association between poor mother assessed child health and lower quality, and one between better chronic disease management and the child having a high number of symptoms.

Table 6 tests whether the results are robust to regression on all the indicators of practice quality simultaneously. The table presents only the estimates with the full set of household controls, and presents the coefficients for both unadjusted and adjusted quality measures. The table shows that the results for low birthweight, number of symptoms, and asthma are little changed. Looking across outcomes within the different dimensions of care (after adjustment for differences in practice populations) indicates whether certain dimensions of quality are more associated with health than others. For preventative care and chronic care quality, poorer quality is generally associated with poorer outcomes, but this is not the case for preventative care measured in terms of cervical smear rates. In terms of measures of quantity/access, lower ratios of GPs and nurses to the population, and lower numbers of GPs are associated with worse child health. On the other hand, aspects of staffing that practices might

alter in response to poorer populations (having more health visitor hours, more night visits) are negatively associated with better health outcomes, so that children in practices which have lower night visits and fewer health visitors have better outcomes. In terms of quality of interpersonal relationships, having fewer female GPs is negatively associated with worse child health as is attending a practice with which people are more satisfied with the care received.

From this analysis of the 12 separate measures, the pattern is one of weak and often contradictory associations between child health and GP quality. There is no consistent relationship between any single measure of quality and child outcomes, nor are there consistent relationships between one dimension of quality and the four outcomes.

The practice quality measures apply to the practice of the child at birth, but some of the outcomes are when the child is aged 7. It may be the case that the children have moved GP practice between birth and age 7. We do not know whether the practice at which the child is registered at age 7 is the same practice as that with which their mother was registered at birth. However, we know whether the child is still with the same GP as age 22 months and whether they had not moved house by age 42 months. We can be confident that most, if not all, of this group of children have the same practice at 42 months as at birth. We re-estimated the age 7 outcomes using this sample. The results were very similar to those reported above (available from the authors), so we feel our results are robust to this possible source of error.

5.3 Reducing the measures of quality to smaller dimensions

The picture is somewhat mixed so we sought to reduce the number of measures of quality. We used factor analysis of the measures that make up each dimension to produce four single measures, one for each dimension. We did this for both the unadjusted and the adjusted measures. We then produced a single measure of practice quality by factor analysing all the measures and taking the first factor. Again, we constructed an unadjusted and an adjusted measure.[25] Table 7, top panel, presents the estimated impact of each of the four dimensions on child outcomes. This table confirms the positive association between low birthweight and poorer quality preventative care shown above. However, almost all the other significant associations are negative, including a negative relationship between poor access and poor birth outcomes. In addition, most of the associations are not significant. Table 7, bottom panel, presents the results for the single measure of practice quality. This shows a positive association between poor care and low birthweight (for one measure before adjustment, for

[25] The factor analysis is after the measures have been adjusted.

another after adjustment) and also a positive association of poor care and higher asthma.[26]

This analysis is based on the first factor from factor analysis of all the aspects of quality. This loads relatively heavily onto preventative care, so we also examined an indicator based on the sum of the practice's rankings on each of the 12 measures. Results using this composite measure on child outcomes (available from the authors) show less association of quality with child health and, in particular, less association of child health at birth with quality. Low birthweight is positively associated with poor quality as measured by performance on preventative care measures; reducing the importance of these measures in the composite indicator reduces the extent of the association of quality and low birthweight.

5.4 Is the impact of quality different for poor children?

It may be that while the average effect is not significant, practice quality impacts more upon poor children than children from better off homes, where perhaps parental inputs may compensate for poorer GP care. To test this, we estimate the relationship between each outcome and the quality measures, allowing for an interaction with low household income. We present results for the four aggregated measures plus the single measure which aggregates across all dimensions, based on factor analysis. Table 8 shows there is little evidence that poor children fare worse when they have access to a GP of low quality. The top part of the table presents results for the four separate domains of quality. While the joint tests of the indicators are statistically significant more often than in Table 7, most of the interaction terms are negative, indicating that children with low income have better outcomes when they have poor quality GPs. For the composite measure of quality, almost all interactions with low income are insignificantly different from zero. So there is little evidence that poor children have worse health when their GPs are of poorer quality: in fact, if anything, there is some evidence of the opposite.

Conclusions

This paper has examined whether the lack of a deepening gradient between the health of rich and poor children in the UK is due to the better access that poor children in the UK have to good primary care. In one of the first studies of the relationship between household income, quality of primary care and children's

[26] Another way of adjusting the practice data for the population is to include measures of the population directly into the regression of child health. This approach also indicated little association between the practice quality and outcomes.

health, children have been matched to their GP at birth. The quality of these GPs is measured by a range of administrative measures of dimensions of care argued to be important for primary care. These measures have been adjusted to reflect the population of the local area in which the GP practices.

Our results indicate that poorer children have access to GPs who have poorer measured quality on some dimensions of care, but better ones on others. Once we allow for the fact that measured performance may reflect population health, these differences between poor and more affluent children fall considerably. So once we allow for the fact that poor children live in areas where GPs have populations with high medical care need, there is very little association between the family income of the child and the quality to which they have access. There is an issue as to whether this is interpreted as poorer children having access to poorer GPs, or whether this is interpreted as children having access to GPs whose quality is mis-measured by indicators which do not take into account the need of the local population. We cannot distinguish between these interpretations, but whichever is adopted, the evidence suggests that poor children do not have access to strongly lower quality primary care than children from richer homes.

Nor do we find any strong evidence that the quality of the GP to which a child has access affects health outcomes in early childhood. There is some evidence that initial child health, as measured by birthweight, is positively associated with the amount of preventative care provided by the practice, but it is also negatively associated with the extent of access provided by the practice. And by age 7 there is no clear pattern in the association of child health and GP quality. From this, it is hard to conclude that differences in the quality of primary care have a role in explaining a gap between rich and poor children's health in the UK. Even if there is some gap in the quality of the service provided to rich and poor children, the fact that quality has little impact on health outcomes means that differences in the quality of service to which poor children have access cannot explain lower levels of health in poor children. Put another way, the lack of an increase in the gap of rich and poor children's health during childhood in the UK could be because they all have access to primary care inputs of similar quality and/or because these inputs have little marginal impact on health in early childhood.

There are three important caveats. First, while poorer children may not have access to primary care of very different quality, we do not know whether they access this care less frequently, so reducing its potentially helpful effect. If they do access this care less than the children of the more affluent, the lack of deterioration in the gradient may be due to other factors. As we have controlled for a relatively large number of measures of characteristics of the child's family

and household, and found the association between practice quality and childhood health is relatively unaffected by these controls, at least some of these protective factors must be external to the household. And second, despite the use of a reasonably large set of measures of both quality and access/quantity and which relate to services given to children and mothers, these are all derived from routine data and may not have captured the essence of good quality for children. Finally, the fact that we find little relationship between the quality of care and child health does not mean that quality is unimportant. It may simply be the case that at the level and range of variation in quality that we observe across primary care providers there is no relationship – in other words, we are at a flat point in the relationship between inputs and outputs.[27] These issues remain to be explored in further research.

[27] The argument is similar to that used to explain a lack of association between class size and childrens' cognitive attainment - a lack of differences in outcomes at around present class sizes does not mean that additional resources are never beneficial.

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Table A1: Correlation coefficients for unadjusted practice quality indicators (practice level)

	Preventative Care			*Chronic Disease Manag-ment*	*Access*				*Interpersonal Care*			
	Rate of smear	**Rate of vaccination**	**Rate of pre-school booster**		**Patient per WTE GP**	**Patients per WTE nurse**	**Health visitor hours per 100 pop age 0-4**	**Number of night visits per 100 pop**	**Patient per WTE GP**	**Health visitor per 100 population**	**Proportion of female GP**	**Number of WTE GPs**
Preventative Care												
Rate of smear	1.00											
Rate of vaccination	0.38***	1.00										
Rate of pre-school booster	0.24*	0.58***	1.00									
Chronic Disease Management												
Composite Index	0.01	-0.12	-0.06	1.00								
Access												
Patient per WTE GP	0.10	0.17*	0.17*	0.14	1.00							
Patients per WTE nurse	-0.09	-0.02	0.08	-0.05	0.13	1.00						
Health visitor per 100 0-4s	-0.06	-0.09	0.01	0.12	-0.06	0.02	1.00					
Number of night visits per 100 pop	-0.08	-0.18*	-0.09	0.04	-0.17*	0.05	0.20**	1.00				
Interpersonal Care												
Satisfaction with GP	0.22**	0.08	0.12	0.08	-0.01	-0.01	-0.03	0.03	1.00			
Satisfaction with health visitor	0.19**	0.20**	0.09	-0.17*	0.02	-0.18*	0.01	0.11	0.09	1.00		
Proportion female GPs	0.19**	-0.01	0.17*	0.08	0.44***	0.09	-0.01	-0.04	0.06	0.18*	1.00	
No. of WTE GPs	0.09	-0.01	0.12	0.17	0.23***	0.01	0.05	0.06	0.08**	0.26	0.26**	1.00

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

Table A2: Decile ratios for practice quality characteristics

Practice Indicator	Practice Level
Preventative Care	
Rate of smear	1.13
Rate of vaccination/ immunisation	1.13
Rate of pre-school booster	1.08
Chronic Disease Management	
Composite index	1.19
Access	
Patient per whole time equivalent GP	1.61
Patients per whole time equivalent nurse	2.29
Health visitor hours per 100 population aged 0-4	2.82
Number of night visits per 100 population	2.75
Interpersonal Care	
GP satisfaction score	1.30
Health visitor satisfaction score	1.48
Proportion of female GPs (%)	2.41
Number of WTE GPs	3.00

Notes:

1. All figures are decile ratios except for proportion of female GPs which is inter quartile ratio (it is not possible to compute the decile ratio since values at the tenth percentile = 0)

Table A3: Variables used in auxiliary regressions (practice level)

Population health at practice level (from ALSPAC data)			
% of mums in poor self-assessed health pre-pregnancy	113	8.03	4.02
% of mums' mums with o-level or lower	113	55.06	6.44
% of mums' mums with A-level or higher	113	14.06	8.15
% with damp or mould	113	6.67	5.36
% of mums with high CCEI score at 18 weeks gestation	113	23.79	6.09
% mums with mental health problem pre-pregnancy	113	11.42	4.44
Median life event score for mum	113	6.42	1.70
Median life event score for mum squared	113	48.78	27.59
Median pre-pregnancy BMI for mum	113	22.22	0.49
Median pre-pregnancy BMI for mum squared	113	494.03	21.72
% mums ever regular smoker	113	504.42	9.62
% mums consume 1+ glasses of alcohol per day	113	11.25	6.11
Practice Quality Indicators (continuous measures)			
Rate of smear	108	87.27	5.28
Rate of vaccination/ immunisation	107	97.77	4.71
Rate of pre-school booster	107	95.14	5.05
Chronic disease management	98	0.01	0.46
Patient per whole time equivalent gp	108	1988.95	407.46
Patients per whole time equivalent nurse	106	4698.23	1946.76
Health visitor hours per 100 population aged 0-4	107	15.14	7.35
Number of night visits per 100 population	108	77.71	35.50
GP Satisfaction	113	13.38	1.24
Health visitor Satisfaction	113	1.81	0.27
Proportion of female GPs (%)	108	29.95	19.41
Number of WTE GPs	108	3.87	1.58

Table A3 cont.

Ward SES (Dummy for highest decile)				
Townsend Score		113	0.09	0.29
Domain:	Income	113	0.12	0.32
	Health	113	0.12	0.32
	Employment	113	0.11	0.31
	Education	113	0.11	0.31
	Access	113	0.10	0.30
Child Poverty Index		113	0.12	0.32
Practice Demographics (Dummy for highest decile)				
% patients aged 65 or more		113	0.08	0.28
No. of patients aged 65 or more per wte GP		113	0.09	0.29
No. of patients aged 0-4 per wte GP		113	0.10	0.30

Table 1: Summary statistics for all variables used in analysis.

	Number of Observations	Mean	Standard Deviation
Poor Child Health (Outcome variables)			
Lowest 10% of log birth weight	12958	0.10	0.30
Lowest 5% of log birth weight	12988	0.05	0.22
Eight or more symptoms at 81 months	8504	0.18	0.39
Poor mother-reported child health at 81 months	7778	0.39	0.49
Top 10% of sex-specific BMI distribution at c.84 months	7760	0.02	0.30
Asthma at 81 months	8411	0.12	0.33
Unadjusted Practice Quality Indicator as used in main regressions at child level: dummy for lowest quartile (binary variables)			
Rate of smear	11698	0.21	0.41
Rate of vaccination/ immunisation	11670	0.24	0.43
Rate of pre-school booster	11670	0.28	0.45
Chronic disease management	10894	0.23	0.42
Patient per whole time equivalent gp	11698	0.25	0.43
Patients per whole time equivalent nurse	11588	0.29	0.45
Health visitor hours per 100 population aged 0-4	11658	0.21	0.44
Number of night visits per 100 population	11698	0.16	0.37
GP Satisfaction	12992	0.21	0.41
Health visitor Satisfaction	12992	0.24	0.43
Proportion of female GPs (%)	11698	0.17	0.38
Number of WTE GPs	11698	0.14	0.35
Adjusted Practice Quality Indicator as used in main regressions at child level: dummy for lowest quartile (binary variables)			
Rate of smear	11698	0.30	0.46
Rate of vaccination/ immunisation	11670	0.22	0.42
Rate of pre-school booster	11670	0.25	0.43
Chronic disease management	10893	0.26	0.44
Patient per whole time equivalent gp	11698	0.27	0.44
Patients per whole time equivalent nurse	11588	0.27	0.44
Health visitor hours per 100 population aged 0-4	11658	0.22	0.42
Number of night visits per 100 population	11698	0.22	0.41
Proportion of female GPs (%)	11698	0.22	0.41

Number of WTE GPs		11698	0.16	0.36
Child fixed characteristics				
Born 37 weeks gestation or earlier		13117	0.11	0.31
Twin		13197	0.01	0.11
Female		13120	0.49	0.50
non-white		11835	0.05	0.22
Household composition				
Two adults in household at 8 weeks gestation		12522	0.84	0.36
Three plus adults in household at 8 weeks gestation		12522	0.11	0.31
One sibling at birth		11020	0.36	0.48
Two siblings at birth		11020	0.14	0.35
Three or more siblings at birth		11020	0.05	0.21
Maternal Human Capital				
Mother aged at child's birth	21 or less	13117	0.09	0.29
	22.25	13117	0.20	0.40
	36 or more	13117	0.07	0.26
Mother's own birth weight in lowest decile		7468	0.10	0.30
Mother in work at 18 weeks gestation		11128	0.62	0.49
Mother's highest education:	CSE/ none	12148	0.20	0.40
	A-level or higher	12148	0.36	0.48
Employment and Income status at 32 weeks gestation				
Financial hardship score = 6 or more		11827	0.20	0.40
Maternal employment status		11128	0.62	0.49
Maternal health and child health related behaviours				
Highest quartile of CCEI score1		11458	0.24	0.43
Mother smokes 1-9 cigarettes per day (32 wks gestation)		11886	0.08	0.26
Mother smokes 10-19 cigarettes per day (32 wks gestation)		11886	0.09	0.28
Mother smokes 20+ cigarettes per day (32 wks gestation)		11886	0.03	0.17

Notes:

1. CCEI score: Crown Crisp Experiential Index
2. Additional variables have been created for all missing categories (except for the outcome variables and practice quality indicators).

Table 2: Quality adjustment regressions

		% of at risk women received smear	% of children vaccinated /immunised	% of at risk children received pre-school booster	Index for chronic disease management (1994/6)	Number of patients per whole time equivalent GP	Number of patients per whole time equivalent nurse
Observations		108	107	107	98	108	106
R-squared		0.46	0.40	0.33	0.26	0.58	0.26
Adj R-Squared		0.32	0.24	0.15	0.04	0.48	0.06
Joint significance tests							
Ward SES	F	3.02***	1.14	1.53	1.87*	1.24	1.25
Practice demographics	F	1.04	2.91**	3.76***	0.60	15.16***	0.24
ALSPAC Health	F	1.25	1.87**	0.84	0.88	1.88**	0.54
All regressors	F	3.25***	2.56***	1.84**	1.18	5.42***	1.29

		Health visitor hours per 100 population aged 0-4	Number of night visits per 100 population	GP satisfaction score (from ALSPAC)	Health visitor satisfaction score (from ALSPAC)	Female GPs as a % of all GPs	Number of WTE GPs
Observations		107	108	108	108	108	108
R-squared		0.31	0.62	0.33	0.14	0.26	0.35
Adj R-Squared		0.13	0.52	0.15	-0.08	0.07	0.18
Joint significance tests							
Ward SES	F	1.44	1.62	1.92*	0.88	1.28	0.96
Practice demographics	F	0.60	3.94***	1.69	0.23	3.21**	5.09***
ALSPAC health	F	1.70*	3.41***	1.42	0.56	0.87	2.04**
All regressors	F	1.72**	6.17***	1.89**	0.89	0.16	2.10***

Notes:

1. CCEI score: Crown Crisp Experiential Index

* significant at 10%; ** significant at 5%; *** significant at 1%. Absolute value of t statistics in parentheses

Table 3: Correlation between practice quality indicators and mean household income

Practice Indicator	Unadjusted		Adjusted	
	Financial Hardship Score Mean from 32wks gestation to 85 months	Net Family Income Mean from 33months to 85 months	Financial Hardship Score Mean from 32wks gestation to 85 months	Net Family Income Mean from 33months to 85 months
Preventative Care				
Rate of smear	-0.06***	0.09***	-0.10	0.02
Rate of vaccination/ immunisation	-0.01	0.04***	0.01	0.00
Rate of pre-school booster	-0.01	0.06***	0.01	0.02
Chronic Disease Management				
Composite index	-0.03**	0.08***	-0.02	0.03**
Access				
Patient per whole time equivalent GP	0.02*	-0.06***	0.01	-0.04***
Patients per whole time equivalent nurse	0.03**	-0.06***	-0.00	-0.01
Health visitor hours per 100 population aged 0-4	0.06***	-0.09***	0.02	-0.01
Number of night visits per 100 population	0.11***	-0.20***	-0.02	0.01
Interpersonal Care				
GP satisfaction score	-0.04**	0.07***	0.01	-0.01
Health visitor satisfaction score	0.01	-0.01	-0.00	0.00
Proportion of female GPs	-0.02	0.05***	-0.02	0.03**
Number of WTE GPs	-0.01	0.03*	-0.01	0.02*

Notes:

1. Financial hardship ranges from 0-15; 0= no financial hardship, 15= maximum possible financial hardship
2. Family income categories range 1-5, 1= less than £100 per week, 5= £400 or more per week
3. Practice quality indicators refer to continuous measure.
4. This information is collected 6 times between 32 weeks of gestation and when the study child is 85 months of age for financial hardship and 3 times between 33 and 85 months of age for income.
5. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 4: The impact of poor practice quality and poor child health: unadjusted practice quality indicators

Poor Practice Quality Indicator	Indicator of poor child health											
	Lowest 10% log birth Weight		Lowest 5% log birth Weight		Eight or more symptoms of poor health at 81 months		Poor mother assessed child health at 81 months		Top 10% of sex specific BMI at 7 years		Mother reported asthma at 81 months	
	w/o controls	with controls	w/o controls	with controls	w/o controls	with controls	w/o controls	with controls	w/o controls	with controls	w/o controls	with controls
Preventative Care												
Rate of smear	.026***	.013**	.020***	.009***	-.009	-.010	.014	.011	-.014	-.017	.013	.011
	[.010]	[.007]	[.006]	[.003]	[.012]	[.011]	[.015]	[.015]	[.011]	[.011]	[.011]	[.009]
Rate of vaccination/ immunisation	.014	.008	.012*	.006**	-.002	-.004	.018	.017	-.003	-.005	.016*	.015*
	[.009]	[.006]	[.006]	[.003]	[.009]	[.009]	[.014]	[.014]	[.010]	[.010]	[.009]	[.008]
Rate of pre-school booster	.024***	.012*	.015**	.005	-.001	-.004	.012	.008	.004	.001	.012	.008
	[.009]	[.006]	[.007]	[.003]	[.010]	[.010]	[.014]	[.013]	[.010]	[.010]	[.008]	[.007]
Chronic Disease Management												
Composite index	.010	.005	.007	.002	-.030***	-.031***	.006	.007	.007	.004	-.014	-.016*
	[.009]	[.007]	[.007]	[.003]	[.011]	[.011]	[.013]	[.013]	[.011]	[.010]	[.009]	[.008]
Access												
Patient per whole time equivalent GP	.001	.003	.003	.003	.019*	.020*	-.005	-.003	.002	.004	-.004	-.003
	[.009]	[.007]	[.006]	[.003]	[.011]	[.011]	[.012]	[.013]	[.009]	[.009]	[.008]	[.007]
Patients per whole time equivalent nurse	-.009	-.003	-.004	-.000	-.002	-.000	.016	.018	-.009	-.008	-.007	-.004
	[.008]	[.006]	[.006]	[.003]	[.011]	[.011]	[.014]	[.014]	[.009]	[.008]	[.009]	[.008]
Health visitor hours per 100 population aged 0-4	-.012*	-.007	-.005	-.001	-.010	-.008	-.003	.003	-.011	-.005	-.014	-.008
	[.007]	[.006]	[.006]	[.003]	[.011]	[.010]	[.014]	[.015]	[.010]	[.010]	[.008]	[.008]
Number of night visits per 100 population	-.009	-.009	-.002	-.002	-.010	-.007	-.007	-.004	-.007	-.004	-.002	.003
	[.007]	[.006]	[.005]	[.003]	[.015]	[.014]	[.020]	[.019]	[.010]	[.009]	[.009]	[.009]

Table 4 cont.

Interpersonal Care												
GP satisfaction score	.014	.007	.006	.002	-.019	-.023*	-.021	-.026*	.011	.008	-.012	-.015*
	[.009]	[.007]	[.006]	[.003]	[.012]	[.012]	[.016]	[.015]	[.009]	[.008]	[.010]	[.009]
Health visitor satisfaction score	-.007	-.003	.000	.002	-.008	-.007	-.008	-.006	-.003	.000	-.003	-.000
	[.008]	[.006]	[.005]	[.003]	[.013]	[.013]	[.015]	[.015]	[.010]	[.009]	[.009]	[.009]
Proportion of female GPs	.001	.001	.003	.002	.013	.012	.011	.011	.001	.002	-.006	-.008
	[.009]	[.007]	[.007]	[.004]	[.017]	[.016]	[.015]	[.015]	[.010]	[.010]	[.009]	[.008]
Number of WTE GPs	.002	.008	-.004	-.000	-.014	-.013	-.028	-.025	-.001	-.002	-.008	-.006
	[.010]	[.009]	[.007]	[.004]	[.012]	[.012]	[.018]	[.018]	[.011]	[.010]	[.012]	[.012]

Notes:

1. Poor practice quality = lowest quartile of practice indicator.
2. Coefficients are marginal effects from probit regressions.
3. Controls include gestation to delivery, whether twin, child sex, ethnicity, no. of adults in household during pregnancy, no. of siblings at birth, age of mother at birth, whether mother was low birth weight, whether mother worked during pregnancy, mother's education, financial hardship, no. of cigarettes smoked during pregnancy, mother's mental health during pregnancy.
4. The number of observations range from 6433 to 12840 according to practice quality indicator and child health outcome
5. Robust standard errors are in brackets and are adjusted for clustering of children within practices * significant at 10%; ** significant at 5%; *** significant at 1%

Table 5. The impact of poor practice quality and poor child health: adjusted practice quality

Poor Practice Quality Indicator	Lowest 10% of log birth weight		Lowest 5% of log birth weight		Eight or more symptoms at 81 months		Poor mother-reported child health at 81 months		Top 10% of sex-specific BMI at 7 years		Asthma at 81 months	
	w/o controls	with controls	w/o controls	with controls	w/o controls	with controls	w/o controls	with controls	w/o controls	with controls	w/o controls	with controls
Preventative Care												
Rate of smear	-.006	-.000	-.007	-.001	.003	.003	.016	.017	.001	.002	.007	.006
	[.008]	[.006]	[.006]	[.003]	[.010]	[.010]	[.013]	[.012]	[.010]	[.009]	[.009]	[.008]
Rate of vaccination/ immunisation	.013*	.009	.011*	.006**	-.008	-.007	.027**	.028**	.003	.004	.002	.002
	[.007]	[.006]	[.006]	[.003]	[.011]	[.010]	[.013]	[.014]	[.011]	[.010]	[.009]	[.008]
Rate of pre-school booster	-.004	-.003	-.003	-.002	-.000	-.001	-.006	-.006	.005	.005	.000	-.002
	[.009]	[.007]	[.007]	[.003]	[.010]	[.010]	[.013]	[.013]	[.010]	[.010]	[.008]	[.008]
Chronic Disease Management												
Composite Index	.014	.003	.010	.002	-.020*	-.021*	.018	.017	.020*	.017*	-.008	-.011
	[.009]	[.007]	[.006]	[.003]	[.012]	[.011]	[.014]	[.014]	[.011]	[.010]	[.009]	[.008]
Access												
Patient per whole time equivalent GP	-.014*	-.006	-.003	.002	.015	.016	-.007	-.004	.013	.016*	.001	.001
	[.008]	[.006]	[.005]	[.003]	[.011]	[.011]	[.012]	[.013]	[.009]	[.009]	[.007]	[.007]
Patients per whole time equivalent nurse	-.003	.001	-.000	.001	-.001	-.001	.015	.016	.002	.002	-.005	-.003
	[.008]	[.006]	[.006]	[.003]	[.011]	[.011]	[.014]	[.014]	[.010]	[.009]	[.009]	[.009]
Health visitor hours per 100 population aged 0-4	.005	.003	.007	.004	-.014	-.014	-.010	-.010	-.006	-.005	-.006	-.005
	[.009]	[.006]	[.007]	[.003]	[.012]	[.012]	[.017]	[.016]	[.010]	[.009]	[.011]	[.009]
Number of night visits per 100 population	.008	.002	.012	.005	-.006	-.006	-.017	-.018	-.008	-.008	.002	.001
	[.009]	[.006]	[.007]	[.003]	[.013]	[.013]	[.016]	[.015]	[.009]	[.008]	[.011]	[.010]

Table 5 cont.

Interpersonal Care												
GP satisfaction score	.003	-.003	.001	-.002	-.011	-.014	-.016	-.019	.017*	.014	-.001	-.004
	[.009]	[.006]	[.007]	[.003]	[.013]	[.012]	[.016]	[.015]	[.009]	[.009]	[.009]	[.008]
Health visitor satisfaction score	-.013*	-.011*	-.003	-.001	-.007	-.007	.002	.003	.003	.002	.013	.013
	[.007]	[.006]	[.005]	[.003]	[.012]	[.011]	[.015]	[.014]	[.010]	[.009]	[.009]	[.008]
Proportion of female GPs	-.021**	-.018***	-.009	-.005	-.008	-.007	-.010	-.009	-.013	-.009	-.011	-.010
	[.009]	[.007]	[.007]	[.003]	[.015]	[.014]	[.013]	[.013]	[.010]	[.009]	[.008]	[.007]
Number of WTE GPs	.010	.010	.002	.002	.007	.006	.013	.011	.011	.007	.022	.018
	[.009]	[.007]	[.007]	[.004]	[.015]	[.014]	[.022]	[.022]	[.013]	[.012]	[.014]	[.013]

Notes:

1. Poor practice quality = lowest quartile of practice indicator.
2. Coefficients are marginal effects from probit regressions.
3. Adjustments based on residuals from auxiliary regressions of Practice Quality indicators on local socio economic scores and health measures (see text for further details)
4. Controls include gestation to delivery, whether twin, child sex, ethnicity, no. of adults in household during pregnancy, no. of siblings at birth, age of mother at birth, whether mother was low birth weight, whether mother worked during pregnancy, mother's education, financial hardship, no. of cigarettes smoked during pregnancy, mother's mental health during pregnancy.
5. The number of observations range from 6433 to 12840 according to practice quality indicator and child health outcome (see appendix A7 for further detail).
6. Robust standard errors are in brackets and are adjusted for clustering of children within practices * significant at 10%; ** significant at 5%; *** significant at 1%

Table 6: Child health & Practice quality indicators (Practice Quality indicators estimated simultaneously)

Poor Practice Quality Indicator	Lowest 10% of log birth weight		Lowest 5% of log birth weight		Eight or more symptoms at 81 months		Poor mother-reported child health at 81 months		Top 10% of sex-specific BMI distribution		Asthma at 81 months	
	Unadjust	**Adjust**	**Unadjust**	**Adjust**	**Unadjust**	**Adjust**	**Unadjust**	**Adjust**	**Unadjust**	**Adjust**	**Unadjust**	**Adjust**
Preventative Care												
Rate of smear	0.011	-0.005	0.008**	-0.006	0.001	-0.003	0.005	0.013	-0.029**	-0.008	0.017	0.008
	[0.007]	[0.007]	[0.004]	[0.004]	[0.014]	[0.012]	[0.018]	[0.012]	[0.011]	[0.011]	[0.011]	[0.010]
Rate of vaccination/ immunisation	-0.001	0.016**	0.002	0.011**	-0.013	-0.011	0.017	0.025*	0.005	-0.003	0.009	-0.004
	[0.010]	[0.007]	[0.004]	[0.004]	[0.013]	[0.016]	[0.019]	[0.015]	[0.015]	[0.012]	[0.011]	[0.011]
Rate of pre-school booster	0.012	-0.004	-0.000	-0.004	-0.000	0.005	0.004	-0.021	-0.000	0.004	0.003	-0.003
	[0.010]	[0.006]	[0.004]	[0.003]	[0.012]	[0.014]	[0.016]	[0.015]	[0.013]	[0.012]	[0.010]	[0.011]
Chronic Disease Management												
Composite index	0.003	0.002	0.002	0.001	-0.035***	-0.017	0.016	0.022*	0.008	0.022**	-0.013	-0.007
	[0.007]	[0.006]	[0.003]	[0.002]	[0.011]	[0.011]	[0.015]	[0.012]	[0.011]	[0.010]	[0.008]	[0.008]
Access												
Patient per whole time equivalent GP	0.001	0.001	0.001	0.007	0.026*	0.022	-0.015	-0.032***	0.005	0.028**	-0.001	0.002
	[0.008]	[0.006]	[0.004]	[0.004]	[0.014]	[0.014]	[0.016]	[0.012]	[0.012]	[0.011]	[0.009]	[0.009]
Patients per whole time equivalent nurse	-0.002	-0.005	-0.002	-0.003	-0.008	-0.007	0.023	0.033***	-0.013	-0.005	-0.004	-0.003
	[0.006]	[0.004]	[0.003]	[0.002]	[0.013]	[0.012]	[0.014]	[0.011]	[0.010]	[0.009]	[0.009]	[0.008]
Health visitor hours per 100 population aged 0-4	-0.005	0.002	-0.001	0.003	-0.003	-0.013	0.010	-0.010	-0.009	-0.007	-0.005	-0.004
	[0.007]	[0.006]	[0.004]	[0.003]	[0.011]	[0.012]	[0.012]	[0.015]	[0.010]	[0.009]	[0.009]	[0.009]
Number of night visits per 100 population	0.002	0.001	0.002	0.004	-0.001	-0.006	-0.008	-0.031**	-0.005	-0.007	0.014	-0.002
	[0.008]	[0.005]	[0.004]	[0.003]	[0.017]	[0.013]	[0.025]	[0.015]	[0.012]	[0.008]	[0.010]	[0.011]

Interpersonal Care												
GP satisfaction score	0.006	-0.000	0.002	-0.000	-0.014	-0.007	-0.025*	-0.018	0.010	0.020**	-0.016	-0.002
	[0.008]	[0.006]	[0.004]	[0.003]	[0.012]	[0.012]	[0.014]	[0.014]	[0.010]	[0.010]	[0.010]	[0.009]
Health visitor satisfaction score	-0.007	-0.012**	0.001	0.001	-0.019	-0.006	-0.017	-0.008	0.005	0.010	-0.013	0.014*
	[0.007]	[0.005]	[0.003]	[0.003]	[0.013]	[0.012]	[0.015]	[0.014]	[0.011]	[0.009]	[0.008]	[0.008]
Proportion of female GPs	-0.007	-0.022***	0.000	-0.007**	0.008	-0.017	0.008	0.002	0.005	-0.019**	-0.008	-0.013
	[0.008]	[0.006]	[0.004]	[0.003]	[0.019]	[0.015]	[0.022]	[0.013]	[0.013]	[0.009]	[0.011]	[0.009]
Number of WTE GPs	0.006	0.014	-0.000	0.007	-0.014	0.012	-0.029	0.016	-0.003	0.020	0.001	0.026*
	[0.011]	[0.008]	[0.005]	[0.005]	[0.015]	[0.016]	[0.022]	[0.019]	[0.013]	[0.012]	[0.014]	[0.014]
Observations	10576	10575	10576	10575	6975	6974	6381	6380	6377	6376	6899	6898
Joint tests for indicators Chi^2	0.52	0.67	1.66	0.77	4.30**	1.41	0.05	0.03	0.59	3.37*	0.46	0.12

Notes:

1. Poor practice quality = lowest quartile of practice indicator.
2. Adjustments based on residuals from auxiliary regressions of Practice Quality indicators on local socio economic scores and health measures (see text for further details)
3. All estimates are net of controls for gestation to delivery, whether twin, child sex, ethnicity, no. of adults in household during pregnancy, no. of siblings at birth, age of mother at birth, whether mother was low birth weight, whether mother worked during pregnancy, mother's education, financial hardship, no. of cigarettes smoked during pregnancy, mother's mental health during pregnancy.
4. Robust standard errors in brackets
5. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 7: Child Health and practice quality: reduced set of indicators (factor analysis)

Poor Practice Quality Indicator	Indicator of poor child health											
	Lowest 10% log birth weight		Lowest 5% log birth weight		Eight or more symptoms of poor health at 81 months		Poor mother assessed child health at 81 months		Top 10% of sex specific BMI at 7 years		Mother reported asthma at 81 months	
	Unadjust	Adjust	Unadjust	Adjust	Unadjust	Adjust	Unadjust	Adjust	Unadjust	Adjust	Unadjust	Adjust
Preventative Care	0.008	0.012**	0.005	0.005	-0.009	-0.009	0.009	0.024*	-0.007	-0.001	0.006	0.005
	[0.007]	[0.006]	[0.003]	[0.003]	[0.011]	[0.011]	[0.014]	[0.014]	[0.010]	[0.010]	[0.008]	[0.009]
Chronic Disease Management	0.007	0.004	0.003	0.002	-0.031***	-0.023**	0.010	0.016	0.003	0.016	-0.014*	-0.012
	[0.008]	[0.006]	[0.004]	[0.003]	[0.011]	[0.011]	[0.013]	[0.013]	[0.011]	[0.011]	[0.008]	[0.008]
Access	-0.012*	-0.011*	-0.005	-0.003	0.019	0.009	0.010	0.002	0.009	0.005	0.010	-0.006
	[0.007]	[0.006]	[0.003]	[0.003]	[0.012]	[0.011]	[0.014]	[0.013]	[0.010]	[0.010]	[0.008]	[0.008]
Interpersonal Care	0.012	0.009	0.004	0.003	-0.012	-0.013	-0.010	-0.021	0.005	-0.006	-0.024**	-0.012
	[0.010]	[0.006]	[0.005]	[0.003]	[0.015]	[0.011]	[0.017]	[0.014]	[0.010]	[0.009]	[0.010]	[0.009]
Joint Test for Practice Quality Indicators												
Chi^2	0.78	1.36	0.78	1.24	1.73	3.68	0.45	0.65	0.23	0.49	1.50	2.46
Single Measure of Practice Quality												
	0.007	0.003	0.007**	0.003	-0.009	-0.005	0.007	0.014	-0.001	-0.003	0.026***	0.003
	[0.006]	[0.007]	[0.003]	[0.003]	[0.011]	[0.010]	[0.014]	[0.013]	[0.011]	[0.010]	[0.007]	[0.008]
Observations	10576	10575	10576	10575	6975	6974	6381	6380	6377	6376	6899	6898

Notes:

1. All estimates are net of controls for gestation to delivery, whether twin, child sex, ethnicity, no. of adults in household during pregnancy, no. of siblings at birth, age of mother at birth, whether mother was low birth weight, whether mother worked during pregnancy, mother's education, financial hardship, no. of cigarettes smoked during pregnancy, mother's mental health during pregnancy.
2. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 8: Child Health and Practice Quality: interactions with low income

Poor Practice Quality Indicator	Indicator of poor child health											
	Lowest 10% log birth weight		Lowest 5% log birth weight		Eight or more symptoms of poor health at 81 months		Poor mother assessed child health at 81 months		Top 10% of sex specific BMI at 7 years		Mother reported asthma at 81 months	
	Unadjust	Adjust	Unadjust	Adjust	Unadjust	Adjust	Unadjust	Adjust	Unadjust	Adjust	Unadjust	Adjust
Preventative Care	0.013*	0.013*	0.005	0.003	-0.007	-0.007	-0.005	0.017	-0.002	0.007	0.010	0.006
	[0.007]	[0.007]	[0.004]	[0.004]	[0.014]	[0.015]	[0.018]	[0.018]	[0.012]	[0.010]	[0.010]	[0.011]
…x low income	-0.026***	-0.003	-0.002	0.015	-0.001	-0.004	0.058	0.036	-0.021	-.036***	-0.017	-0.003
	[0.009]	[0.013]	[0.006]	[0.010]	[0.034]	[0.037]	[0.039]	[0.037]	[0.017]	[0.013]	[0.015]	[0.017]
Chronic Disease Management	0.008	0.005	0.004	0.003	-0.028**	-0.017	0.010	0.023	0.006	0.021*	-0.014	-0.016
	[0.008]	[0.007]	[0.004]	[0.003]	[0.012]	[0.013]	[0.017]	[0.017]	[0.011]	[0.011]	[0.009]	[0.010]
…x low income	-0.008	-0.009	-0.008	-0.003	-0.019	-0.027	-0.005	-0.030	-0.012	-0.018	-0.001	0.013
	[0.014]	[0.013]	[0.005]	[0.006]	[0.023]	[0.023]	[0.042]	[0.039]	[0.016]	[0.013]	[0.021]	[0.024]
Access	-0.013*	-0.012*	-0.003	-0.000	0.013	0.010	0.014	0.007	0.008	0.010	0.008	-0.006
	[0.007]	[0.006]	[0.003]	[0.003]	[0.014]	[0.013]	[0.017]	[0.015]	[0.011]	[0.012]	[0.010]	[0.010]
…x low income	0.005	0.005	-0.008*	-0.011***	0.021	-0.004	-0.013	-0.020	0.008	-0.018	0.007	-0.000
	[0.014]	[0.015]	[0.004]	[0.003]	[0.032]	[0.029]	[0.037]	[0.036]	[0.021]	[0.016]	[0.015]	[0.017]
Interpersonal Care	0.015	0.011	0.003	0.004	-0.013	-0.005	-0.008	-0.014	0.013	0.002	-0.014	-0.005
	[0.011]	[0.007]	[0.006]	[0.004]	[0.019]	[0.014]	[0.021]	[0.016]	[0.011]	[0.010]	[0.010]	[0.010]
…x low income	-0.016	-0.008	0.001	-0.007	0.008	-0.037	-0.008	-0.030	-0.033	-0.032*	-0.041**	-0.033**
	[0.014]	[0.013]	[0.009]	[0.005]	[0.035]	[0.027]	[0.052]	[0.031]	[0.020]	[0.018]	[0.020]	[0.016]
Joint Test for Practice Quality Indicators												
Chi^2	4.09**	0.80	1.71	10.91***	0.02	3.52	0.13	2.45	2.53	13.01***	1.67	4.96**
Single Measure of Practice Quality												
Single measure of practice quality	0.009	0.004	0.007*	0.003	-0.011	-0.005	-0.013	0.006	0.001	0.005	0.026***	0.006
	[0.007]	[0.008]	[0.004]	[0.003]	[0.015]	[0.013]	[0.018]	[0.018]	[0.012]	[0.011]	[0.009]	[0.010]
…x low income	-0.014	-0.009	0.003	-0.001	0.016	-0.001	0.085**	0.040	-0.015	-0.034**	0.000	-0.017
	[0.011]	[0.012]	[0.007]	[0.007]	[0.035]	[0.031]	[0.040]	[0.037]	[0.017]	[0.014]	[0.019]	[0.016]
Observations	10576	10575	10576	10575	6975	6974	6381	6380	6377	6376	6899	6898

Notes:
1. Composite indicators from factor analysis.
2. All estimates are net of controls for gestation to delivery, whether twin, child sex, ethnicity, no. of adults in household during pregnancy, no. of siblings at birth, age of mother at birth, whether mother was low birth weight, whether mother worked during pregnancy, mother's education, financial hardship, no. of cigarettes smoked during pregnancy, mother's mental health during pregnancy.
3. Low income equals a score of 3+ for mean financial hardship. The financial hardship score ranges from 0 to 15; information is gathered 6 times between 32 weeks gestation and when the study child is aged 85 months. Approximately a third of the sample are in low-income according to this definition.
4. * significant at 10%; ** significant at 5%; *** significant at 1%