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# Quality of Schooling and Inequality of Opportunity in Health

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# QUALITY OF SCHOOLING AND INEQUALITY OF OPPORTUNITY IN HEALTH

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**Abstract**
This paper explores the role of quality of schooling as a source of inequality of opportunity in health. Substantiating earlier literature that links differences in education to health disparities, the paper uses variation in quality of schooling to test for inequality of opportunity in health. Analysis of the 1958 NCDS cohort exploits the variation in type and quality of schools generated by the comprehensive schooling reforms in England and Wales. The analysis provides evidence of a statistically significant and economically sizable association between some dimensions of quality of education and a range of health and health-related outcomes. For some outcomes the association persists, over and above the effects of measured ability, social development, academic qualifications and adult socioeconomic status and lifestyle.

**JEL codes:** I12, I28, C21
**Keywords:** Health; Quality of Education; Inequality of opportunity; NCDS

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Recent empirical work, such as Rosa Dias (2009) and Trannoy *et al.* (2010), suggests that differences in education are an important dimension of inequality of opportunity in health. This is in line with the earlier literature on socioeconomic inequalities in health, such as Wagstaff, van Doorslaer and Watanabe (2003) and van Doorslaer and Jones (2003), and with the large body of evidence emphasising the role of complementary educational policies in reducing long-run health inequalities. The issue of complementary policies has been brought to the fore in various fields of economics, and the reciprocal association between health and education policy has attracted particular attention. First, the way childhood health constitutes a pre-requisite for the success of educational policy is well documented: in empirical papers such as Mayer-Foulkes (2001), Miguel (2004), Alderman *et al.* (2006) and Contoyannis and Dooley (2010); in the official guidelines of policy makers, for example the World Food Program (2006); and in theoretical models of child nutrition and human capital formation, such Currais *et al.* (2010) and De la Croix and Doepke (2003). Second, the role of education as an input in the health production function has been established by papers such as Lleras-Muney (2005), Arendt (2005; 2008), Oreopoulos (2006), Silles (2009) and Van Kippersluis *et al.* (2009); these provide evidence of the existence of positive long term health effects of successive increases in the number of years of compulsory education in Europe and in the USA.

Cutler and Lleras-Muney (2010) recently contributed to this body of evidence by carrying out an empirical assessment of the most common explanations for the relationship between years of schooling and the wide disparities observed in individual health related behaviours. Their results show that education influences health behaviours through a series of channels, such as the acquisition of higher disposable income and the development of a better capacity for processing health-related information. Nonetheless, this literature leaves important questions unanswered. One such question, underlined in Cutler and Lleras-Muney (2008, p.22), concerns the existence of health returns to different qualities of education. This is a topical policy issue, since evidence on the existence of such returns is vital to inform the design of complementary policy interventions connecting the educational and healthcare sectors. This paper seeks to narrow this gap. We examine the association between quality of schooling and health inequalities in adulthood. This is done by exploiting the wide variation in quality of the primary and secondary schools attended

by cohort-members of the 1958 National Child Development Study (NCDS). We address three main issues:

- The extent to which, from a normative standpoint, there is inequality of opportunity in health by the type of secondary school attended among NCDS cohort-members.
- The measurement of the statistical association between quality of schooling and health and lifestyle in adulthood.
- The identification of channels that mediate these associations.

The educational experience of members of the NCDS cohort has some distinct features that we aim to exploit, both at primary and secondary levels. To begin, some of them attended state primary schools while others went to private primary schools; these schools were typically different in terms of available resources, peer effects, and curricula. Nonetheless, the main source of variability in the cohort members' quality of schooling relates to the very different types of secondary schools attended. This is mainly due to the fact that the cohort's secondary schooling years lie within a transition period corresponding to the major comprehensive schooling reform, implemented in England and Wales[1]. The reform was not introduced simultaneously nationwide. Some pupils were unaffected by it and attended the pre-existing, highly selective state-funded tri-partite system, which comprised grammar schools, secondary modern schools and a small and declining number of technical schools. The majority of the cohort was affected by the reform and attended comprehensive schools. Also, a minority of NCDS cohort went to private fee-paying schools, independent of the state schools educational systems and reforms. The distribution of the NCDS cohort members by type of secondary school is shown in Figure 1.

**INSERT FIGURE 1 AROUND HERE**

Inequality of opportunity in health is assessed by testing for first order stochastic dominance in the distribution of adult health outcomes across types of school. The results

[1] Data on Scotland are not used: the Scottish educational system of the 1960's and 1970's was structurally very different from the one experienced by all the other NCDS cohort-members, and comprehensive schooling was introduced earlier, preventing a legitimate comparison of types of school, educational qualifications and outcomes.

show that conditioning on attendance at different types of secondary schools is sufficient to establish inequality of opportunity among NCDS cohort-members with regard to most health outcomes. In the case of long-standing illness this finding is robust to conditioning on a rich set of covariates, that capture childhood health and family background, characteristics of the schools, educational qualifications, adult socioeconomic status and health related behaviours.

Further parametric analysis of the health outcomes shows evidence of the long-term association with different qualities of education, over and above the effects of measured ability, social development, years of schooling and academic qualifications. After controlling for a rich set of covariates, attendance at some types of schools, such as secondary modern and comprehensive schools, is associated with a much higher incidence of chronic illness and disability in adulthood, than others, such as grammar schools. Standard measures of poor quality of secondary schooling, such as the pupil expulsion rate are also associated with poorer self-assessed health in adulthood. The associations are however uneven across the set of outcomes of interest. Furthermore, we find no evidence in support of several hypothesised mediating channels between quality of schooling and health such as educational attainment, lifestyle and socioeconomic status in adulthood.

## 1. Methods

To detect the presence of inequality of opportunity in health by quality of schooling among the NCDS cohort-members we apply testable conditions for stochastic dominance, as defined by Lefranc *et al.* (2009). Then we explore the existence of a statistical association between quality of schooling and both health and lifestyle in adulthood, adopting a similar approach to that of Cutler and Lleras-Muney (2010).

### 1.1 Inequality of opportunity in health by type of school

To examine the role of quality of schooling as a source of inequality of opportunity in health we adopt the framework of Roemer (2002); this has been the workhorse in most of the applied literature on inequality of opportunity in health. Roemer (2002) sorts all factors influencing individual attainment between a category of *effort factors*, for which individuals should be held partly responsible, and a category of *circumstance factors*, which, being beyond individual control, are a source of unfair differences in outcomes. In our case, we assume that the type of secondary school in which pupils are enrolled at age 11 is largely beyond their individual control and therefore constitutes a circumstance. Since the outcomes of interest are a range of health outcomes in adulthood (*H*), a generalised health production function can be defined along the lines of Roemer (2002) as $H(C, E(C))$, where C denotes individual circumstances and E denotes effort, which is itself a function of circumstances.

Roemer (2002) defines social types consisting of individuals who share exposure to the same circumstances, for example, attendance at the same type of secondary school. Roemer's definition of equality of opportunity is that, on average, all those who exert the same effort should be entitled to equivalent health status, irrespective of their circumstances. Such a situation corresponds to a full nullification of the effect of circumstances, leaving untouched the differences in outcome that are caused solely by effort.

Denoting by $F\left(H \mid C\right)$ the cumulative distribution function of the health outcome of interest conditional on circumstances, a literal translation of Roemer's notion of inequality

of opportunity would mean considering that there is inequality of opportunity whenever: $\forall C \neq C', F\left(H \mid C\right) \neq F\left(H \mid C'\right)$. This condition is however too stringent to be useful in empirical work. Lefranc *et al.* (2009) propose that the data are consistent with the hypothesis of inequality of opportunity if the social advantage provided by different circumstances can be unequivocally ranked by first order stochastic dominance[2] (FSD), i.e. if the distributions of health conditional on different circumstances can be ordered according to:

$$\forall\, C \neq C', \quad F\left(H \mid C\right) \succ_{FSD} F\left(H \mid C'\right)$$

As shown by Davidson and Duclos (2000) this type of condition is testable. We follow this literature, carrying-out Kolmogorov-Smirnov first order stochastic dominance tests to detect inequality of opportunity in a series of health outcomes. Our testable condition for inequality of opportunity is therefore:

$$\forall \text{ school type A, school type B}, \quad F\left(H \mid \text{school type A}\right) \succ_{FSD} F\left(H \mid \text{school type B}\right)$$

[2] A lottery stochastically dominates another if it yields a higher *expected utility*. Several orders of stochastic dominance may therefore be defined according to the restrictions one is willing to make on the individual utility function. First order stochastic dominance (FSD) holds for the whole class of increasing utility functions ($u'>0$); this corresponds to simply comparing *cdfs* of the earnings paid by alternative lotteries. Second order stochastic dominance (SSD) applies to utility functions which are increasing and concave in income, reflecting the notion of risk aversion ($u'>0$ and $u''<0$); SSD evaluates integrals of the *cdfs*. While FSD implies SSD, the converse is clearly not true. SSD cannot be defined for discrete and ordinal outcomes such as the ones used in this paper, hence all definitions and tests refer to FSD.

### 1.2 Regression analysis

Regression analysis is used to take the analysis of quality of schooling, and of the factors that mediate the association between schooling and adult health, a step further. In this section the focus shifts from only looking at the type of secondary school attended to looking at characteristics of the primary and secondary schools. For each outcome of interest, we estimate baseline models of the form[3]:

$$\text{health outcome}_{i,age46} = \alpha + \beta_{1,i} * (\text{type and characteristics of school}) + \beta_{2,i} * (\text{childhood health}) + \\ + \beta_{3,i} * (\text{ability prior to enrolment}) + \beta_{4,i} * (\text{parental background}) + \beta_{5,i} * (\text{local area / other control variables}) + \varepsilon_i$$

By exploiting the rich set of covariates that are observed prior to enrolment at secondary school we control for most of the potential confounders of the relationship between quality of schooling and health in adulthood. While potentially over-controlling, this specification establishes a conveniently stringent test for the statistical significance of the association in question.

We then estimate a sequence of models in order to illuminate three possible mediating channels for this association: lifestyles (model 3), academic qualifications (model 4), and socioeconomic status in adulthood (model 5), successively. Each model adds a set of covariates to the preceding one, in a sequence that reflects the chronological realisation of these channels: as shown by Balia and Jones (2010), lifestyles such as cigarette smoking are likely to be acquired before the attainment of academic qualifications, which, in turn, influence socioeconomic status later in life. For each health outcome, the specifications that account for all these factors are of the form:

$$\text{health outcome}_{i,age46/42} = \alpha + \beta_{1,i} * (\text{type and characteristics of school}) + \beta_{2,i} * (\text{childhood health}) + \\ + \beta_{3,i} * (\text{ability}) + \beta_{4,i} * (\text{parental background}) + \beta_{5,i} * (\text{local area / other control variables}) + \\ + \beta_{6,i} * (\text{lifestyles}_{age33/42}) + \beta_{7,i} * (\text{highest edu. qualification}_{age42}) + \beta_{8,i} * (\text{social class}_{age42}) + \varepsilon_i$$

[3] In practice, as some of the outcomes are binary or ordered categorical variables, some of these models are estimated using probits or ordered probits. For simplicity and clarity the specifications are presented here in linear form.

## 2. Data

The National Child Development Study (NCDS) follows a cohort of nearly 17,000 individuals, who were born in Great Britain in the week of 3rd March 1958, from birth up until age 46. Seven waves of interviews have been carried-out when cohort members were 7, 11, 16, 23, 33, 42 and 46 years old. The study compiles in-depth information on the cohort-members' childhood health and parental background. It records cognitive ability and social development in childhood and adolescence, and, crucially for this paper, quality of schooling at primary and secondary levels together with overall educational achievement. It also includes measures of social status in adulthood, and detailed information on health-related behaviours and health outcomes in adulthood.

### 2.1 Defining quality of schooling

#### Primary education

Table 1 shows the breakdown of the type of primary education experienced by the NCDS cohort-members, by type and characteristics of the schools. The mean pupil-teacher ratios were different between state and private schools and their distributions were markedly dissimilar, as made clear in Figure 2, which contrasts state with private primary schools. The effect of these differences on educational attainment and wages is examined using NCDS data by Dearden, Ferri and Meghir (2005). However, their effect on health-related behaviours and outcomes has not been taken into account by the existing literature. The fraction of pupils reported by their parents to be unhappy at school is also different between state and private schools[4].

**INSERT TABLE 1 AROUND HERE**

**INSERT FIGURE 2 AROUND HERE**

[4] Dissatisfaction at school is likely to reflect school characteristics but may also capture the influence of third factors such as the lack of family-based support for schooling and early learning.

**Secondary education: the comprehensive reform and equality of opportunity**

As shown in Figure 1, nearly 40 per cent of the state schools students in the NCDS cohort were not affected directly by the comprehensive reform and attended the tri-partite system of state-funded education. Grammar schools were academically oriented state schools that provided teaching for the entire age range 11-18, including a sixth form for Advanced level ('A-level') studies, and prepared pupils to go on to higher education. Admission into these schools was determined by an exam taken at age 11 (the 'Eleven Plus' exam). Pupils whose examination score did not permit entry into a grammar school went to secondary modern schools, which were also state schools, but less academically oriented and covered the ages 11-16 or, in a small minority of cases, vocational schools aimed at providing training and technical apprenticeships[5].

A substantial share of the cohort members were affected by the reform, which was explicitly designed to promote equality of opportunity between children of different parental backgrounds. The reform replaced the selective educational system (both grammar and secondary modern schools) by a unified mixed ability secondary schools system ("comprehensive schools") [6]. The types of schools were substantially different in their curriculum, examinations, and academic environment and peer effects. Table 2 shows that, among the schools attended by the NCDS cohort members at age 16, 79 per cent of private schools and 68 per cent of grammar schools were single sex, while only 13 per cent of comprehensives were single sex. Streaming of classes by academic ability was common in secondary moderns and comprehensives but rare among grammar schools. Some comprehensives were former secondary moderns (18 per cent) or grammar schools (25 per cent) with the rest being newly created. Furthermore, the distribution of the pupil-teacher ratio also differs considerably across these four types of schools as shown in Figure 3.

**INSERT TABLE 2 AROUND HERE**

**INSERT FIGURE 3 AROUND HERE**

[5] In a few cases, pupils whose grades were sufficient transferred to grammar schools or sixth form colleges to complete their A-levels.

[6] Following much controversy over the Eleven Plus, the selective system went into decline in the 1960's and 1970s, until it was abolished in England and Wales by the 1976 Education Act. The selective system has persisted in certain areas, such as Kent.

### 2.2 Childhood health, parental background and neighbourhood characteristics

The NCDS data include extensive information on the cohort-members' early health endowments. In order to control for these we have constructed morbidity measures that aggregate twelve categories[7] of health conditions affecting the child at age 7 (following Power and Peckham, 1987). We have also created indicator variables for the number of hospitalisations at age 7 and for the occurrence of diabetes, epilepsy and other chronic conditions in parents and siblings in order to account for the incidence of hereditary conditions in the cohort members' family. NCDS data on the height and weight of the cohort-members also allows us to control for the long-term impact of obesity in childhood and adolescence.

In terms of parental background, the NCDS allows us to trace the socioeconomic group and the years of schooling of the parents of the cohort members. Following Case *et al.* (2005) and Lindeboom et al. (2009), we have complemented this information with data on the incidence of household financial difficulties during the cohort member's childhood and adolescence.

The NCDS also includes rich information about the socioeconomic characteristics of the cohort-members' neighbourhood during childhood and adolescence. For the year of 1971, NCDS survey data was linked to census data[8]; this makes it possible to use census enumeration district level data (the smallest unit for which census statistics were available with an average population of about 460) to control for geographic heterogeneity in the individual's immediate social milieu.

### 2.3 Cognitive ability, social development and educational achievement

[7] The childhood morbidity index is the sum of points, where one point is attributed to the occurrence of each of the following medical conditions: infectious diseases; ear and throat problems; recurrent acute illnesses; acute illnesses (other); asthma, bronchitis and wheezing; allergies; chronic diseases (medical); chronic physical or mental handicaps; chronic sensory illnesses; injuries; psychosocial problems; psychosomatic problems; other childhood morbidity (unspecified).

[8] This small area data are available under a special licence, which imposes restrictions on the handling and usage of the data. Details can be found at http://www.cls.ioe.ac.uk/studies.asp?section=0001000200030015.

The NCDS is rich in measures of cognitive and social development prior to secondary schooling. Scores of ability tests taken at ages 7 and 11 are available on a series of cognitive dimensions: mathematics, reading, copying designs and general ability. Since test scores are highly correlated, hence leading to multicollinearity in econometric models, we follow Galindo-Rueda and Vignoles (2005) and use principal components analysis to construct a single measure of cognitive ability using the first principal component. We use as controls both the individuals' measure of cognitive ability and their relative rank in the distribution of cognitive ability of their peers.

Recent work has underlined the importance of early social development, especially in determining education (Heckman and Rubinstein, 2001), and labour market outcomes (Carneiro *et al.*, 2007; Heckman *et al.*, 2006; Kuhn and Weinberger, 2005; Feinstein, 2000). Following Carneiro *et al.* (2007) the score for the Bristol Social Adjustment Guide (BSAG) is used as a measure of social development at age 11: teachers are asked whether the child has problems in twelve behavioural domains such as hostility towards children and adults, anxiety, withdrawal, 'writing off' adults, unforthcomingness, depression, restlessness, acceptance by adults, inconsequential behaviour and miscellaneous psychological and nervous symptoms. One point is attributed to each positive answer; points are then summed to obtain the BSAG social maladjustment score. The distribution of both cognitive and non-cognitive ability measures is shown in Figure 4.

The NCDS also includes information on the educational attainment and qualifications awarded to cohort members: no formal qualifications; Certificates of Secondary Education (CSE), O-levels, A-levels and university degree or equivalent[9]. We further disaggregate this information on educational achievement into thirteen categories, ordered according to the grades obtained and number of passes.

**INSERT FIGURE 4 AROUND HERE**

[9] CSEs and O-level (Ordinary levels) were secondary education qualifications corresponding, typically, to 11 years of education in total; CSEs were academically less demanding than O-levels. A-levels (Advanced levels) are a qualification which typically corresponds to 13 years of education. Completion of A-levels is ordinarily a prerequisite for university admission.

### 2.4 Health-related behaviours, attitudes and outcomes

The NCDS contains self-reported information on a series of health-related lifestyles: cigarettes smoked per day, average units of alcohol consumed per week[10] and dietary choices, such as the frequency of consumption of fried food, vegetables and sweets. These data are only available in the four most recent waves of the study, once respondents are aged 23 and above. We also look at other health-related behaviours among women, such as teenage pregnancy and maternal smoking during pregnancy, susceptible of being affected by qualitative aspects of education.

The effect of quality of schooling is examined for a range of health outcomes in adulthood and late adolescence. The first of these is self-assessed health (SAH) at age 46, measured on a five-point scale: excellent, good, fair, poor and very poor health. SAH is widely used in health economics and has been shown to predict mortality and deterioration of health even after controlling for the medical assessment of health conditions.

A more specific measure of health in adulthood is the incidence of self-reported long-standing illness or disability at age 46. Information on the particular medical condition associated with it is also available and classified according to the International Classification of Diseases (ICD-10).

Mental health in adulthood is taken into account as a separate outcome: NCDS respondents answer a series of questions from the Cornell Medical Index Questionnaire, each targeting a particular mental ailment and the number of positive answers given at age 42 is then used as a malaise score along the lines of Carneiro *et al.* (2007).

### 2.5 Sample selection and non-response

The size of our final estimation samples was significantly affected by attrition and especially by the patterns of item non-response. However, recent papers that analyse NCDS data, such as Case *et al.* (2005) and Lindeboom *et al.* (2009), recognise the problem

[10] NCDS respondents are asked about their weekly consumption of a wide range of alcoholic drinks (glasses of wine, pints of beer and so forth). These are then converted to units of alcohol using the UK National Health Service official guidelines that are available at:
http://www.nhsdirect.nhs.uk/magazine/interactive/drinking/index.aspx .

but do not find evidence of bias due to non-random attrition. Analysis of the available data in our sample shows that, on average, individuals in the estimation sample come from slightly richer and better-educated backgrounds when compared with the full sample. They score higher than the full sample in ability tests taken at age 11, but do not have systematically better childhood health.

## 3. Results

### 3.1 Nonparametric tests of inequality of opportunity

Within the framework of Roemer (2002), quality of schooling, at both primary and secondary levels, constitutes a circumstance. A general picture of its association with health is clear in Figure 5, which shows the possible pairwise comparisons between the empirical distributions of SAH at age 46 by type of secondary schooling. When we contrast the SAH profiles of individuals who attended secondary modern and grammar schools, the gap between the two empirical distributions is remarkably wide. This is striking since it is attributable to one single circumstance. Conversely, the empirical distributions of SAH for grammar and private schools are very similar; the same happens when we compare the SAH profiles for comprehensive and secondary moderns. Figure 6 features the same type of pairwise comparisons applied to the empirical distributions of the mental illness index at age 46; the gaps are slightly less pronounced, but still notable.

In order to formally assess the existence of inequality of opportunity, using the formulation presented in Section 1.1, Kolmogorov-Smirnov tests for first degree stochastic dominance are carried-out; the statistically significant comparisons at the 1% significance level are shown in Table 3. The results for SAH at age 46 establish four statistically significant dominance relationships: the distribution of SAH for cohort-members who attended at grammar and private schools dominates the one of those who went to secondary modern and comprehensive schools. For detrimental outcomes, this pattern is reversed: secondary modern schools dominate grammar schools for cigarette smoking and incidence of chronic disease and mental illness and private schools for cigarette smoking and incidence of chronic diseases. Comprehensive schools dominate grammar schools at first order for all the detrimental outcomes and private schools for

cigarette smoking only. These results establish the existence of inequality of opportunity in health and health-related outcomes, favouring the cohort members who attended at grammar and private schools relative to their counterparts who attended comprehensive and secondary modern schools.

**INSERT FIGURE 5 AROUND HERE**

**INSERT FIGURE 6 AROUND HERE**

**INSERT TABLE 3 AROUND HERE**

### 3.2 Quality of primary schooling

Table 5 shows estimates of the association between primary school characteristics and a series of health-related behaviours and outcomes in adulthood. Model 1 includes the rich set of pre-schooling control variables described in Section 1.2 and listed in Table 4: parental socioeconomic status and education, childhood health and local area characteristics (census enumeration district). Models 2 to 5 each add an additional set of control variables to the preceding models. Model 2 controls, additionally, for cognitive ability and social adjustment, measured at age 7. Models 3, 4 and 5 add, respectively, three potential channels for the influence of quality of schooling on health: lifestyle in adulthood (age 33/42), highest academic qualifications attained and socioeconomic group at age 42. Table 5 displays average partial effects on the outcomes of interest. Models for self-assessed health and for the weekly consumption of fried food are ordered probit specifications and partial effects correspond, respectively, to the probability of reporting excellent health and of consuming fried food on a daily basis at age 33. For smoking status, incidence of chronic illness, teenage pregnancy and maternal smoking during pregnancy probit specifications are used. Finally, the models for the Cornell index of mental illness and for the number of weekly units of alcohol are linear regressions.

**INSERT TABLE 5 AROUND HERE**

The results do not indicate a statistically significant association between schools being privately owned and operated, pupil-teacher ratios, and self-assessed health at age 46. However, the indicator variable for whether pupils were happy at primary school is a good predictor of health in adulthood: after controlling for parental background, cognitive ability and social development, lifestyle and academic qualifications, dissatisfaction at primary school is associated with nearly a 6 percentage points reduction on the probability of reporting excellent health at age 46[11]. In terms of prevalence of long standing illness and disability (age 46), the partial effects of private school indicators and pupil-teacher ratios remain statistically insignificant and generally small. Also, the pattern of large and statistically significant partial effects of unhappiness in primary school persists. Their magnitude and precision are however attenuated once we control for the effects of overall educational achievement and social class in adulthood (models 4 and 5).

The results for mental illness at age 42 show a different pattern. There is a clear negative and statistically significant association between the pupil-teacher ratio and the prevalence of mental illness in adulthood. The size of the partial effects is roughly constant across models, suggesting that lifestyle choices, educational qualifications and social status in adulthood are not the chief mediators of this relationship. Also, although imprecise, the partial effects of attendance at a private primary school are consistently positive and large in all models[12]. Once more, unhappiness at school is strongly and positively associated with the incidence of mental illness at age 42 in all the models considered. Social status in adulthood appears to be an important channel for this association given that partial effects are reduced by nearly 30 percentage points once we control for the effect of social class.

In the models for these three health outcomes, self-reported health, chronic and mental disorders, the magnitudes of the estimated partial effects do not change much once we control for lifestyle choices, suggesting that health related behaviours do not mediate the effect of quality of primary schooling on health outcomes. This fact is corroborated by the estimates obtained for the models for cigarette smoking and consumption of alcohol and

[11] As emphasised by the large literature on the harmful impact of bad parenting on human development, this association should not be interpreted as a causal effect, since *dissatisfaction at school* is likely to also reflect the lack of family-based support for schooling and early learning.

[12] Reverse causality may be a possible explanation for this association if mentally troubled children were relatively more likely to benefit from smaller class size and to attend to private schools.

fried food. In almost all cases, the partial effects for the quality of school indicators are statistically insignificant and economically negligible.

The results also provide no evidence of an impact of quality of primary education on the occurrence of teenage pregnancies and on cigarette smoking during pregnancy. Due to the smaller size of the estimation samples for the last two outcomes shown in Table 5 none of the female cohort-members who attended at private primary school reported to have smoked during their pregnancies and we therefore dropped the indicator for private school from the last model of the table.

### 3.3 Quality of secondary schooling

Table 6 presents the results for the relationship between quality of secondary education and the same range of outcomes and health-related attitudes considered in the previous section[13]. The main variables of interest are now indicators for the four types of schools described above (comprehensive schools, secondary modern schools, grammar schools, private schools), school characteristics and resources. The reference category for the comparisons between types of school is attendance at a grammar school, which, on average, is associated with the best health outcomes.

**INSERT TABLE 6 AROUND HERE**

The estimates in the table show no evidence of a statistically significant association between types of schools and SAH at age 46. The negative association with attendance at secondary modern schools, reported in Model 1, disappears after controlling for differences in cognitive ability and social development. The only school characteristic that bears a negative and statistically significant association with SAH at age 46 is the schools' student expulsion rate. This variable is commonly used as a proxy for the school's

[13] Table 6 also shows partial effects on the outcomes of interest, computed by averaging across all individual marginal effects in the sample. Models for self-assessed health and for the weekly consumption of fried food are ordered probit specifications; partial effects correspond, respectively, to the probability of reporting excellent health and of consuming fried food on a daily basis at age 46. For the smoking status, incidence of chronic illness, teenage pregnancy and maternal smoking during pregnancy probit specifications are used. Finally, the models for the Cornell index of mental illness and for the number of weekly units of alcohol are linear regressions. The set of control variables included in Models 1 to 5 is the same as in Table 5.

academic environment and peer effect, which potentially shapes lifestyle and preferences such as risk aversion and subjective valuation of the future. Interestingly, however, the size of its estimated partial effects is relatively constant across the five models, suggesting that its association with health is not mediated by lifestyles, academic achievement, or social status in adulthood.

The models for the incidence of chronic illness and disability show a different pattern. Attendance at comprehensive and secondary modern schools is associated with a higher incidence of chronic illness and disability than grammar schools. The size of these effects is substantial with nearly an 11 per cent higher incidence in the case comprehensives and roughly 8 percentage points higher incidence in the case of secondary moderns, when the full set of controls is included in the model. This constitutes evidence of a large association between quality of schooling and health, over and above the pathways through educational qualifications, ability and lifestyle.

The association between the attendance at different types of schools and the occurrence of mental illness in adulthood is also sizable and statistically significant. In line with the results obtained for primary education, the partial effect of attendance at private secondary schools is positive and large, after controlling for the entire available set of covariates. The relative constancy of these partial effects across the five models suggests once more that lifestyle quality and academic qualifications are not channels for this relationship. Indicator variables for whether these schools were single-sex schools and boarding schools are not statistically significant.

Attendance at boarding schools is a perfect predictor of the two maternity-related outcomes in Table 6 with none of the cohort-members educated in such schools reporting either to have been a mother during their teenage years or to have ever smoked during pregnancy. After controlling for ability at age 11, the female cohort-members who attended comprehensive and secondary modern schools are more likely to become pregnant before age 18. This association however disappears after controlling for academic qualifications. Several qualitative characteristics of secondary schooling are also statistically significantly associated with the probability of maternal smoking during pregnancy. Expulsion rates are positively associated with this health-related behaviour, although this

relationship becomes statistically insignificant when educational qualifications and social class in adulthood are used as controls in the models. There is also a statistically significant positive partial effect of the pupil-teacher ratio, which remains statistically significant in all the models.

## 4. Conclusions

We use the analytical framework proposed by Roemer (2002), to examine the role of quality of schooling as a source of inequality of opportunity in health. The results show that conditioning solely on the type of secondary school attended by the cohort-members is sufficient to formally establish first order stochastic dominance relationships between the empirical distributions of most of their health outcomes.

We provide evidence of the existence of long-term associations between adult health and different qualities of education, over and above the effects of measured ability, social development, years of schooling and academic qualifications. This association, postulated but not explored in earlier literature, proves to be statistically significant and economically sizable for several important health outcomes and health-related behaviours, after controlling for a rich set of controls.

The influence of the different qualitative dimensions of primary and secondary education is uneven across the set of outcomes of interest. Our measures of quality of primary school education are not significantly correlated either with SAH, or with the occurrence of chronic conditions in adulthood. Conversely, the pupil-teacher ratio in primary schools is strongly and negatively associated with the incidence of mental illness at age 42. Unhappiness at school, interpreted in the paper as a broad measure of adequacy of schooling, is associated with a significant increase in the incidence of mental disorders at age 42 and with a reduction in the probability of reporting excellent health at the same age of about 6 percentage points. This association remains valid after controlling for lifestyle and overall educational achievement, but social status is a possible mediating channel, linked to roughly a 30 per cent reduction of the measured effect.

The main source of variation in quality of schooling is, in the NCDS, attendance at very dissimilar types of secondary schools. The association between types of schools and health outcomes is also much stronger than in the case of primary education. Measures of poor quality of schooling, such as the pupil expulsion rate, are positively correlated with a deterioration of SAH in all the estimated models. Attendance at particular types of schools, such as comprehensive and secondary moderns, is associated with a much larger incidence of chronic illness than others, such as grammar schools. Individuals who went to private secondary schools are associated with a higher prevalence of mental disorders in adulthood than those who attended at grammar schools. No evidence was found to confirm the influence of the hypothesised transmission channels for these effects, since they remain sizable and statistically significant after controlling for health endowments, parental background, ability, lifestyle, educational qualifications and social status in adulthood. One explanation for this is the impracticality of controlling directly for other potentially important transmission mechanisms for the effect of education, such as subjective discount rates, risk aversion, information processing capacity, health and health care-related knowledge[14].

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| Table 1: NCDS cohort-members by type of primary school | | | |
|---|---|---|---|
| | Observations | Unhappy at school | Pupil-teacher ratio |
| State schools | 12309 | 803 (6.52%) | 35.07 |
| Private schools | 449 | 22 (4.9%) | 21.9 |

| Table 2: Secondary school characteristics | | | | |
|---|---|---|---|---|
| | Grammar | Sec Modern | Comprehensive | Private |
| % single sex | 68.2 | 25.1 | 13.1 | 78.7 |
| % with ability streams | 16.6 | 42.8 | 40.6 | 23.7 |
| % former grammar | - | - | 24.7 | - |
| % former sec modern | - | - | 18.3 | - |
| Observations | 1314 | 2710 | 6134 | 706 |

**Table 3: Stochastic dominance tests for inequality of opportunity in health**

| SAH (age 46) | Comprehensive school | Secondary modern school | Grammar school | Private School |
|---|---|---|---|---|
| Comprehensive school | | | | |
| Secondary modern school | | | | |
| Grammar school | Gr. *FSD* Comp. | Gr. *FSD* Sec. Mod. | | |
| Private School | Priv. *FSD* Comp. | Priv. *FSD* Sec. Mod. | | |

| Chronic illness / disability (age 46) | Comprehensive school | Secondary modern school | Grammar school | Private School |
|---|---|---|---|---|
| Comprehensive school | | | Comp. *FSD* Gr. | |
| Secondary modern school | | | Sec. Mod *FSD* Gr. | Sec. Mod *FSD* Priv. |
| Grammar school | | | | |
| Private School | | | | |

| Mental illness (age 42) | Comprehensive school | Secondary modern school | Grammar school | Private School |
|---|---|---|---|---|
| Comprehensive school | | | Comp. *FSD* Gr. | |
| Secondary modern school | | | Sec. Mod. *FSD* Gr. | |
| Grammar school | | | | |
| Private School | | | | |

| Smoking (age 42) | Comprehensive school | Secondary modern school | Grammar school | Private School |
|---|---|---|---|---|
| Comprehensive school | | | Comp. *FSD* Gr. | Comp. *FSD* Priv. |
| Secondary modern school | | | Sec. Mod. *FSD* Gr. | Sec. Mod. *FSD* Priv. |
| Grammar school | | | | |
| Private School | | | | |

Note: *Kolmogorov-Smirnov test results at one per cent significance level*

**Table 4: Pre-schooling characteristics**

Indicator for male
Morbidity index (age 7)
Number of hospitalisations (age 7)
Indicator for diabetes in family
Indicator for epilepsy in family
Indicator for heart disease in family
Indicator for father's occupational SES professional
Indicator for father's occupational SES other non-manual
Indicator for financial hardship in family (age 7)
Enumeration district: percentage unemployed/long-term sick
Enumeration district: percentage women working
Enumeration district: percentage employed in manufacturing
Enumeration district: percentage emplyed in agriculture
Enumeration district: percentage in professional/managerial occupations
Enumeration district: percentage in other non-manual occupations
Enumeration district: percentage in skilled manual occupations
Enumeration district: percentage in semi-skilled manual occupations
Enumeration district: percentage in unskilled manual occupations
Enumeration district: percentage owner occupiers
Enumeration district: percentage council tenants
Enumeration district: percentage non-white
Enumeration district: percentage immigrants
Indicators for Standard Regions

| Table 5: Quality of primary schools | | | | | |
|---|---|---|---|---|---|
| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
| **Dep. variable: SAH, age 46** | | | | | |
| Private school, 1969 | -0.045 | -0.047 | -0.055 | -0.045 | -0.041 |
| Ratio: #pupils / # teachers, 1969 | 0.001 | 0.000 | 0.001 | 0.001 | 0.001 |
| Unhappy at school. 1965 | -0.068** | -0.050* | -0.064** | -0.057* | -0.051 |
| **Dep. variable: Chronic illness / disability, age 46** | | | | | |
| Private school, 1969 | 0.026 | 0.027 | 0.033 | 0.017 | 0.012 |
| Ratio: #pupils / # teachers, 1969 | -0.002 | -0.002 | -0.003* | -0.002 | -0.001 |
| Unhappy at school. 1965 | 0.073** | 0.083** | 0.061 | 0.029 | 0.044 |
| **Dep. variable: Mental illness, age 42** | | | | | |
| Private school, 1969 | 0.427 | 0.427 | 0.562 | 0.618 | 0.634 |
| Ratio: #pupils / # teachers, 1969 | -0.022** | -0.022** | -0.019** | -0.018* | -0.019* |
| Unhappy at school. 1965 | 0.788*** | 0.788*** | 0.871*** | 0.761** | 0.374 |
| **Dep. variable: Smoker, age 42** | | | | | |
| Private school, 1969 | -0.039 | -0.038 | -- | -0.032 | -0.020 |
| Ratio: #pupils / # teachers, 1969 | -0.001 | -0.000 | -- | 0.000 | 0.000 |
| Unhappy at school. 1965 | 0.016 | -0.002 | -- | -0.003 | -0.012 |
| **Dep. variable: Units of alcohol / week, age 33** | | | | | |
| Private school, 1969 | -0.325 | 0.233 | -- | 1.413 | 1.666 |
| Ratio: #pupils / # teachers, 1969 | 0.010 | 0.001 | -- | -0.016 | -0.019 |
| Unhappy at school. 1965 | -2.545* | -2.080 | -- | -2.734* | -1.162 |
| **Dep. variable: Fried food / week, age 33** | | | | | |
| Private school, 1969 | 0.008 | 0.004 | -- | -0.001 | -0.002 |
| Ratio: #pupils / # teachers, 1969 | -0.000 | -0.000 | -- | 0.000 | -0.000 |
| Unhappy at school. 1965 | -0.003 | -0.004 | -- | -0.004 | -0.002 |
| **Dep. variable: Teenage pregnancy** | | | | | |
| Private school, 1969 | -0.033 | -0.018 | -- | -0.018 | -0.011 |
| Ratio: #pupils / # teachers, 1969 | -0.002* | -0.001 | -- | -0.001 | -0.000 |
| Unhappy at school. 1965 | 0.012 | 0.003 | -- | -0.001 | 0.000 |
| **Dep. variable: Smoking during pregnancy** | | | | | |
| Private school, 1969 | -- | -- | -- | -- | -- |
| Ratio: #pupils / # teachers, 1969 | -0.002 | -0.001 | -- | -0.002 | -0.003 |
| Unhappy at school. 1965 | -0.025 | -0.052 | -- | -0.053 | -0.071 |
| ***p<0.001, **p<0.05, *p<0.1 | | | | | |

**Notes:**
**1.**Model 1 includes the rich set of pre-schooling control variables listed in Table 4: parental socioeconomic status and education, childhood health and local area characteristics (census enumeration district).
Model 2 controls, aditionally, for cognitive and non-cognitive ability, measured at age 7.
Model 3 controls, in addition to the covariates in Model 2, for lifestyle in adulthood (cigarette smoking, alcohol consumption and weekly consumption of fried food).
Model 4 controls, in addition to the covariates in Model 3, for the highest academic qualifications attained.
Model 5 controls, in addition to the covariates in Model 4, for socioeconomic group at age 42
**2.** The partial effects on the outcomes of interest are computed by averaging across all individual marginal effects in the sample. Models for self-assessed health and for the weekly consumption of fried food are ordered probit specifications; partial effects correspond, respectively, to the probability of reporting excellent health and of consuming fried food on a daily basis at age 46. For the smoking status, incidence of chronic illness, teenage pregnancy and maternal smoking during pregnancy probit specifications are used. Finally, the models for the Cornell index of mental illness and for the number of weekly units of alcohol are linear regressions.

**Table 6: Quality of secondary schools**

| | M 1 | M2 | M3 | M4 | M5 |
|---|---|---|---|---|---|
| **Dep. variable: SAH, age 46** | | | | | |
| Comprehensive school | -0.039 | -0.014 | -0.016 | -0.021 | -0.029 |
| Secondary modern school | -0.060** | -0.013 | -0.013 | -0.004 | -0.025 |
| Private school | -0.018 | -0.006 | -0.011 | -0.025 | -0.034 |
| Single sex | 0.000 | -0.006 | -0.002 | 0.005 | 0.005 |
| Boarder | -0.057 | 0.001 | 0.046 | 0.021 | -0.052 |
| # pupils / # teachers, age 16 | -0.001 | -0.002 | -0.002 | -0.002 | -0.000 |
| # expelled pupils / # pupils at school | -15.279*** | -14.192*** | -16.616** | -20.020*** | -14.747** |
| | M 1 | M2 | M3 | M4 | M5 |
| **Dep. variable: chronic illness, age 46** | | | | | |
| Comprehensive school | 0.085*** | 0.079** | 0.108*** | 0.108*** | 0.111*** |
| Secondary modern school | 0.083** | 0.057 | 0.072* | 0.071* | 0.078* |
| Private school | 0.031 | 0.032 | 0.042 | 0.059 | 0.087 |
| Single sex | 0.022 | 0.025 | 0.037 | 0.029 | 0.036 |
| Boarder | -0.046 | -0.033 | -0.069 | -0.010 | -0.025 |
| # pupils / # teachers, age 16 | -0.001 | 0.001 | 0.000 | -0.001 | -0.003 |
| # expelled pupils / # pupils at school | 11.364 | 12.334 | 16.478 | 17.956 | 11.922 |
| | M 1 | M2 | M3 | M4 | M5 |
| **Dep. variable: mental illness, age 42** | | | | | |
| Comprehensive school | 0.346* | 0.052 | 0.058 | 0.137 | 0.211 |
| Secondary modern school | 0.293 | -0.241 | -0.293 | -0.163 | -0.225 |
| Private school | 0.729** | 0.858** | 0.918*** | 1.161*** | 0.993*** |
| Single sex | 0.034 | -0.019 | -0.041 | 0.040 | 0.047 |
| Boarder | 0.123 | -0.229 | -0.198 | 0.300 | 1.435 |
| # pupils / # teachers, age 16 | 0.025 | 0.024 | 0.011 | 0.028 | 0.029 |
| # expelled pupils / # pupils at school | 54.209 | 80.642 | 83.476 | 62.277 | 34.156 |
| | M 1 | M2 | M3 | M4 | M5 |
| **Dep. variable: smoker, age 42** | | | | | |
| Comprehensive school | 0.040 | 0.014 | --- | -0.012 | -0.037 |
| Secondary modern school | 0.068** | 0.013 | --- | -0.030 | -0.050 |
| Private school | -0.011 | -0.010 | --- | -0.052 | -0.055 |
| Single sex | -0.010 | -0.009 | --- | -0.023 | -0.026 |
| Boarder | 0.091 | 0.032 | --- | 0.107 | 0.190 |
| # pupils / # teachers, age 16 | 0.003 | 0.002 | --- | 0.001 | 0.002 |
| # expelled pupils / # pupils at school | 13.381** | 4.700 | --- | 3.997 | 4.522 |

| | M 1 | M2 | M3 | M4 | M5 |
|---|---|---|---|---|---|
| **Dep. var: units alcohol / week, age 33** | | | | | |
| Comprehensive school | -0.811 | 0.169 | --- | 0.095 | -0.351 |
| Secondary modern school | -2.339* | -0.770 | --- | -0.878 | -1.316 |
| Private school | 0.023 | 1.480 | --- | 1.570 | 1.372 |
| Single sex | -1.325 | -1.194 | --- | -1.281 | -1.548 |
| Boarder | 4.834 | 4.539 | --- | 0.456 | 1.151 |
| # pupils / # teachers, age 16 | -0.020 | -0.018 | --- | 0.036 | 0.109 |
| # expelled pupils / # pupils at school | 447.360 | 515.972 | --- | 225.261 | 536.518 |
| | M 1 | M2 | M3 | M4 | M5 |
| **Dep. var: fried food / week, age 33** | | | | | |
| Comprehensive school | 0.007* | 0.002 | --- | 0.005 | 0.003 |
| Secondary modern school | 0.001 | -0.004 | --- | 0.002 | 0.001 |
| Private school | 0.009 | 0.005 | --- | 0.001 | 0.002 |
| Single sex | 0.002 | 0.001 | --- | 0.001 | 0.000 |
| Boarder | 0.009 | 0.011 | --- | 0.023 | 0.042 |
| # pupils / # teachers, age 16 | 0.000 | 0.000 | --- | 0.000 | 0.000 |
| # expelled pupils / # pupils at school | 1.043 | 1.513 | --- | 1.224 | 1.784 |
| | M 1 | M2 | M3 | M4 | M5 |
| **Dep. var: teenage pregnancy** | | | | | |
| Comprehensive school | 0.079*** | 0.040* | --- | 0.024 | -0.001 |
| Secondary modern school | 0.119*** | 0.054* | --- | 0.020 | -0.018 |
| Private school | 0.121** | 0.084 | --- | 0.146 | 0.084 |
| Single sex | 0.011 | 0.018 | --- | 0.028 | 0.013 |
| Boarder | --- | --- | --- | --- | --- |
| # pupils / # teachers, age 16 | -0.003 | -0.003 | --- | -0.001 | 0.000 |
| # expelled pupils / # pupils at school | -6.387 | -3.915 | --- | -11.149 | -4.585 |
| | M 1 | M2 | M3 | M4 | M5 |
| **Dep. var: smoking during pregnancy** | | | | | |
| Comprehensive school | 0.051 | 0.007 | --- | 0.005 | 0.007 |
| Secondary modern school | 0.095 | 0.006 | --- | 0.004 | -0.042 |
| Private school | -0.071 | -0.087 | --- | -0.044 | -0.034 |
| Single sex | 0.021 | 0.011 | --- | 0.021 | 0.077 |
| Boarder | --- | --- | --- | --- | --- |
| # pupils / # teachers, age 16 | 0.012 | 0.013 | --- | 0.019* | 0.033*** |
| # expelled pupils / # pupils at school | 33.131** | 29.502* | --- | 17.366 | 18.244 |

***p<0.01, **p<0.05, *p<0.01

Note: same notes as in Table 5

**Figure 1: NCDS cohort-members by type of school (age 16)**

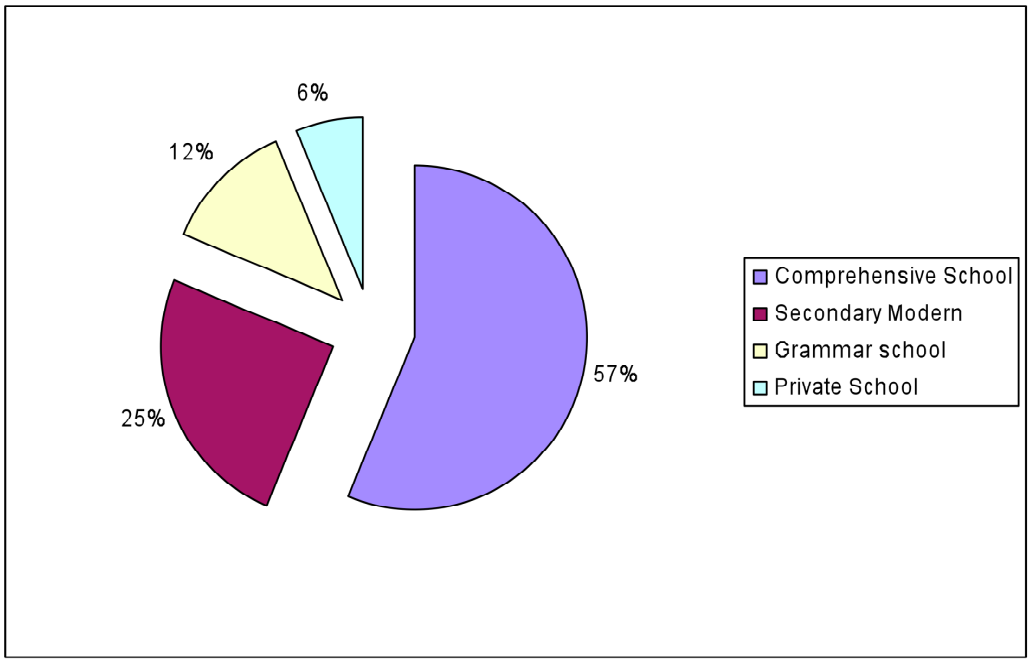


**Figure 2: Distribution of pupil-teacher ratios by type of primary school**

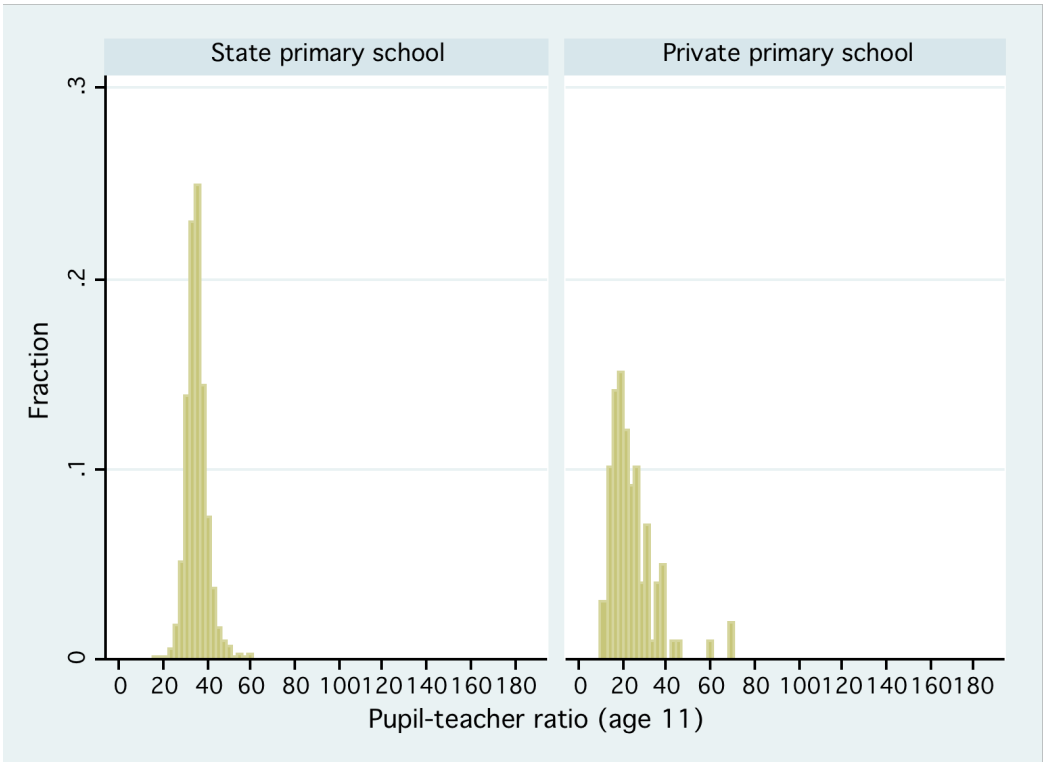


**Figure 3: Distribution of pupil-teacher ratios by type of secondary school**

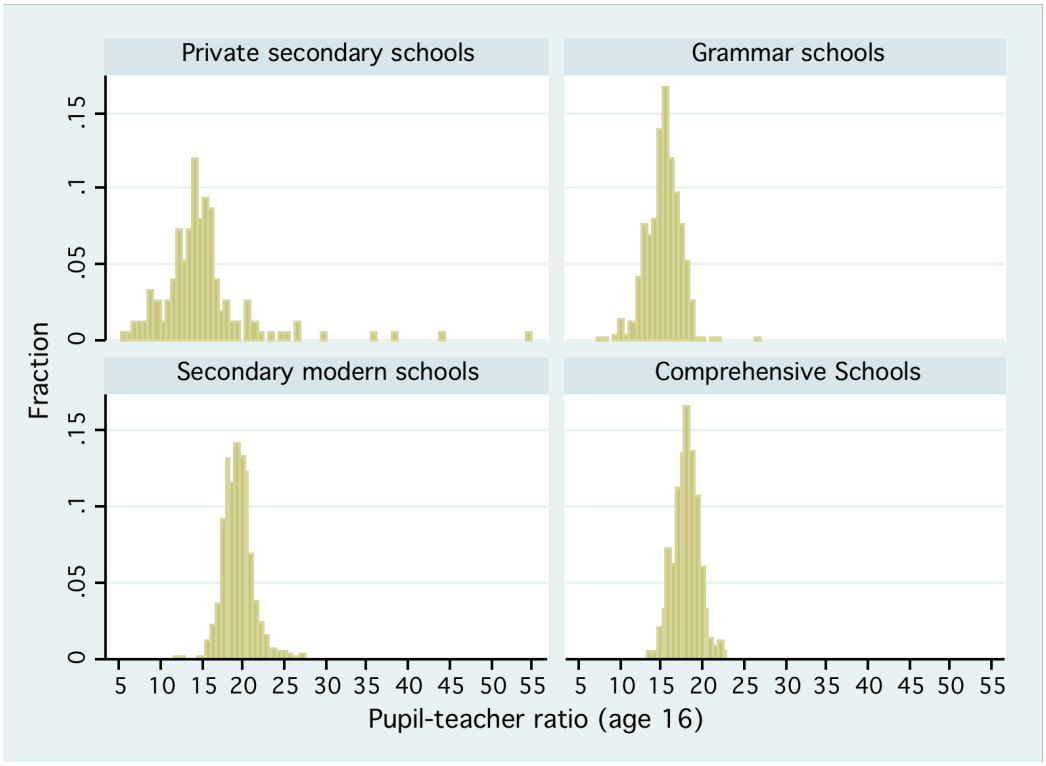
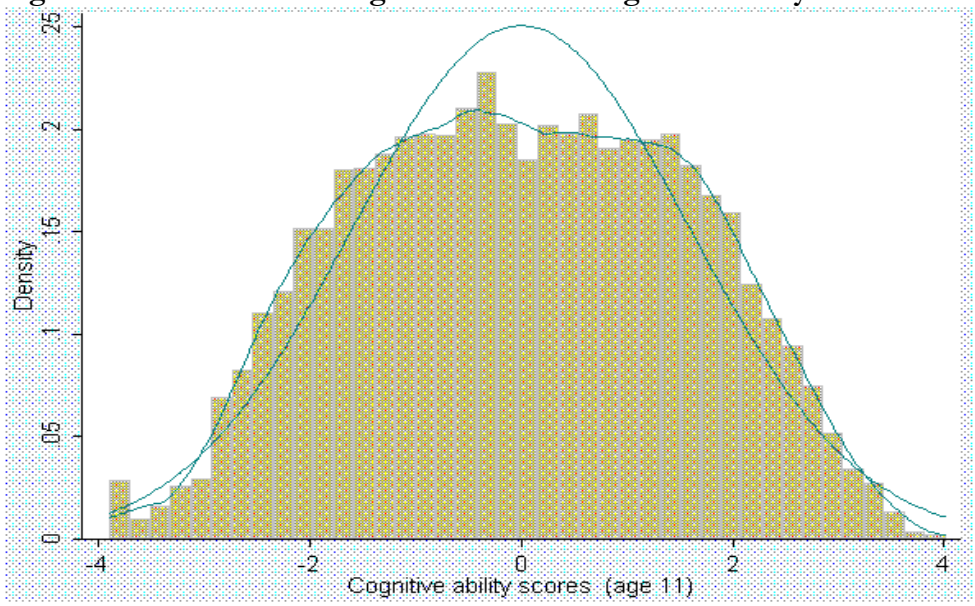


**Figure 4: Distribution of cognitive and non-cognitive ability in the NCDS cohort**



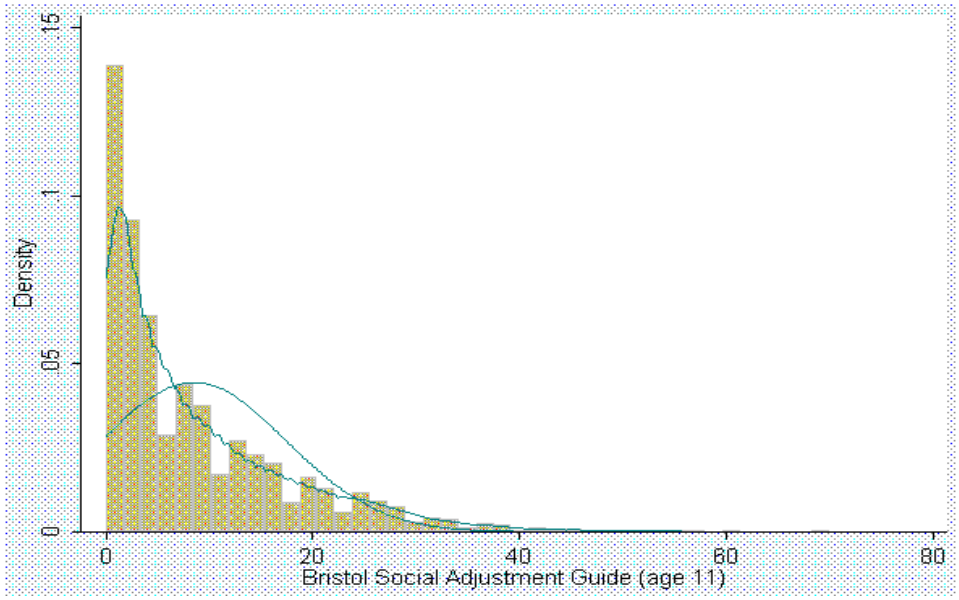



**Figure 5: Empirical distributions of SAH (age 46) by type of secondary school**

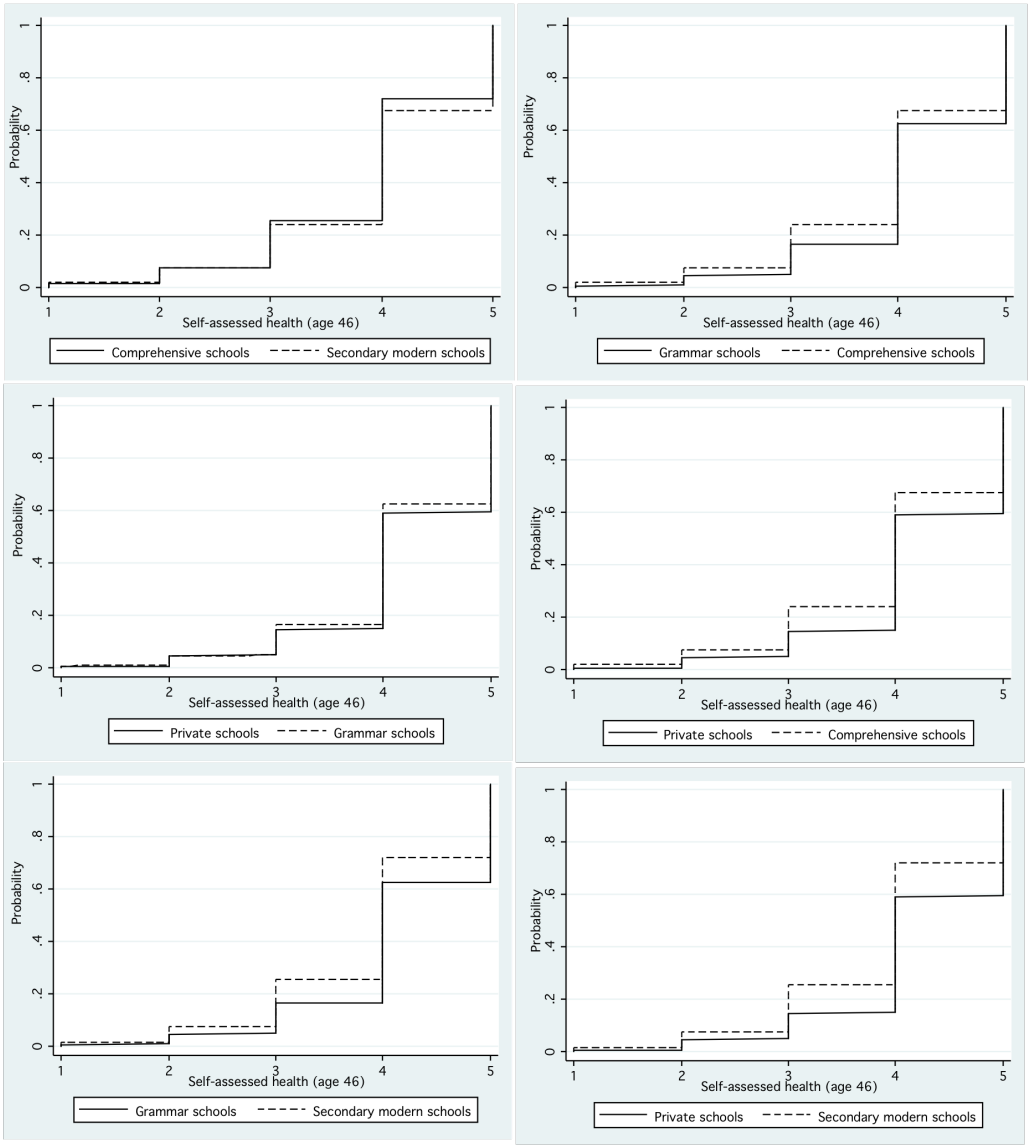


**Figure 6: Empirical distributions of mental illness (age 42) by type of secondary school**