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The Contribution of Basic Skills to Health Related Outcomes During Adulthood: Evidence from the BCS70

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Executive Summary

Using data from the British Cohort born in 1970 this report set out to answer the following research question: can adult basic skills contribute to better health in adulthood?

Key findings:

- We found that lack of adult numeracy skills were associated with deteriorating self-rated health for men and women.

- We also found that low adult literacy and numeracy skills were associated with worsening health limiting conditions. In particular, low numeracy was associated with worsening health limiting conditions for men and women and low literacy was associated with worsening health limiting conditions for women only.

- We found weak evidence that low basic skills are associated with smoking (as an indicator of a health behaviour). We only found that low literacy is associated with increased smoking for men.

- Our results showed no evidence that basic skills are associated with depression (as an indicator of mental health).

The report had the following research strategy. BCS70 data, which contain information on adult basic skills (at age 34) and health outcomes (at ages 34 and 38) was used to estimate the association of adult basic skills to changes in health. In addition, information on highest educational qualifications in adulthood was used to estimate if there was a relationship between adult basic skills and changes in health in addition to the impact of highest educational qualifications. Finally, we included important childhood factors such as childhood health and academic ability to condition out the association of these factors to the formation of basic skills in adulthood and adult health. Multivariate regression analysis was used to estimate parameters of the models and several sensitivity analyses were performed.

Results here are presented using the language of ‘association’ rather than ‘causation’. This is because low basic skills are associated with multiple and complex forms of disadvantage. Therefore, it is not possible with the use of the cohort data to establish the causality of poor basic skills on adult outcomes. Nevertheless, our results point to the importance of poor basic skills in adulthood for low general subjective health and health limiting conditions. As such, we do not propose a single intervention to improve basic skills to tackle the problems of adult ill-health, but rather poor basic skills should be considered as an important component of policy design which aims at supporting adults who are in a situation of relative disadvantage.

1. Introduction

There is a growing body of evidence pointing to the importance of literacy, numeracy skills and achievement of academic and vocational qualifications in the current labour market (Grinyer, 2006; Denny et al, 2003; Dearden et al, 2002; McIntosh & Vignoles, 2001; Machin et al, 2001; Vignoles et al, 2011; Groot & Massed van der Brink, 2006) and that those without them became increasingly disadvantaged (Bynner, Wiggins & Parsons, 1996; Bynner & Parsons, 2001, 2002, 2006; Parsons & Bynner, 2007, 2008). Figures from the Labour Force Survey confirm the proportion of unemployed in the economically active population increases substantially during a recession and that the young and less skilled are hardest hit (ONS, 2010).

Although recent UK learning strategies have almost exclusively promoted lifelong learning as a mechanism to equip individuals with the skills to remain employable in an ever-changing job market, there is an accumulating body of knowledge that points to the wider set of factors that motivate learners to pursue learning opportunities (Lynch, 2008) and improve their basic skills. The acquisition – and indeed improvement – of literacy or numeracy skills can be seen as strengthening personal agency by building the capabilities that enable the individual to progress along pathways towards achievement and fulfilling outcomes in the different domains of adult life (Schoon et al, 2010a; St Clair, 2010; Bynner et al, 2001).

Benefits of such learning and improvement in basic skills include increased civic engagement, for example, voting (Parsons & Bynner, 2002; Tett & Maclachlan, 2007), but also reduced offending, increased support for own children's early learning and enhanced own physical and psychological wellbeing (Bynner et al, 2001; Bynner, 2009; Schuller et al, 2004; Schuller & Watson, 2009; Gale et al, 2009; Bynner & Parsons, 2006; Law et al, 2009; Parsons & Bynner, 2007; Schoon et al, 2010b). Evidence suggests that through learning in general, and acquisition of basic skills in particular, self-efficacy and self-confidence are also strengthened (Eldred et al, 2002; Feinstein et al, 2008; Maclachlan et al, 2009). Social participation in terms of membership and involvement in clubs and organisations also rises (Bynner & Parsons, 2006; Parsons & Bynner, 2007). Failure to learn on the other hand, and make the necessary progression in literacy or numeracy acquisition from one stage to the next, may leave the individual disadvantaged and functioning ineffectively in the labour market, their family life and wider community (Ekinsmyth & Bynner, 1994; Bynner & Parsons, 1997, 2006).

Evidence from interviews with adult learners provides further evidence of the wider benefits which can be attributed to basic skills acquisition. The most frequently reported benefits from attending skills provision centre is the take up of new literacy practices, gains in employment and increased self-esteem and confidence (Burton et al, 2010; Bingman & Ebert, 2000; Beder, 1999). Balatti et al (2006) also emphasise the positive 'social capital' outcomes in terms of strengthened social relations through new networks and more community involvement. Despite evidence showing the range of disadvantages associated with poor basic skills, it is important to acknowledge that many adults with poor literacy and numeracy skills are not always and obviously hindered in their everyday lives. They learn to cope with written communications and computational tasks by calling on friends, family and colleagues for support. Difficulties tend to arise when faced with challenges at work or in personal life that place a demand on literacy and numeracy competence – as,

for example, when faced with redundancy, ill health, or helping children with school work (Barton & Hamilton, 2000; Barton et al, 2006; Hamilton & Hillier, 2006). In these cases, support from family or friends may be crucial in surmounting individuals who lack basic skills successfully. The context in which literacy and numeracy skills are deployed, in the sense of a 'social practice' (Barton & Hamilton, 2000), is critical to understanding their contribution to capability (St Clair, 2010). It is when these established sources of support are non-existent or no longer sufficient to meet needs that opportunities for formal learning are likely to be taken up.

Institutional frameworks, driven by external influences stemming from the work place, the community and the family, therefore also shape individual functioning in the different domains of life. As such, the consequences of achieving, or strengthening individual literacy or numeracy skills are likely to be integrally connected with changes in status and attributes within these other life domains as conditioned by gender and social class. For example, adults who are released from child-care responsibilities as children grow up may seek formal learning opportunities to improve their basic skills. Improvement in basic skills can in turn benefit their employability and provide capabilities to support children's learning (Cieslik, 2006). Conversely, a negative change in life, such as a health problem in the family or job loss, may be a barrier to learning and progress (Tough, 2002). Therefore, we find that there are enablers and constrainers for individuals to take up learning opportunities. These enablers and constrainers are shaped by the social context of individuals and are likely to boost the potential learning benefits of basic skills acquisition.

Overall the above studies point towards the importance of basic skills in adulthood for socioeconomic attainment and family functioning. At the same time, what is absent from the above research is the possible effects of basic skills for adult health. Although there is an existing literature on the health benefits of education (Hammond, 2003; Hammond & Feinstein, 2005; Grossman, 2005 & 2006; Feinstein et al. 2006; Sabates & Feinstein, 2006), there is virtually no evidence which quantifies the health benefits of adult basic skills. For this reason, this research focuses on the contribution of basic skills to health related outcomes during adulthood. The following research questions are addressed here:

- Is there a contribution made by the basic skills of literacy and numeracy to health related outcomes during adulthood beyond and above that of early ability and educational qualifications?

- Is there a difference between the impact of literacy and numeracy skills on the formation of health outcomes during adulthood?

- Are there gender differences in the above processes?

2. Method

2.1 Data and Sample

Data for this project come from the 1970 British Cohort Study (BCS70). BCS70 is an on-going longitudinal study that involves over 17,000 cohort members born in Great Britain in one week in 1970 (see www.cls.ioe.ac.uk for full details of the study's design and coverage). Since the birth survey, there have been six follow-up studies in the 1970 cohort at ages 5, 10, 16, 30, 34 and most recently at age 38 when 8,874 (51% of the original birth cohort) participated. The next wave of date collection will take place during 2012.

The BCS70 study adopts the lifecourse perspective, attempting to embrace holistically the course of human development, with the data collected being relevant to the particular stage of life reached. This provides an invaluable resource which can be used to monitor cohort member's physical, educational and social development and transitions to adult life. As part of this research we focus on information that was collected on cohort member's basic skills in adulthood and we relate this information to their adult health status. Our research also adopts the lifecourse perspective, and so we include key information collected from birth to adulthood which may potentially confound the relationship between basic skills and health related outcomes in adulthood

Assessment of response bias suggests that the overall profile of the cohort remains remarkably similar across surveys. The sample at age 34 is representative, in most respects, of the general UK population of that age, although there is a trend towards under-representation of males and those less educationally advantaged (Elliott & Shepherd, 2006) which is a feature of all longitudinal studies. This research is based on the cohort members with complete data for the key variables of interest, namely health outcomes at age 38, adult basic skills and highest educational attainment at age 34. Of the 9562 cohort members who completed both the literacy and numeracy assessments at age 34, more than 7,700 cohort members participated at age 38 and provided information on their current health status.

2.2 Measures

Outcome Variables: Health status in adulthood

Key to this project was the availability of health outcomes measured in adulthood at two different time points, age 34 and age 38, in order to measure changes over time. This is important as we relate basic skills with sustaining as well as transforming effects on health outcomes (Schuller et al. 2004). As mentioned by Schuller et al. adult learning (and in our case adult basic skills) is related not only to positive changes in health, for example improving health, but also to sustaining health, and as such it is relevant to individuals being able to maintain good health.

Indicators of health at ages 34 and 38 were self-rated, providing a subjective measure of individuals rating of their own health as well as health behaviours. The four different measures available are detailed below together with the distribution of cohort members

across categories for our estimation sample (that is, cohort members with valid information on the key variables for this research).

Self-rated health is an assessment of the cohort member's subjective health at age 38 using a 5 point rating from excellent to poor. 24% of cohort members rated their health as excellent, 39% as very good, 26% as good, 8% as fair and only 3% as poor. The second indicator for health relates to the limiting impacts of health in everyday activities compared with people of the same age. The vast majority of cohort members did not find that their health limits their daily activities in any way (92%), and only 8% responded health as the factor limiting their daily activities.

The third indicator is about mental health, where cohort members were asked if they suffer from depression. Only 7% of cohort members indicated that they were suffering from depression. Finally, the last indicator is about health behaviours, where cohort members reported their current smoking habits. 52% of cohort members had ever smoked, and of this group little over half (53%) were ex-smokers, 11% were occasional smokers, 15% smoked up to 10 cigarettes a day, 19% smoked between 11 and 20 cigarettes a day and only 2% smoked more than 20 cigarettes a day. For this health behaviour we generated a dichotomous variable indicating whether cohort members were regular smokers; that is, the variable combines cohort members who regularly smoke more than 1 cigarette per day (36% of cohort members were regular cigarette smokers).

Basic skills: The basic skills of literacy and numeracy were measured in 2004 when BCS70 cohort members were age 34 by an objective indicator of basic skills in adulthood. The assessments consisted of questions adapted from the 2002 *Skills for Life* survey of the literacy and numeracy skill levels of the English working-age population (Williams et al, 2003). The items in the tests were set at four levels of difficulty: Entry 2, Entry 3, Level 1 and Level 2. Level 2 questions equate to GCSE grade A*-C standard. To be operating at Entry Level (that is Entry 2 and Entry 3) suggests a very poor mastery of the basic skills of literacy and/or numeracy.

The literacy assessment was made of 30 multiple-choice questions and the numeracy assessment was made of 17 multiple-choice questions. The literacy assessment contained ten screening questions that were designed to locate cohort members in their correct level of competency in literacy. The numeracy test contained diverse items that represented different levels of difficulties associated with numeracy. Application of psychometric scaling techniques identified good internal consistency as assessed by Cronbach's alpha coefficient (Cronbach, 1951) for the resulting literacy (0.83) and numeracy (0.82) scales (Parsons & Bynner, 2005b). For further details of the assessment see Parsons & Bynner (2005a).

The assessments identified 8% of adults with Entry Level literacy and 40% with Entry Level numeracy (Bynner & Parsons, 2006). Table 1 gives the distribution of cohort members across the four literacy and numeracy skill levels, comparing those who took part in the age 34 survey with the reduced sample (81%) who participated in the age 34 and age 38 survey. We can see that the attrition was not random. Cohort members assessed with the poorest (Entry 2) skills at age 34 were the least likely to take part four years later, those with the highest skills (Level 2) the most likely. As such, the distribution of cohort members across the four skills groups is slightly skewed towards those with a better grasp of the basic skills.

Table 1: Distribution of BCS70 cohort members by literacy and numeracy skill levels – comparison of those in the 2004 survey and the reduced sample in 2004 and 2008 survey

	Literacy					Numeracy				
	2004 (age 34)		2008 (age 34 & 38)		% age 34 in 2008 survey	2004 (age 34)		2008 (age 34 & 38)		% age 34 in 2008 survey
	%	n	%	n		%	n	%	n	
Entry 2	4.3	*409*	3.2	*245*	59.9	15.0	*1439*	12.7	*984*	68.4
Entry 3	3.9	*375*	3.2	*246*	65.6	24.8	*2367*	23.6	*1828*	77.2
Level 1	30.2	*2885*	29.4	*2274*	78.8	33.9	*3241*	35.1	*2715*	83.8
Level 2	61.7	*5899*	64.2	*4969*	84.2	26.3	*2515*	28.5	*2205*	87.7
N(100 %)		*9568*		*7734*	80.8		*9562*		*7732*	80.9

Highest educational qualifications at age 34: The measure of highest qualification includes both academic and vocational qualifications and equates them on a six-point NVQ scale. This scale ranges from: 0 = no qualifications; 1 = NVQ1 qualifications (i.e. GCSE D-G grades or equivalent); 2 = NVQ2 qualifications (i.e. GCSE A*-C grades or equivalent); 3 = NVQ3 qualifications (A-levels or equivalent); 4 = NVQ4 (i.e. university degree or equivalent); and 5 = NVQ5+ (i.e. post-graduate qualifications). Approximately 8.2 percent of women and 10.4 percent of men left schooling without qualifications. For this cohort, one-third of men and women had achieved a graduate or post-graduate qualification by age 34.

Control variables from childhood: The richness of the BCS70 data allow us to control for different factors from childhood known to be important in the formation of basic skills, educational attainment and health status in adulthood. The measures selected covered the family's socio-economic position and the child's health and academic ability, and had the strongest, statistical, association with the basic skills measures and health outcomes from the wide range of measures available.

Among the main socioeconomic variables that we included in the analysis are housing tenure, which was measured at age 10 and distinguishes between cohort members living in owner occupied from other forms of housing tenure. Family social class was measured when the cohort members were born and it is based on the Registrar General Social Class scale (RGSC), itself based on the occupation of the parent holding the job with the highest social-economic status. This variable differentiates between unskilled occupations, semi-skilled occupations, skilled (manual and non-manual) occupations, technical and managerial and the highest occupation is professional. Another important socioeconomic background variable is the education of the parents. This variable was collected when the cohort member was born and it refers to the age at which the mother left full-time education.

Variables related to the health of the cohort member during childhood included the weight of the cohort member at birth. This was measured in grams, and the full range is from 200 to 6464 grams. A second variable on the health of the cohort member during childhood was a parental response to whether the cohort members had a health limiting condition

when the cohort members were age 10. Both low birthweight and health problems during childhood have been associated with a range of medical conditions during adulthood (Blane et al. 2004).

We also include variables related to academic ability during childhood as these have important relationship with literacy and numeracy during adulthood (Bynner & Steedman, 1995; Parsons & Bynner, 1998; Bynner & Parsons, 2008). Reading comprehension at age 10 was assessed by *The Shortened Edinburgh Reading Test* (Hodder & Stoughton, 1979). Cohort members were asked to complete a variety of tasks over 66 items, including selecting the incorrect word in a sentence, matching answers to questions, extracting information from a picture, understanding the meaning of words, putting sentences in the correct order, etc. Scores ranged between 0 and 65. Mathematics assessment, the *Friendly Maths Test*[1], was developed specifically for use in the age 10 survey to provide a score over the full range of mathematical competence. The 72 items in the assessment covered knowledge, concept and applications in the areas of the four basic rules, fractions, other number skills, measure in a variety of forms, geometry, algebra and statistics. As far as possible the individual items assessed single rather than multiple skills. Scores ranged between 1 and 72.

Finally, we also have information on gender and the region where cohort members lived during adulthood (at age 38), and these are used in the analyses performed below.

2.3 Analytic Strategy

We undertake multivariate regression analysis to estimate the association of poor basic skills in adulthood (literacy and numeracy) with poor health outcomes. Two key issues are investigated in this project. First, we are interested to estimate whether basic skills in adulthood is related to changes in health outcomes in adulthood. Secondly, we are interested to estimate whether the relationship of basic skills and changes in health outcomes remains statistically significant after conditioning out (i) highest educational qualifications in adulthood and (ii) background childhood factors known to affect health outcomes and basic skills formation.

Based on the above, we estimate four models for each outcome. The first model (Model 1) estimates the raw relationship of basic skills (literacy or numeracy) with the health outcome measured at age 38. The second model (Model 2) introduces as control in the analysis the health outcome measured at age 34. Model 2 basically changes Model 1 from looking into the association of basic skills with the level of the outcome to the association of basic skills with changes in the outcome. Model 3 then introduces the highest qualifications of the cohort members. The aim of Model 3 is to estimate whether any significant association of basic skills with changes in health outcomes remains after conditioning out highest educational qualifications. Model 4 includes in the analysis a set of childhood controls. The aim of Model 4 is to estimate whether the relationship of basic skills to changes in health outcomes is robust to some important observed factors such as

[1] For further details of the age 10 assessments see http://www.cls.ioe.ac.uk/page.aspx?&sitesectionid=818&sitesectiontitle=Guide+to+Dataset

health during childhood, reading and mathematics ability and parental socioeconomic background, among others.

In summary, the modelling strategy for each health outcomes consists of:

Model 1:

$$HO_i^{02} = \beta_0 + \beta_1 \frac{Lit}{Num}_i^{04} + e_i$$

Model 2:

$$HO_i^{02} = \beta_0 + \beta_1 \frac{Lit}{Num}_i^{04} + \beta_2 HO_i^{04} + \theta_1 Gender_i + \omega Region + e_i$$

Model 3:

$$HO_i^{02} = \beta_0 + \beta_1 \frac{Lit}{Num}_i^{04} + \beta_2 HO_i^{04} + \beta_3 HO_i^{04} + \theta_1 Gender_i + \omega Region + e_i$$

Model 4:

$$HO_i^{02} = \beta_0 + \beta_1 \frac{Lit}{Num}_i^{04} + \beta_2 HO_i^{04} + \beta_3 HO_i^{04} + \mu * Childhood + \theta_1 Gender_i + \omega Region + e_i$$

Each of these models is estimated separately for literacy and numeracy skills. When the health model is estimated using adult literacy, we include childhood reading ability when we include childhood controls. This means that we only use reading tests at age 10. Similarly, when the health model is estimated using adult numeracy we use childhood mathematics test scores at age 10 to condition out for previous ability.

The estimation method used depends on the nature of the outcome variable. For outcome variables that were binary, for example health limiting daily life, depression and smoking, we used logistic regression to estimate the parameters of the model. Estimated parameters from these models were interpreted as increasing or decreasing the log of the odds that the cohort member has a certain health outcome. To quantify the association of the parameters to the health outcome in a more meaningful way we estimated the odd ratios and presented results in graphical form. For self-rated health, we used ordinary least squares (OLS) to estimate the relationship of each of the covariates with the outcome. Parameters estimated by OLS have a direct interpretation as being the marginal effect (either percentage change or discrete change in the explanatory variable). Estimated parameters from OLS are also presented in graphical form. Parameter estimates for all health outcomes and for literacy and numeracy are presented in the appendix.

Our final step is to investigate the potential gendered relationships between basic skills in adulthood and health outcomes. In doing so, we explore whether the main results obtained for the models estimating the associations between basic skills and health outcomes in adulthood were mainly found for men, women or both. Previous studies have shown that adult learning is associated with some health outcomes for women and others for men

(see Chevalier & Feinstein, 2006; Adams, 2002). Here we explored the potential gendered nature of the relationship of adult basic skills to health outcomes.

3. Results Descriptive Analyses

3.1 Basic skills and health outcomes

Table 2 and Table 3 show the relationship between assessed literacy and numeracy skills and the different health outcomes at age 38. For literacy, it can be shown that across all health outcomes, a higher percentage of respondents who self-reported a poorer health status had Entry 2 skills whilst fewer had Level 2 skills (Table 2:). For example, the gradient of the relationship between excellent health and literacy levels is much steeper than the gradient of the relationship between poor health and literacy levels. For the gradient of excellent health to literacy levels, only 2.4 per cent of cohort members with excellent health at age 38 had Entry 2 literacy skills and 70.6 per cent had Level 2 literacy. For the gradient of poor health, 8.3 per cent of cohort members with poor health had Entry 2 level literacy and 48.5 of cohort members had Level 2 literacy.

Table 2: Distribution of literacy skills across health outcomes at age 38

	Entry 2	Entry 3	Level 1	Level 2	N
General Health at age 38					
Excellent	2.4	2.8	24.2	70.6	1882
Very good	2.5	2.4	30.3	64.8	2992
Good	3.2	3.9	31.6	61.3	2037
Fair	6.8	3.6	32.3	57.4	617
Poor	8.3	9.2	34.0	48.5	206
Health limits daily activities					
No	2.8	3.0	29.4	64.9	7119
Yes	7.8	5.6	29.7	57.0	630
Suffered from depression					
No	3.0	3.0	29.2	64.8	7171
Yes	6.0	5.0	31.4	57.6	564
Smoking habits					
Never – occasional smoker	2.5	2.6	28.0	67.0	6271
Regular smoker	5.9	5.9	35.6	52.6	1464

Results for the relationship between adult numeracy skills and health outcomes at age 38 also show that poorer basic skills are associated with worse health outcomes (Table 3). The steepness of the gradient of the relationship changes for different levels of numeracy skills in adulthood. For instance, for cohort members whose health does not limit daily activities only 11.8 per cent had Entry 2 numeracy skills. However, for cohort members whose health does limit daily activities 23.1 per cent had Entry 2 numeracy skills.

Table 3: Distribution of numeracy skills across health outcomes at age 38

	Entry 2	Entry 3	Level 1	Level 2	N
General Health at age 38					
Excellent	10.6	22.6	33.7	33.2	1882
Very good	11.3	22.6	36.2	29.8	2992
Good	13.5	24.6	35.6	26.4	2037
Fair	18.8	26.5	34.7	20.0	616
Poor	27.8	30.2	28.3	13.7	205
Health limits daily activities					
No	11.8	23.5	35.4	29.3	7119
Yes	23.1	26.0	32.2	18.8	628
Suffered from depression					
No	12.1	23.2	35.5	29.1	7169
Yes	20.0	28.4	30.0	21.6	564
Smoking habits					
Never – occasional smoker	11.3	22.2	35.9	30.5	6269
Regular smoker	18.7	29.7	31.6	19.9	1464

3.2 Basic skills and childhood controls

Table 4 and Table 5 show the relationship between assessed literacy and numeracy skills and the different childhood control variables used in the modeling. We can see that across the family socio-economic measures, those living in rented housing, had a mother who left full-time education at the minimum age or a had a relatively lower family social class were more likely to have poor, Entry 2 literacy or numeracy skills in adulthood. Similarly, adults with Entry 2 literacy skills had the lowest reading scores at age 10 and adults with Entry 2 numeracy skills had the lowest maths scores at age 10. Both cohort members with Entry 2 literacy or numeracy skills have the lowest average birthweight (see Table 4 and Table 5 for adult literacy and numeracy, respectively). More of those who had a medical problem that limited the daily activities they could do as a child had poor literacy and numeracy skills in adulthood. These results confirm the importance of background factors in conditioning out the potential relationship of adult basic skills to health outcomes.

Table 4: Relationship between adult literacy skills and childhood variables

	Entry 2	Entry 3	Level 1	Level 2	N
Age mother left education [0]					
Minimum age	5.4	4.9	34.3	55.4	5564
After minimum age	2.2	2.2	23.0	72.6	3279
Family Social class [0]					
V (unskilled manual)	11.5	8.4	35.5	44.6	453
IV (semi-skilled manual)	5.5	5.4	35.5	53.6	1320
III (manual)	4.8	4.7	32.3	58.2	3953
III (non-manual)	1.2	1.7	26.9	70.3	1292
II (technical/managerial)	2.3	1.3	24.6	71.8	1164
I (professional)	1.2	0.8	17.1	80.8	485
Housing Tenure [10]					
Owner occupied	2.4	2.5	27.6	67.5	4762
Rented housing	6.5	5.8	34.7	53.1	3108
Health limits daily activities [10]					
No	3.2	3.7	29.5	63.6	7178
Yes	8.7	3.7	32.3	55.3	1082
Birthweight [0]					
Average [mean] birthweight (gms)	3215.9	3217.9	3290.2	3336.9	8837
Reading assessment [10]					
Average [mean] reading score	25.5	31.0	38.3	45.3	7163

Table 5: Relationship between adult numeracy skills and childhood variables

	Entry 2	Entry 3	Level 1	Level 2	N
Age mother left education [0]					
Minimum age	18.5	28.2	32.6	20.8	5561
After minimum age	9.2	18.5	36.3	35.9	3277
Family Social class [birth]					
V (unskilled manual)	26.5	31.9	24.6	17.0	452
IV (semi-skilled manual)	19.0	32.9	29.6	18.5	1320
III (manual)	17.0	25.3	35.1	22.6	3950
III (non-manual)	10.7	20.7	34.6	34.1	1292
II (technical/managerial)	9.2	19.2	38.0	33.6	1163
I (professional)	3.7	13.4	34.6	48.2	485
Housing Tenure [10]					
Owner occupied	11.3	21.3	36.1	31.2	4761
Rented housing	20.0	29.6	31.4	19.0	3105
Health limits daily activities [10]					
No	13.8	23.7	34.8	27.7	7173
Yes	19.0	27.8	32.1	21.1	1082
Birthweight [0]					
Average [mean] birthweight (gms)	3205.9	3266.5	3341.3	3381.0	8832
Maths assessment [10]					
Average [mean] maths score	35.7	40.0	47.9	53.1	7163

3.3 Health outcomes and childhood controls

Table 6 shows the relationship between self-rated health at age 38 and the childhood factors and Table 7 shows the relationship between our three other health outcomes and childhood factors. Our results show that across the family socio-economic measures included, those living in rented housing, had a mother who left full-time education at the minimum age or a had a relatively lower family social class were more likely to report poor self-rated health at age 38 (Table 6). Health during childhood is also related to health in adulthood. We find that there is a gradient of health in adulthood according to weight at birth. Finally, we also find a gradient according to test scores during childhood whereby higher test scores at age 10 are associated with better self-reported health at age 38.

Table 6: Relationship between general health at 38 and childhood variables (row percentages presented)

	Excellent	Very good	Good	Fair	Poor
Age mother left education [0]					
Minimum age	21.9	38.2	27.6	9.1	3.3
After minimum age	28.1	38.6	24.0	7.0	2.2
Family Social class [0]					
V (unskilled manual)	17.1	36.2	31.3	11.4	4.0
IV (semi-skilled manual)	21.2	37.0	28.5	9.8	3.4
III (manual)	23.2	38.4	27.2	8.2	3.0
III (non-manual)	25.9	38.6	25.5	8.0	2.0
II (technical/managerial)	27.4	41.1	22.2	6.7	2.6
I (professional)	34.4	39.2	20.1	4.6	1.7
Housing Tenure [10]					
Owner occupied	27.6	39.2	24.5	6.9	1.9
Rented housing	19.6	36.9	29.1	10.1	4.3
Health limits daily activities [10]					
No	25.1	39.1	25.5	7.7	2.5
Yes	17.3	36.1	30.1	11.3	5.1
Birthweight [0]					
Average [mean] birthweight (gms)	3338.7	3321.6	3294.7	3271.7	3239.6
Reading assessment [10]					
Average [mean] reading score	44.7	42.9	40.7	39.8	37.5
Maths assessment [10]					
Average [mean] reading score	47.6	46.8	44.6	43.0	40.9

For our binary health outcomes at age 38 we also find strong gradients according to the background socioeconomic factors as well as health related measures and academic ability during childhood (Table 7). In particular, the social class gradient indicates that cohort members whose parents belonged to the lowest social class are more likely to have a health limiting condition, depression and be a regular smoker at age 38. We also find that the birthweight is, on average, similar to that of adults reporting fair or poor health in adulthood. Finally, we find that the average test scores during childhood for cohort members who reported health limiting conditions, depression and smoking at age 38 is similar to that of cohort members who reported poor health at age 38. Our results support the inclusion of background factors in the modelling for conditioning out the potential relationship of adult basic skills to health outcomes.

Table 7: Relationship between health limiting daily life, depression and smoking at 38 and childhood variables (row percentages presented)

	Health limiting	Depression	Regular smoker
Age mother left education [0]			
Minimum age	9.1	8.3	22.5
After minimum age	7.8	7.2	15.1
Family Social class [0]			
V (unskilled manual)	13.1	10.2	27.8
IV (semi-skilled manual)	10.0	8.8	23.5
III (manual)	8.7	8.2	20.5
III (non-manual)	7.1	7.2	17.6
II (technical/managerial)	6.6	5.7	14.9
I (professional)	7.5	6.5	12.2
Housing Tenure [10]			
Owner occupied	7.0	6.4	15.3
Rented housing	10.8	9.9	25.9
Health limits daily activities [10]			
No	7.8	7.5	18.5
Yes	13.3	11.2	24.1
Birthweight [0]			
Average [mean] birthweight (gms)	3252.1	3258.4	3277.5
Reading assessment [10]			
Average [mean] reading score	40.1	40.3	38.8
Maths assessment [10]			
Average [mean] reading score	43.1	43.0	42.6

Note: Percentages represent, for example, the proportion of adults living in a rented house at age 10 that had health limiting, were depressed and regularly smoked at age 38. Hence these are row percentages.

4. Results Multivariate Analyses

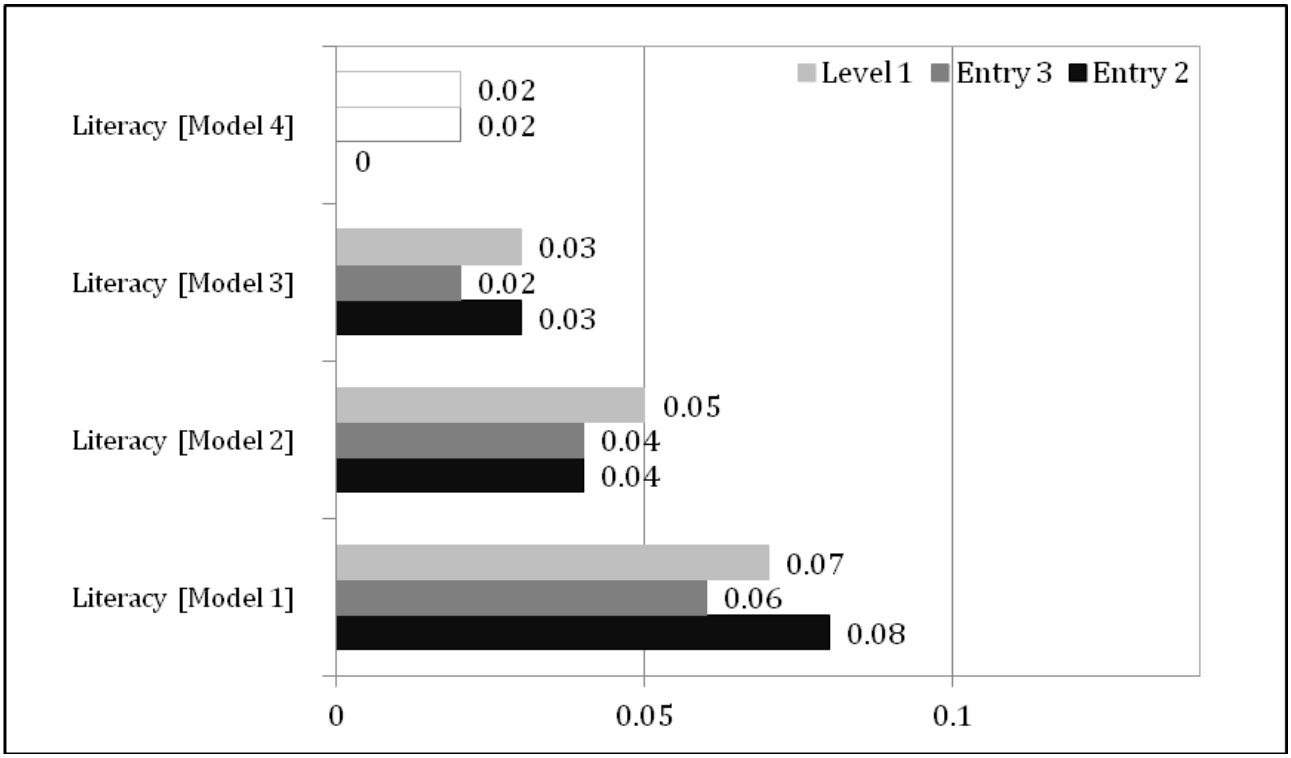
In the modelling, we estimate the association between basic skills and poor health outcomes, e.g. poor general health, having a health condition that limits daily activities, experience of depression, and being a current smoker. To best capture the relationship of poor basic skills in adulthood to these poor health outcomes, Level 2 literacy or numeracy skills, the highest skills group, are set as the reference category. We are therefore capturing the relationship between 'worsening' self-rated health and lower basic skills in adulthood. This, we hope, simplifies the interpretation of parameters.

4.1 Self-rated health at age 38

The scale of self-rated health at age 38 ranges on a five-point scale from excellent to poor health. Figure 1 shows results for the models estimating the relationship of adult basic skills to self-rated health at age 38 using the four models described in our analytical strategy. Model 1 shows the raw relationship of adult literacy skills to self-rated health at age 38. We found that compared with cohort members with Level 2 skills, those with poorer literacy skills reported poorer self-rated health at age 38 (all results show statistically association at least at 5% significance level). In particular, cohort members with Entry 2 skills reported 0.08 percentage points higher probability of poor health relative to those with Level 2 literacy skills. In Model 2, we measure whether adult literacy is associated with changes in self-rated health. We found that compared with cohort members with Level 2, those with Entry 2 are more likely to have negative changes in self-rated health between the ages of 34 to 38 (0.04 percentage points more likely to reported a deteriorating health status during this period compared with cohort members with Level 2 literacy skills).

Model 3 shows that the association of adult basic skills and changes in self-rated health between ages 34 and 38 remains statistically significant after conditioning out the association of highest educational qualifications at age 34. We still find, for example, that cohort members with Entry 2 literacy are 0.03 percentage points more likely to have deteriorating self-rated health between ages 34 and 38 compared with cohort members with Level 2 skills. Finally, Model 4 indicates that the association of adult literacy skills and changes in self-rated health is not statistically significant when we include childhood controls in the model.

Figure 1: Standardized Beta coefficients relating adult literacy (age 34) to self-rated health (age 38)



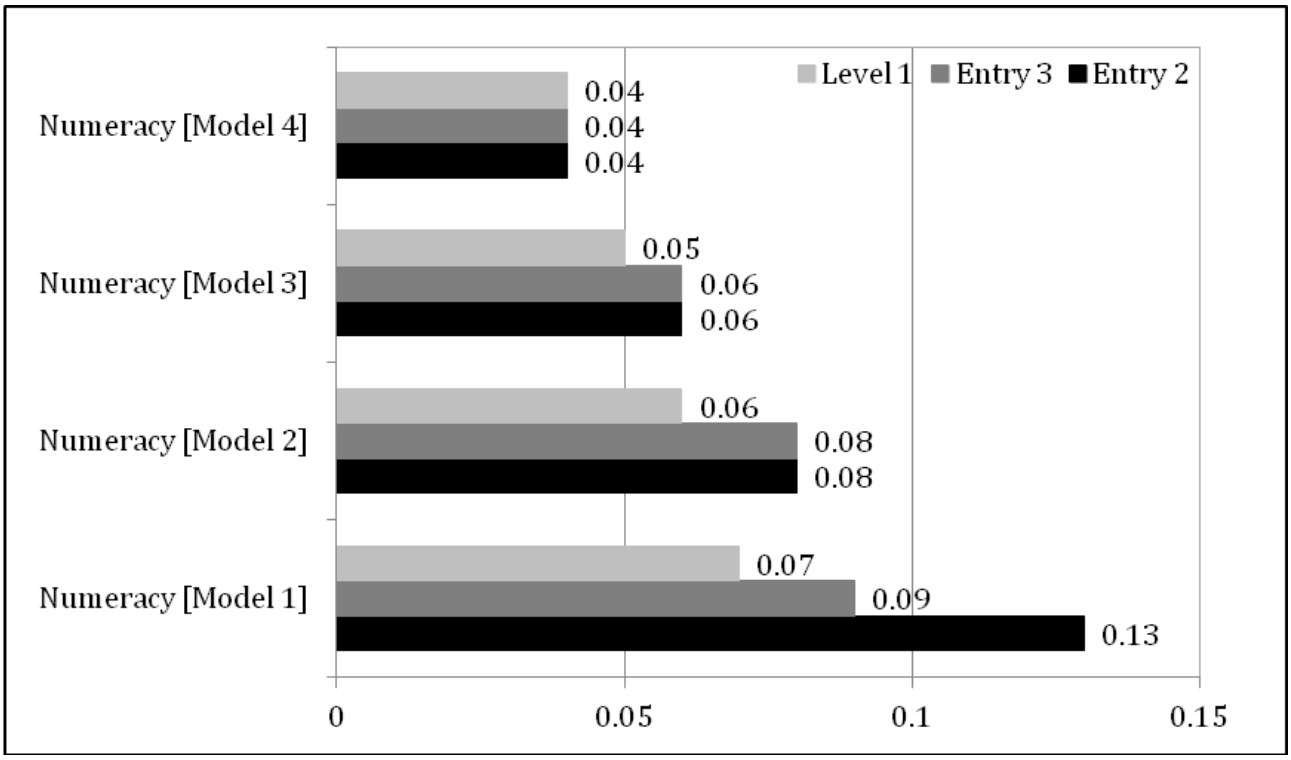
Source: BCS70. Notes: Shaded bars indicated parameters are statistically significant at 5% level (or below). Different degrees of shade are used to differentiate between different levels of basic skills. White bars indicate that the association is not statistically significant.

The relationship of adult numeracy skills to self-rated health at age 38 is different to what it is for adult literacy skills. Figure 2, Model 1, shows a sharp gradient whereby cohort members with lower adult numeracy skills also reported poorer self-rated health. The model for health changes (Model 2) indicates that cohort members with Entry 2 numeracy skills are 0.08 percentage points more likely to have deteriorating health status between ages 34 and 38 as compared with cohort members with Level 2 numeracy skills. Model 3 shows that the strength of the relationship of changes in adult health to adult numeracy skills is conditioned out with the inclusion of highest educational qualifications at age 34, but it still remains statistically significant for all 3 comparison levels of numeracy skills. Finally, Model 4 shows that the association of poor numeracy skills with deteriorating self-rated health in adulthood remains significant even after the inclusion of childhood controls.

Figure 2 also shows that the difference in this relationship seems to apply only between individuals with Level 2 skills and the rest of the cohort members with poorer numeracy skills, as the steepness of the gradient disappeared as we moved from Model 1 to Model 4. This is important as we can start to understand some possible thresholds in the relationship between basic skills and health in adulthood.[2]

[2] The strongest association between poorer general health at age 38 and other measures in the model was with general health status at age 34. Other measures that also held a significant association with poorer health at age 38 were low qualifications at age 34, being male, having a limiting health condition and low family income in

Figure 2: Standardized Beta coefficients relating adult numeracy (age 34) to self-rated health (age 38)



Source: BCS70. Notes: Shaded bars indicated parameters are statistically significant at 5% level (or below). Different degrees of shade are used to differentiate between different levels of basic skills. White bars indicate that the association is not statistically significant.

4.2 Health limiting daily activities at age 38

At age 38 we identified cohort members whose health status limits their daily activities. Hence parameter estimates, or the odd ratios indicated in the figures below, measure the likelihood that health limits daily activities.

For adult literacy, Model 1 indicates that cohort members with Entry 2 level are 3.2 times more likely to have their health limiting daily activities compared with cohort members with Level 2 literacy (Figure 3). Notice, however, that in Model 1 we did not find a statistically significant difference in health limiting activities between cohort members with Level 1 literacy and cohort members with Level 2 literacy. In Model 2, cohort members with Entry 2 have 2.7 times higher odds to report deteriorating health limiting daily life between ages 34 and 38 compared with cohort members with Level 2 literacy. As we moved to Model 3, the

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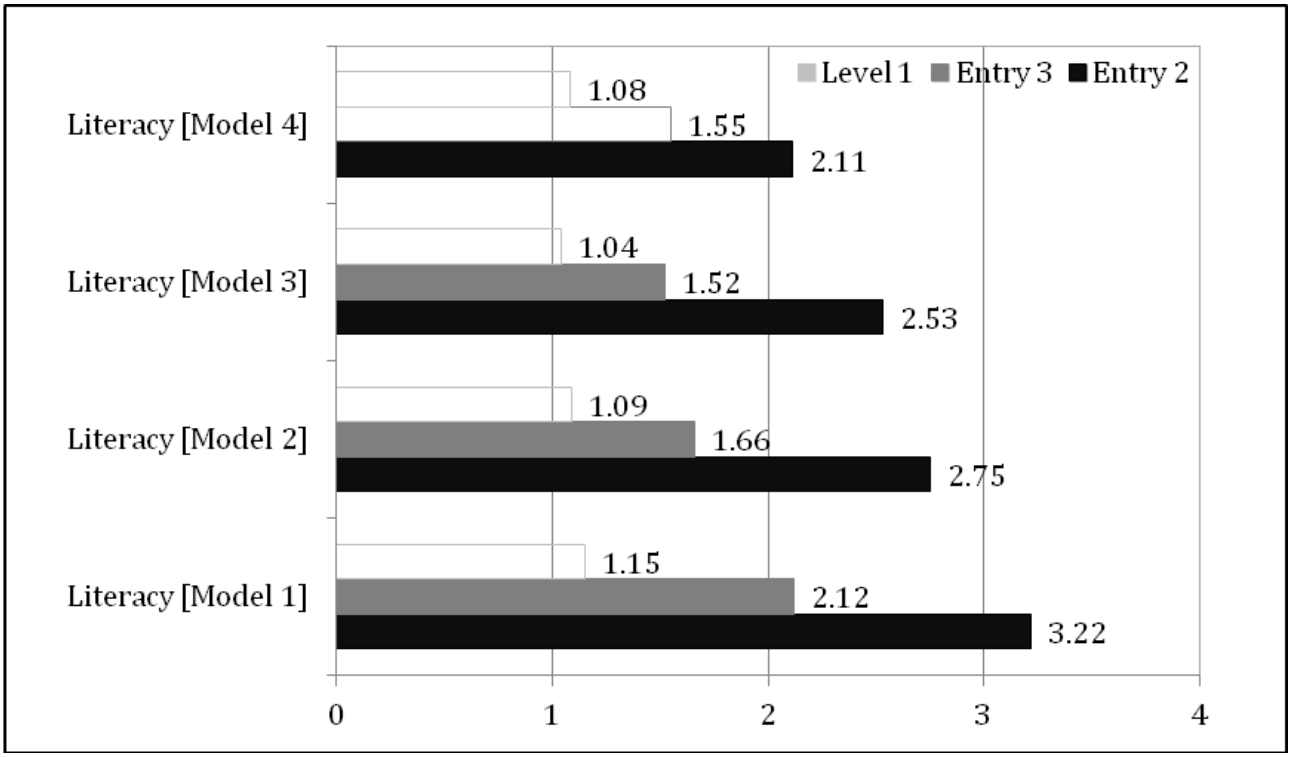
childhood (Appendix Tables contain results mainly showing parameters for literacy and numeracy, but not individual parameters for controls. Individual parameters for controls are available from the authors upon request).

relationship of low adult literacy skills and changes in health limiting daily activities remains statistically significant after the inclusion of highest educational qualifications at age 34. Finally, Model 4 indicates that cohort members with the lowest adult literacy skills (Entry 2) are twice as likely to have deteriorating health limiting daily activities between ages 34 and 38 compared with cohort members with Level 2 literacy.

Figure 3: Odd ratios relating adult literacy (age 34) to health limiting daily activities (age 38)

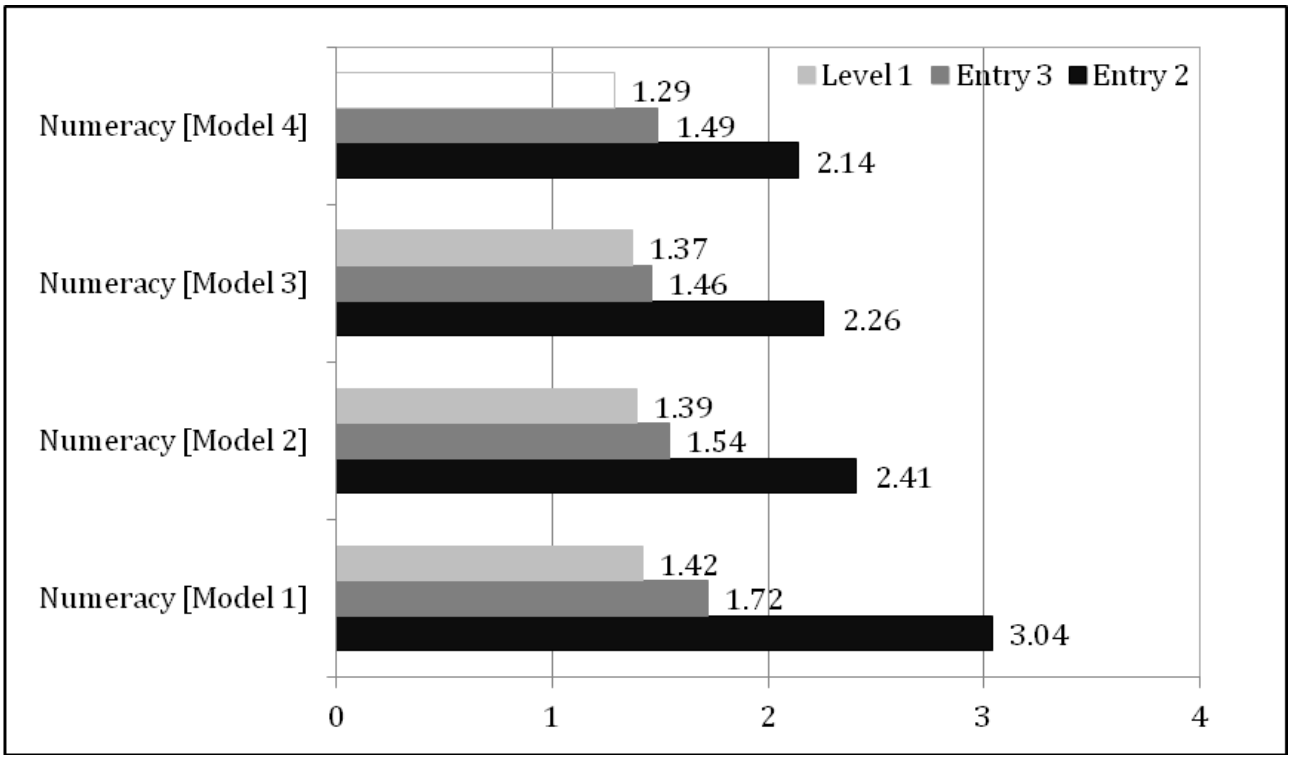


Source: BCS70. Notes: Shaded bars indicated parameters are statistically significant at 5% level (or below). Different degrees of shade are used to differentiate between different levels of basic skills. White bars indicate that the association is not statistically significant.

Similar results were found for numeracy. Figure 4, Model 1, shows that all cohort members with lower than Level 2 numeracy were more likely to report health limiting their daily activities compared with cohort members with Level 2 numeracy. This association remains statistically significant in Models 2 and 3 (with the inclusion of health at age 34 and highest qualifications at age 34). In Model 4, however, we find that only cohort members with Entry 1 and Entry 2 numeracy skills were more likely to have deteriorating health limiting daily activities between ages 34 and 38 compared with cohort members with Level 2.[3]

[3] Looking at the other measures included in the models for health limiting daily activities we find that previous heath status at age 34 had the strongest association with health limiting daily activities at age 38. Women were more likely to report health that limited daily activities, but highest qualification held did not keep an independent association once childhood controls were introduced into the model (for literacy). Of the childhood controls, poor health status in childhood and a low family social class both had an independent association with

Figure 4: Odd ratios relating adult numeracy (age 34) to health limiting daily activities (age 38)



Source: BCS70. Notes: Shaded bars indicated parameters are statistically significant at 5% level (or below). Different degrees of shade are used to differentiate between different levels of basic skills. White bars indicate that the association is not statistically significant.

4.3 Depression at age 38

Figure 5 shows results from the models estimating the relationship between literacy and depression at age 38. Model 1 shows that there is a health gradient in basic literacy skills whereby individuals with the lowest literacy skills are more likely to have suffered from depression. Model 2 indicates that only those with literacy Entry 1 and Entry 2 had higher odds to report increasingly suffering from depression between ages 34 and 38, as compared with cohort members with Level 2 literacy. This association remains significant even after conditioning for highest qualifications (Model 3). However, in Model 4 we find that the association of literacy skills to risk of depression is accounted by the inclusion of childhood controls.

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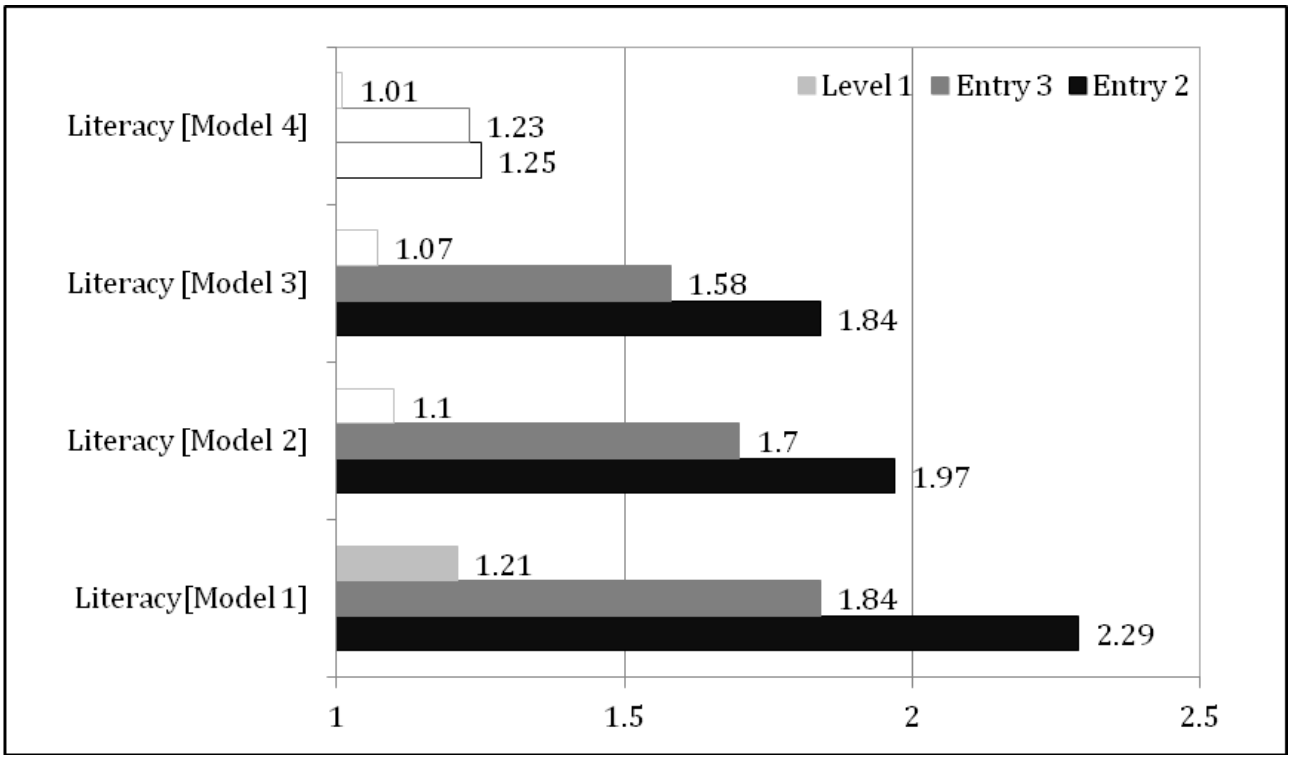
having health that limited daily activities in adulthood (results not shown in Appendix tables but available from the authors upon request).

Figure 5: Odd ratios relating adult literacy (age 34) to depression (age 38)

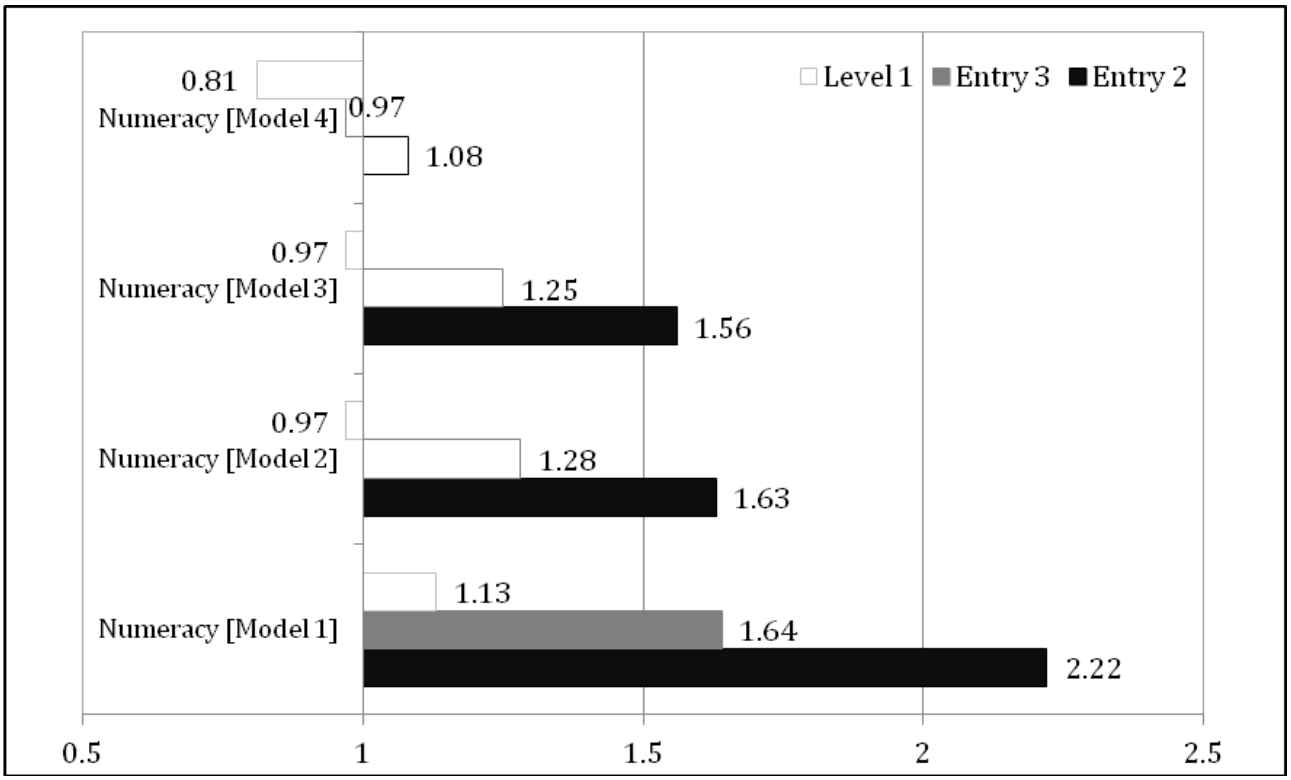


Source: BCS70. Notes: Shaded bars indicated parameters are statistically significant at 5% level (or below). Different degrees of shade are used to differentiate between different levels of basic skills. White bars indicate that the association is not statistically significant.

For numeracy, Figure 6 shows that the association of poor numeracy skills and risk of depression holds for the model in changes (Model 2) and with the inclusion of highest qualifications at age 34 (Model 3). However, once we condition out the impact of childhood factors the association of adult numeracy skills and depression at age 38 is not statistically significant (Model 4 in Figure 6).[4]

[4] Looking at the other measures included in the models, previous experience of depression at age 34 had the strongest association with current depression at age 38. Women were also significantly more likely to report depression, but highest held qualification had no independent association. Of the childhood controls we included, poor health in childhood increased the risk of adult depression and a higher family social class significantly reduced the risk of depression in adulthood.

Figure 6: Odd ratios relating adult numeracy (age 34) to depression (age 38)

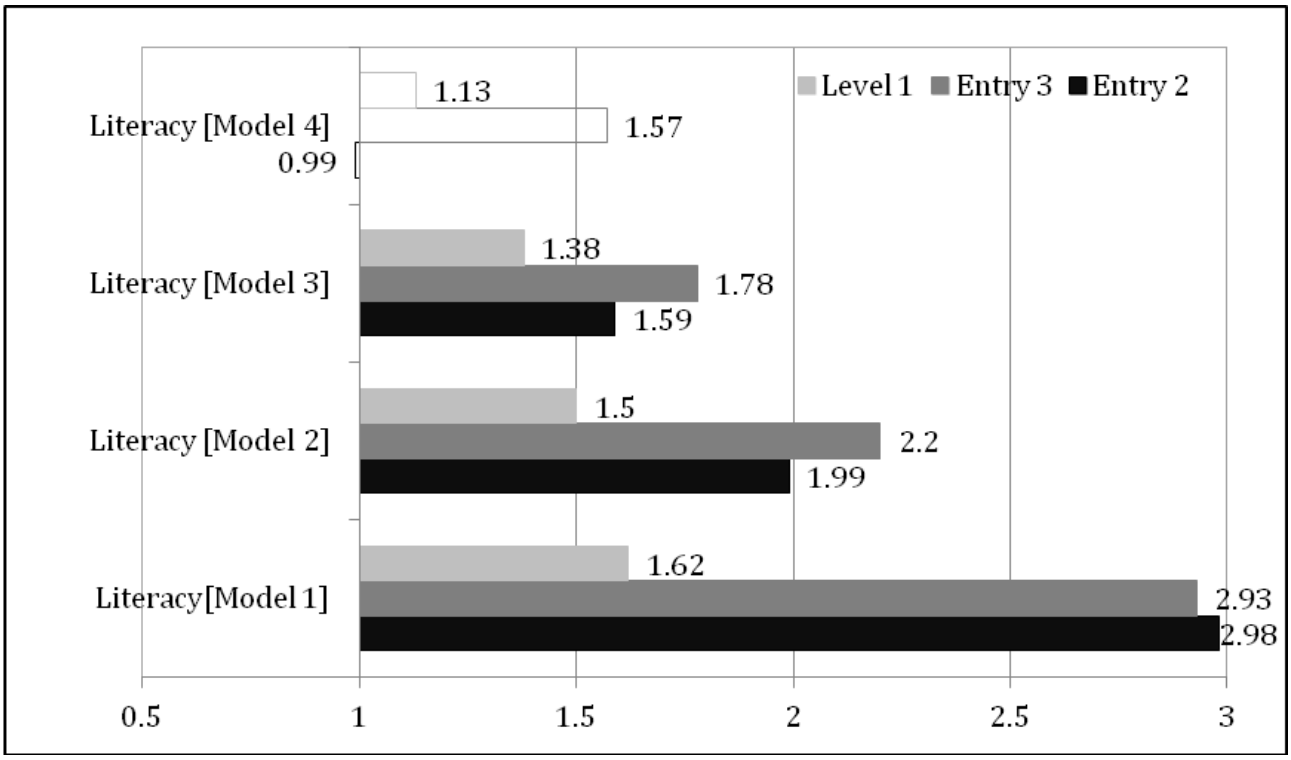


Source: BCS70. Notes: Shaded bars indicated parameters are statistically significant at 5% level (or below). Different degrees of shade are used to differentiate between different levels of basic skills. White bars indicate that the association is not statistically significant.

4.4 Regular smoker at age 38

Figure 7 shows results for the models estimating the association of literacy skills and smoking at age 38. Model 1 suggests a strong relationship between lack of literacy skills and likelihood of smoking. Cohort members with Entry 2 literacy have nearly three times higher odds of smoking relative to cohort members with Level 2 literacy. This association remains statistically significant once we conditioned out previous smoking behaviour (Model 2) and highest qualifications at age 34 (Model 3). However, once we introduce background childhood factors, the association between lack of basic literacy skills and higher likelihood of smoking becomes statistically insignificant.

Figure 7: Odd ratios relating adult literacy (age 34) to smoking (age 38)

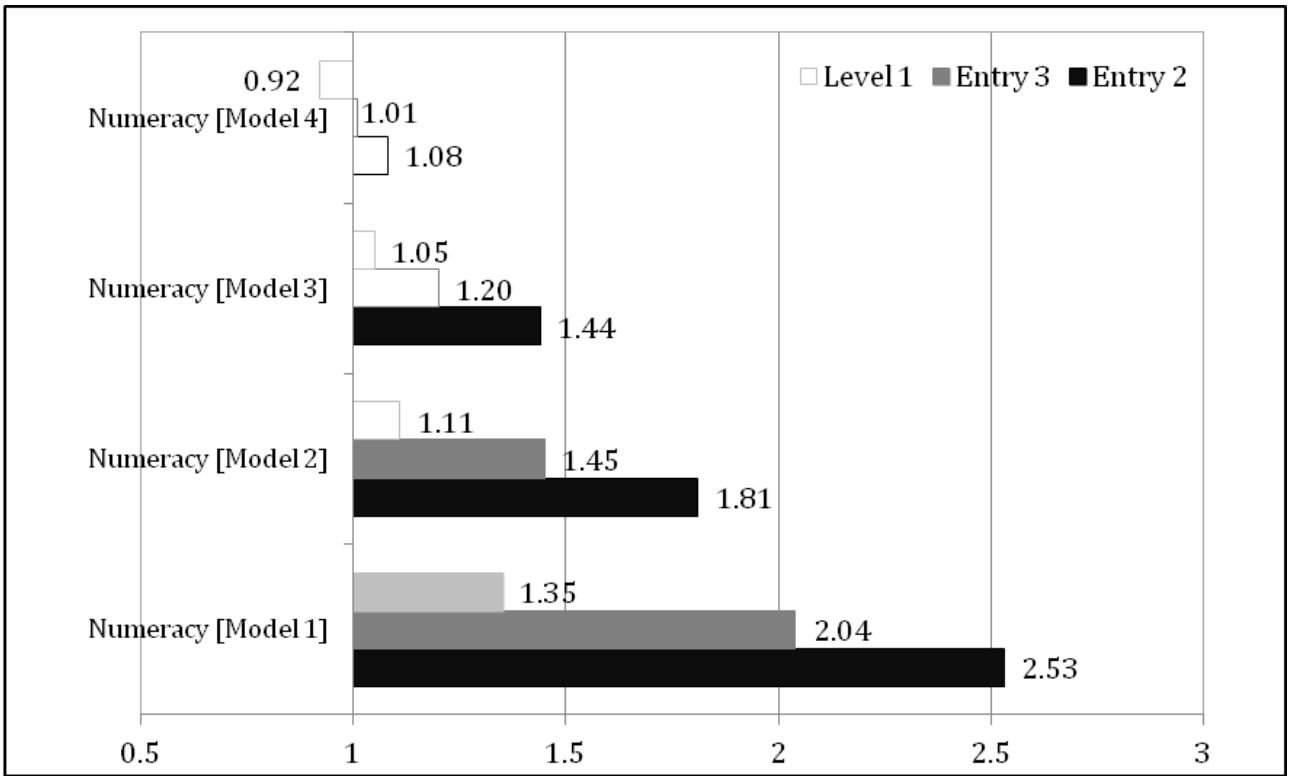


Source: BCS70. Notes: Shaded bars indicated parameters are statistically significant at 5% level (or below). Different degrees of shade are used to differentiate between different levels of basic skills. White bars indicate that the association is not statistically significant.

Finally, Figure 8 shows results from the models estimating the relationship between adult numeracy and smoking at age 38. Similar to results for literacy, we find that the statistical significant association of numeracy skills and smoking at age 38 (Model 1) is significantly reduced with the inclusion of previous smoking (Model 2) and highest qualifications (Model 3). In fact, once controls for childhood factors are introduced in the model, we did not find a statistical significant association between numeracy skills and smoking at age 38 (Model 4).[5]

[5] Apart from smoking practice at age 34, not having any or low (NVQ1) level qualifications, being male, low birthweight and having a limiting health condition in childhood were significant predictors of smoking in adulthood (Results available from the authors upon request).

Figure 8: Odd ratios relating adult numeracy (age 34) to smoking (age 38)



Source: BCS70. Notes: Shaded bars indicated parameters are statistically significant at 5% level (or below). Different degrees of shade are used to differentiate between different levels of basic skills. White bars indicate that the association is not statistically significant.

4.5 Health outcomes at age 38: Gender analysis

Table 8 shows results on the relationship of basic skills in adulthood to health outcomes disaggregated by gender. For ease of presentation, we focus exclusively on results emerging from Model 4 that is the model which includes all controls in the analysis. Also, we only report parameters (odd ratios) which are statistically significant at 5 or 1 per cent levels.

Our results show that for both males and females there is a relationship of adult numeracy skills and self-rated health at age 38. For men, we find that those who have Entry 2 and Entry 3 are 0.06 more likely to report deteriorating health between ages 34 and 38 compared with males who have Level 2 numeracy. For women, however, we only find that those who have Entry 2 are 0.05 more likely to report poorer health between ages 34 and 38 compared with women who have Level 2 numeracy skills.

For health limiting daily life we also find that lack of basic skills are associated with worsening health for both men and women. For women, however, we find that it is both women with Entry 2 literacy and Entry 2 numeracy who are more likely (three times for literacy and twice for numeracy) to have deteriorating health limiting conditions between ages 34 and 38 compared with women with Level 2 in these basic skills. For men, we only find that those with Entry 2 numeracy skills are nearly three times more likely to have

deteriorating health limiting conditions between ages 34 and 38 compared with men with Level 2 numeracy skills.

Finally, we find that lack of literacy skills is associated with greater likelihood of smoking for men. Although our previous results showed that basic skills were not associated with smoking at age 38, once we conditioned out for childhood factors, results indicate that there is a gendered dimension. Men with literacy Entry 3 are 2.3 times more likely to be regular smokers at age 38 than men with Level 2 numeracy skills. For depression, we did not find any statistical association of basic skills for men or women.

Table 8: Association of basic skills and health outcomes by gender. Results from Model 4.

	Self-Rated Health(1)	Health Limiting	Depression	Smoking
Men				
Literacy				E3 vs L2 2.36 (.422)**
Numeracy	E2 vs L2 0.06 (0.071)*** E3 vs L2 0.06 (0.057)***	E2 vs L2 2.96 (.327)***		
Women				
Literacy		E2 vs L2 2.99 (.363)***		
Numeracy	E2 vs L2 0.05 (0.045)**	E2 vs L2 1.81 (.269)**		

Source: BCS70. Notes: (1) Results shown for self-rated health are estimated parameters. For all other outcomes table shows odd ratios. E2 stands for Entry 2; E3 stands for Entry 3; L1 stands for Level 1 and L2 stands for Level 2 (comparison group). Robust standard errors in parenthesis. Asterisks ***, ** indicate statistical significance at 1% (p<.01), and 5% (p<.05) respectively. Table only shows results that are statistically significant.

5. Discussion

This research set out to investigate the contribution of adult basic skills to health outcomes in adulthood. Previous empirical studies established that adult learning is associated with positive changes in health and well-being. Most of these studies, however, focused on learning episodes (either learning leading to qualifications or informal learning) as indicators of adult learning. What was missing was evidence on the contribution of basic skills in particular to health outcomes during adult life. This has been the focus of the report.

In preparing our quantitative research strategy it was important to select a dataset that contains information on adult basic skills and health outcomes in adulthood. In addition, it was important to use a lifecourse analysis. The BCS70 is a unique cohort dataset with the required elements for an analysis of the kind we have undertaken. Not only we have objective indicators for adult literacy and numeracy skills, we also have information about highest qualifications achieved, as well as a wealth of childhood factors known to affect the formation of basic skills and to be relevant to adult health. With these elements in place, we explored the question: is there an association of adult basic skills at age 34 with changes in health outcomes between ages 34 and 38 which are robust to the inclusion of highest qualifications at age 34 and childhood controls?

Interestingly, the answer to this question was positive for some, but not all health outcomes. We found that lack of adult numeracy skills was associated with deteriorating self-rated health for men and women. This result is consistent with Metcalf et al. (2009) who found that after four waves of data collection both learners of basic skills and non-learners (control group) had worse health than they had during the first round of data collection. However, the health disbenefit was lower for learners (12 percentage points change) than for non-learners (27 percentage points). Metcalf, et al. found that this difference was statistically significant. Our results add depth to the results of Metcalf et al. as we differentiate here on gender and type of basic skills. We found that the result holds for male and female cohort members but only for those who had low levels of adult numeracy skills.

We also found consistently that adult literacy and numeracy skills were associated with worsening health limiting conditions. In particular, cohort members with the lowest level of literacy and numeracy skills were more likely to report deteriorating health limiting conditions between the ages of 34 and 38 compared with cohort members with the highest literacy or numeracy skills. A previous review by Vorhaus et al., (2011) on the contribution of adult literacy and numeracy skills to wide set of outcomes found that basic skills was associated with individuals being able to undertake everyday tasks. In Scotland, for example, adults with a good grasp of basic skills had a greater ability to contribute to family life (Tett et al., 2006). For instance out of 378 Scottish learners who answered the question "*how you feel about yourself, more confident, more able to tackle things*" the vast majority, 355 (94%), expected to see either some or a great difference in their personal lives as result of learning (Tett et al., 2006). Therefore, we are consistently finding that adult basic skills are linked to individuals' ability to get on with daily life activities and in the particular case of health, individuals with good basic skills are less likely to report a health limiting condition.

We did not find evidence to support the role of adult basic skills in reducing the risk of depression. We found that the initial association of adult basic skills and risk of depression was controlled for with the inclusion of background childhood factors. This result is consistent with research by Schoon et al., (2010a, 2010b) who showed that poor basic language skills in childhood (at age 5) was associated with poor adult literacy (at age 34) and poor mental wellbeing at age 34. So it is possible that in our case the association of poor adult literacy with high risk of depression was controlled for by the inclusion of literacy test scores in childhood.

Nonetheless, it is interesting that we did not find statistical evidence for the relationship between adult basic skills and risk of depression given that previous studies have found that adult basic skills are strongly associated with improvements in confidence and self-esteem (Vorhaus, et al., 2011). One might expect that, through its impact on these psychosocial factors, adult basic skills may be shown to be linked to better mental health. Although, of course, there is no contradiction in finding that basic skills have a positive impact on improving confidence and self-esteem and no impact on reducing depression.

For health behaviours, as measured by smoking, we find weak evidence that adult basic skills was associated with reduced likelihood of smoking at age 38. We only find that men with Entry 3 literacy skills were more likely to smoke between ages 34 and 38 compared with men with Level 2 literacy. To our knowledge there is limited evidence on the links between adult basic skills and different health behaviours, including routine exercise, smoking, drinking, use of drugs, among others (Vorhaus, et al., 2011).

One question which emerges from our analyses is: why has poor numeracy been detected to be associated with poor health outcomes more than poor literacy has? We discussed two possible explanations. One is distributional. There are more cohort members with Level 2 literacy than there are cohort members with Level 2 numeracy. So, the comparison group for Level 2 literacy is more heterogeneous than the comparison group for Level 2 numeracy. This result implies that it is easier to find differences in numeracy than in literacy. However, at the lower end of the skills distribution, we also find that there are fewer cohort members with low levels of literacy than numeracy, making the group of low literacy skills more selective. This implies that it should be easier to find associations with disadvantage for the group of low literacy. To deal with this possible explanation we estimated all health models interacting low literacy/ numeracy with good literacy/numeracy. Our result showed that low numeracy was driving the statistical significance of our previous results, as found in previous research by Parsons & Bynner (2005c).

A second explanation is about differences in literacy and numeracy as basic skills and their relationship with other forms of disadvantage. We can observe that the gradients of childhood factors with adult basic skills are different for literacy and for numeracy. For instance, 8.8 per cent of cohort members with low numeracy had a father in an unskilled occupation compared with 13.9 per cent of cohort members with low literacy. It is possible, therefore, that lack of basic skills, whether literacy or numeracy, interact not only in complex ways but also in different ways with other forms of disadvantage. Hence, it is the result of the complex but differentiated interaction which may be driving our results.

Furthermore, it is important to highlight that our results are measured at one point in the lifecourse for a particular British cohort born in 1970. As such, any association of basic skills with health functioning is likely to change as the cohort ages. In particular, we expect

health to deteriorate over time and the risk of depression to increase, in particular between the 40s and 50s. We expect potential benefits of adult basic skills on health to be more important as individual's age. And, we would expect that as depression becomes more prevalent for this cohort lack of basic skills may be identified as a potential risk factor.

We acknowledge that our research strategy has several limitations but we have tried to deal with at least some of these as outlined below. First, the sample size becomes smaller as we include additional variables in the analysis. Results presented above are drawn only from samples for whom we have complete information in each of the models. (Hence the sample changes from Model 1 to Model 4 - in particular in Model 4). So, we re-estimated the models first by using dummy variables for all factors with non-responses, and then using only those with complete information in Model 4. Results presented in this report did not change. Secondly, the BCS70 contains a number of other potential factors that can be used as controls in the analysis. For example, when we made use of parental income rather than parental social class as an indicator results did not change. We also used the copying designs test at age 5 (see Osborn et al, 1984) instead of reading and mathematics assessments at age 10 to condition out previous ability, and still results did not change. Of course there may be a number of factors which could be included in the model which may (or may not) affect our results. For example school experiences and school engagement during childhood could affect the child's ability to learn and hence be related to poor basic skills and adult health. But our research strategy was to build a parsimonious model, include some of the most common factors known to affect adult basic skills and adult health, as opposed to all possible indicators in the data.

Thirdly, it would have been desirable to gain deeper knowledge into the relationship between adult highest qualifications and adult basic skills. In doing so, our modeling strategy could have included interactions between basic skills and highest educational qualifications. This is an approach which we hope to pursue in the future. Fourthly, there are limitations in terms of the outcome variables used. For instance, depression as measured at age 38 is not the most robust measure since it was self-reported. Depression was better measured from an overall score captured by the malaise scale, which is available in the BCS70 at age 34 but not at age 38. (Since the age 38 survey was a telephone interview the malaise questionnaire - Rutter et al., 1970 - could not be included). Finally, there are always more complex modeling techniques which could be used to account for unobservable effects. Sometimes there are small gains in precision, but results remain the same in statistical terms. So, we have been careful at all times to present our results using the language of 'association' rather than 'causation'.

Not establishing causality does not mean that our results are not important or should not be taken seriously. The fact that basic skills in adulthood are related to poor health should be seen as a possible area for policy intervention. We are unable to suggest specific interventions, as this research was not intended to answer this question. Nonetheless, our research contains enough evidence to suggest that poor basic skills in adulthood are associated with multiple forms of earlier disadvantage and together these are related with poor health outcomes in adulthood. Therefore, different interventions should consider the acquisition skills in adulthood as an integral part of joined up initiatives to deal with the root causes and indeed the consequences of adult disadvantage.

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