The impact of birth weight and adolescent health on educational attainment

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Abstract

This article examines the relationship between birth weight, adolescent health (general health and psychological distress) and high school completion in Norway, using survey data linked to longitudinal registry data (N=5354). The findings show that the positive association between birth weight and high school completion can be attributed to socioeconomic status. General adolescent health is explained by socioeconomic status combined with risk- and protective behavior. Psychological distress is mediated by having a close relationship with family and friends among the most affluent students, but not among the lower income students. Among the lower income students it was rather absence from school and feeling comfortable in class that mediated the association between psychological distress and high school completion, net of other factors.

Keywords: adolescent health; educational attainment; upper secondary education, social inequality

Introduction

Higher levels of educational attainment tend to be associated with higher positions in the labor

market, better health and better welfare. Previous research has found that poor health at birth, and

mental and physical health during childhood and adolescence has adverse effects on educational

outcomes. Most of the research addressing this relationship is generated in the US (e.g. Janet

Currie, 2008; Gan & Gong, 2007; Taras & Potts-Datema, 2005). A WHO report examined the

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evidence on the effect of health on educational outcomes in high income countries and the authors concluded that there is a need for more European research on this subject (Suhrcke & de Paz Nieves, 2011).

In the Norwegian context, mental health problems have been found to be an important explanation for non-completion of upper secondary school (Markussen & Seland, 2012; Sagatun, Heyerdahl, Wentzel-Larsen, & Lien, 2014). However the association between a wider range of health measures and educational attainment has not been adequately analyzed using quantitative data sources and multivariate analyses in Norway. It would seem, therefore, that further investigations are needed in order to produce more knowledge about the relationship between health and educational attainment in this national context.

The aim of the present article is to examine the relationship between infant health, adolescent health and high school completion. In particular, we examine the ways health and social background act together to create differences in educational attainment, using a questionnaire on health, which is linked to register data providing detailed information on educational attainment over time, and the Medical Birth Registry of Norway which gives information on health at birth.

The following three research questions will be pursued: 1) To what extent is infant health, and general and mental health in 10th grade associated with high school completion? 2) To what extent is the relationship between health in childhood/adolescence and high school completion mediated by parental resources, adolescent risk behavior, and/or educational aspirations, choices and performance? 3) Do the mediating factors predicting high school completion vary across socioeconomic groups?

This study provides new knowledge on important aspects of educational disparities, particularly the interplay between health, socioeconomic status and educational outcomes. The

innovative aspect of this article is that we have information on both the individuals' infant health and adolescent health, and detailed information on later educational attainment. We will be able to shed light on how health at birth and in adolescence are similarly or differently related to other important predictor variables for educational outcomes as well as the educational outcomes themselves.

Previous research

A growing body of research has shown a strong connection between early-life health and future outcomes. Much of this research has focused on birth weight as a measure of early child health. Unobserved factors, such as early childhood experience or genetic endowments may influence both health and socioeconomic status, and thus makes it very difficult to establish a causal relationship (Case, Fertig, & Paxson, 2005). To control for unobserved factors in the family, many studies use sibling comparisons to better assess the relationship between low birth weight and future outcomes, such as educational outcomes and labor market prospects (see e.g. Black, Devereux, & Salvanes, 2005; Conley & Bennett, 2000; J. Currie & Moretti, 2007; Johnson & Schoeni, 2007). The overall finding from these studies is that low birth weight babies have lower educational attainment, poorer test scores and worse labor market outcomes later in life compared to normal weight babies.

Health at birth might be a significant predictor of future outcomes because it predicts future health. Janet Currie, Stabile, Manivong, and Roos (2010) use family fixed effects models on Canadian data and show that physical health problems in early childhood are associated with poorer outcomes later in life because they predict health later in life. However, the study shows that

childhood asthma and serious early health problems that are short lived have little impact on future educational outcomes. Case et al. (2005) find similar results in the US, examining the effect of health at birth and childhood health on adult health, employment and socioeconomic status. Children with poor health have significantly lower educational attainment, poorer health, and lower social status as adults even after controlling for socioeconomic background. Using the National Longitudinal Survey of Youth 1997 Haas and Fosse (2008) and Jackson (2009) find that poor self-rated health in adolescence predicts lower educational attainment. One recent study uses a national sample of U.S children aged 5 to 14 (Le, Diez Roux, & Morgenstern, 2013). The result from their sibling fixed effects model shows that poorer general health status over a ten year period was associated with fewer years of schooling.

Norwegian research shows that individuals with health problems (measured by basic benefits and attendance benefits paid to parents) in childhood do not achieve education, employment and income in line with their potential (Gravseth & Kristensen, 2008). Using survey data from the 10th grade coupled with registry data, a recent Norwegian study found that externalizing problems (conduct problems and hyperactivity-inattention) impair completion of upper secondary school, and that the relationship is to a large extent mediated by the students' grades (Sagatun et al., 2014). Another recent study finds that a number of adolescent health problems are associated with high school dropout after controlling for parental socioeconomic status. Moreover, the study shows that, within families, siblings with poor health are less likely to complete high school compared to healthy siblings (De Ridder, Pape, Johnsen, Holmen, Westin, & Bjørngaard, 2013).

A comprehensive in-depth study of upper secondary school leavers in one Norwegian county found that mental health problems was the single most important reason for leaving mentioned by the student or the school (21 percent). Physical illness ranked below choosing the wrong study

program or being tired of school, but was still high on the list, especially among the girls (11 percent) (Markussen & Seland, 2012). However, this study was unable to investigate the association between different factors, such as socioeconomic status, health problems, academic performance and dropout.

Several studies have found a link between mental health problems and educational outcomes. For example, Fletcher (2010) uses data from the US and found that internalizing problems such as depressive symptoms was negatively associated with years of schooling. Using a sibling fixed effects model the study showed that depressive symptoms were mainly associated with dropping out of school, but in addition it had some impact on the probability of college attendance. Eisenberg, Golberstein, and Hunt (2009) also found that depression in adolescence predicts poorer grades and higher probability of dropping out of college using a random sample of college students in the US. Externalizing problems (Currie & Stabile, 2006) are also associated with lower educational achievement. In fact, of mental health problems externalizing problems are found to have the largest impact on educational outcomes (Goodmann & Currie, 2010; Sagatun et al., 2014).

Educational outcomes may also be affected by health related behavior in adolescence, such as smoking and physical exercise. Smoking and lack of exercise during adolescence may lower the probability of obtaining a high school degree by directly affecting performance, or they may be associated with lower attainment due to underlying differences in unobserved heterogeneity. In other words that the types of adolescents engaging in unhealthy behavior more than others are also the types of students that are less likely to complete high school in a timely fashion.

The relationship between smoking and educational outcomes is not fully understood. Clinical studies have documented negative impact of nicotine on the development of the brain and cognitive abilities of adolescent smokers (see Jacobsen et al., 2005). In line with this Ding, Lehrer,

Rosenquist, and Audrain-McGovern (2006) use genetic markers and show that smokers have lower GPA-scores than non-smokers. However, Norton and Han (2008) used genetic information as an instrument variable and found that the negative effect of smoking on educational attainment disappear after controlling for endogeneity; indicating that there is no causal relationship between smoking and educational attainment. Comparable results are found in Zhao & Glewwe et al. (2010).

Previous research has also found that physical exercise has a positive impact on educational attainment (e.g. Howie & Pate, 2012; Bach, 2011). The causal pathways linking physical exercise to educational attainment have been found to go through cognition and absenteeism. However the strongest evidence of a causal relationship is found through cognition (Basch, 2011). Ploughman (2008) present a summary of how exercise may influence executive functioning (a set of mental skills) affecting the brain, memory and ability to learn. Executive functioning operate as a mediator in the relation between physical exercise and educational attainment (Basch, 2011). Moreover, research has found that physical activity in school increase attendance in school by decreasing obesity, which has been related to absenteeism (Geier et al., 2007). Physical activity in school may also increase connectedness, and have a positive impact on adolescent health (Basch, 2011).

According to previous research friendships are important for adolescents' social well-being, academic motivation and academic outcomes (Ryan, 2001; Wentzel et al., 2004; Patacchini, Rainone, & Zenou, 2011). However, the relationship between friendships and academic outcomes is not entirely clear. Jones et al., (2011) examine how perceptions of friends' social and academic behaviors influence academic outcomes. The study shows that the perceptions of friends' academic behavior (e.g. how important it is to them to get good grades) are linked to academic performance, but only when perceptions support the respondent's self-concept. However, the perceptions of the

friends' social behavior (e.g. how important it is to them to be popular) were negatively linked to academic outcomes. Along the same lines, Dyer (2010) shows that relationships with friends that were oriented towards learning are positively related with academic outcomes, while relationships with deviant friends impair academic outcomes. A recent Norwegian study found that spending time with friends can have a detrimental effect on students' academic choices (Heggebø, 2014).

The association between health and educational attainment may vary across socioeconomic and/or ethnic groups. The literature has documented that parental investment is crucial for children's educational attainment (e.g. Blau & Duncan, 1967). Yet, only a few studies have examined possible interaction effects between early childhood health and socioeconomic status. The strength and nature of the relationship between early childhood health and educational outcomes may vary with parental socioeconomic status (SES). Curry and Hyson (1999) use data from the 1958 British birth cohort study and show that low birth weight has a particularly negative impact on educational attainment among boys with low SES. Moreover, the study shows that low birth weight girls with high SES are less likely to report poor health later in life compared to low birth weight girls with low SES. Johnson and Schoeni (2007) examine the long term effect of poor health at birth using nationally representative data from the US. In models with sibling fixed effects. Johnson and Schoeni (2007) find that the negative impact of low birth weight on educational attainment is more pronounced among children who grew up in families were the parents did not have health insurance. Jackson (2009) used data from the National Longitudinal Survey of youth 1997 and also found that the association between adolescent health and educational attainment differs across groups. However, she found that the reduction in attainment is particularly large for non-Hispanic White adolescents compared to Black or Hispanic youth. This result indicates that

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the negative effect of poor health is not only limited to the most disadvantaged adolescents. It is not clear whether these findings from the US and the UK are applicable to the Norwegian context.

Theoretical framework

There are a number of explanations for why poor health in childhood and adolescence is associated with lower educational achievement and attainment, and several reasons why this relationship is expected to differ among students from high and low SES households. We will first give a brief outline of which mechanisms may drive the relationship between health and educational outcomes, and then examine possible interrelations between poor health and socioeconomic background.

How can early- life health influence educational outcomes?

Health can influence education not only directly but also through several mediating factors. First, poor health at a young age can have adverse effects on the development of a child's cognitive abilities (Guo & Harris, 2000; Jason, Powers, Padilla, & Hummer, 2002). However, the pathways from reduced cognitive development to lower educational success depend on type of health problems. Reduced cognitive development may be a direct result of sensory impairment or neurological impairment. Other types of health conditions, including premature birth and chronic illness, may affect the interaction between child and care giver, resulting in less positive nurturing with consequences for the child's cognitive development (Haas & Fosse, 2008).

Secondly, children with poor health might have more absent days from school compared to their healthy peers. Therefore, they miss schoolwork and learning and might fall behind academically. Educational participation and performance has been found to be important for understanding the link between early childhood health and academic attainment (Fowler, Johnson,

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& Atkinson, 1985; Haas & Fosse, 2008; Jackson, 2009). It might also be that health disadvantaged youth develops reduced aspirations for their future educational career, due to their health conditions (Stevens, Steele, Jutai, Kalnins, Bortolussi, & Biggar, 1996). However, Jackson (2009) found that educational expectations did not explain why adolescents with poorer health have lower educational attainment.

Third, children with health problems might also have limited opportunities to play sports and other social activities, which in turn might reduce interaction with other children and limit the opportunity to build strong relationships (Haas & Fosse, 2008). Health problems and physical disability may also lead to stigma and discrimination. This can adversely affect self-esteem and lead to social isolation and weak attachment to school.

Why would we expect poor health to have differential effects on low and high SES households?
Certain forms of poor health are correlated with disadvantaged socioeconomic background. Children born to lower educated parents are more likely to have low birth weight and are more often born prematurely (Dahl, Bergsli, & van der Wel, 2014). This may have to do with the mother's nutrition, stress and other health related behaviors during pregnancy, such as smoking (Härkönen, Kaymakçalan, Mäki, & Taanila, 2012). Moreover, studies show that certain chronic conditions such as asthma, allergies and eczema (Grøholt, Stigum, Nordhagen, & Köhler, 2001) and recurrent pain such as headaches, abdominal pain and back pain (Grøholt, Stigum, Nordhagen, & Köhler, 2003) are more prevalent among children in low income and/or low educated households. These differences are partly related to differential exposure to unhealthy surroundings. Children from lower educated and lower income families are more often exposed to negative environmental factors such as dust, smell, noise and other pollution (Dahl et al., 2014, p. 112).

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Moreover, research from the United States indicates that poor children are less likely than richer children to manage their asthma properly, which makes having asthma more detrimental for these children (Currie, 2009, p. 92). Children from lower SES backgrounds are also less likely to take part in organized leisure activities, which is associated with lower likelihood of engaging in risk behavior and healthier adjustment later in life (Samdal, Bye, Torsheim, & Fismen, 2012).

There is also a well-established association between socioeconomic status and educational outcomes (Boudon, 1974; Bourdieu & Passeron, 1977; Breen & Goldthorpe, 1997; Shavit & Blossfeld, 1993). It is possible that the association between health status in childhood and adolescence and educational outcomes appears due to inadequate controls for socioeconomic status, and that it is not poor health in itself, but rather socioeconomic status that makes a difference. However, it is also possible that socioeconomic status has an effect on educational outcomes *through* poor health. This is sometimes referred to as the "double jeopardy" effect (Jackson, 2009). Living in a family with limited resources may affect child development and stress (Schilling, Aseltine, & Gore, 2008), which in turn may have consequences for educational achievement and attainment (Fergusson & Woodward, 2002). Moreover, advantaged families can pay for facilities and assistance that make everyday life easier for health disadvantaged children, so that they are more able to focus on school.

In this article we ask if there is a variation by socioeconomic background in the link between health and educational outcomes in Norway. Specifically we investigate to what extent parental income interact with general health and/or mental health in predicting completion of upper secondary school by age 21.

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Data and methods

Sample

In this study we use information from several data sources: The longitudinal databases NUBD and FD-trygd and the Medical Birth Registry of Norway linked to a cross-section questionnaire surveys on health: The Oslo health Study 2000-2001 (UNGHUBRO). In 2000-2001 the survey was administered to all 10th graders in Oslo, most of whom were 15-16 years old (N=5354). Other counties have been included in the survey later, but some relevant questions were only asked in Oslo. For this reason we use only the Oslo sample in this article.

Dependent variable

One dependent variable was used. The variable *high school completion* distinguishes between two different outcomes: 1) completed upper secondary education by age 21, 0) not completed upper secondary education by age 21.

Independent variables

The independent variables are taken from UNGHUBRO and the various sources of register data. In the following, we describe the variables and which source they are taken from. The following variables are taken from the UNGHUBRO survey: The participant's general health status (self-reported) in adolescence is coded as 1) poor/not very good 2) good 3) very good. The survey also contains a battery of questions related to psychological distress in adolescence. These are 1) fear (suddenly feeling panicky for no reason), 2) suddenly feeling frightened or anxious, 3) feeling faint or dizzy, 4) feeling tense or harassed, 5) self-critical (easily finding fault with oneself), 6)

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sleeplessness, 7) feeling depressed, dejected, 8) feeling useless, of little worth, 9) feeling that everything is a burden and 10) feeling hopeless about the future. Psychological distress was measured by combining these 10 items into the SCL-10 scale score – a validated 10 item short version of the original SCL-90 (Hopkins Symptom Checklist) (Dalgard, Thapa, Hauff, McCubbin, & Syed, 2006).

A self-report measure of health may have disadvantages, because it reflects the respondents' perceived health, not their actual health status. This means that two respondents with similar health problems may rate their health differently. However, previous research indicates that self-reported health is a valid measure of a range of physical and psychological dimensions of adolescent well-being (Fosse & Haas, 2009). In other words, if a respondent with some medical condition does not perceive it as a problem or an obstacle, she may rate her health as very good, whereas medical records or other data sources would indicate that her health is below par. For the purpose of this study how the respondents themselves see their health is a relevant measure because we are interested in the effect of experiencing health related challenges in adolescence on later life educational outcomes.

The survey also contains information on health related behavior. Smoking habits were coded: 0) non-smokers 1) previous smokers or occasional smokers and 2) regular smokers. Physical activity was measured by asking: "Out of school hours: How many times per week do you take part in sport/do physical exercise to the extent that you feel out of breath or sweat?"

Relationship to family was measured by asking: "when you think about your family, would you say that: I feel attached to my family". Relationship to friends was derived from the statement: "I feel closely attached to my friends". Answers were coded into two categories: 1) completely agree, 0) otherwise.

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Future educational expectations are derived from the question "What is the highest education you have considered?" Answers were coded into two categories: 0) upper secondary school and lower and 1) higher education. Days absent from school due to pain was derived by first asking a question if the respondent in the course of the last 12 months has been troubled several times by pain and the respondents were then asked if this pain caused them to stay home from school. The variable ranges from 0 to 10 days and more. Persons who report no pain were coded as 0. Whether the respondent feels comfortable in class was measured by asking: "How do you find it at school? I feel comfortable in class" Answers were coded into two categories: 0) completely/partly disagree and 1) partly/completely agree.

From the registry data administered by Statistics Norway, we obtained the following variables: *immigrant status[i]:* non-Western second-generation immigrants, Western second-generation immigrants, native origin; gender, *study program:* academic or vocational track; combined grades in 10th grade in the 11 main school subjects (divided by 10 and centered around its mean); whether parents live together/are married and socioeconomic status (SES). SES is measured by separate variables for parental education, income and wealth. Parental education is the education level of the parent with the highest education or of the only parent who is present. Parental education is divided into four levels: compulsory school or less, upper secondary school, bachelor's level and master's level or above. The parental income and wealth variables are measured as both parents' combined mean incomes/gross worth during the years that the persons in the sample were 7–16 years of age. Income includes salary, income from self-employment and some state support benefits, such as unemployment benefits, sickness benefits and maternity benefits. Wealth includes taxable assets and financial capital. Parents' income and parents' wealth are originally recorded in Norwegian currency (NOK). In the analyses we use the natural logarithm (to the base e), of parental income and wealth.

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These variables are also centered on their mean. Birth weight is taken from the Medical Birth Registry of Norway and is entered into the models as the natural logarithm (to the base e), of birth weight. The logarithmic transformations are used in order to facilitate comparisons with previous research, easier interpretation (percentage change) and better model fit due to a more normal distribution of otherwise positively skewed distributions.

Statistical methods

When the outcome variable is a binary variable, logistic regression is often used. However, the coefficients in logistic regression not only reflect the effect of the independent variables but also the size of the unobserved heterogeneity; therefore, it is problematic to compare coefficients across samples (Mood, 2010). For that reason, we compute linear probability models (LPM), i.e. linear regressions on a binary variable with robust standard errors. LPM gives results in terms of change in probability. One advantage of LPM is that the effects of the health measure on educational outcomes can easily be compared across models and between different socioeconomic groups. In addition to LPM, we have computed a logistic regression model (not shown).[ii] The estimates from the LPM and the logistic regression returned very similar results, and thus led to the same conclusions.

In the dataset we have some missing values (between 6 and 185 cases out of 5354). Excluding missing cases or including the missing cases as a separate category can lead to biased estimates. Therefore, we have run multiple imputations using the mi impute chained command in Stata 13 and the results are based on 5 imputed datasets. The procedure replaces each missing value with a set of plausible values based on all other variables in the dataset. For further description, see White, Royston, and Wood (2011).

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Results

Descriptives

Table 1 lists the means and proportions for the complete sample, as well as by low and high parental income, divided at the median. Significant differences between the two income groups are indicated within the 95% confidence interval. First of all, the table shows a significant difference between the groups in graduation rates. Second, both birth weight and general health vary significantly across the two groups, with higher birth weight and better self-reported health among the more affluent students. The psychological distress measure, however, is similar across the two groups. The more affluent students also engage in more health promoting behavior and less risk behavior. Students in this group also report higher academic aspirations, are more likely to start the academic high school track and have higher grades in 10th grade (Table 1)[iii].

High school completion

Table 2 presents the regression results for high school completion. We present results from six nested models. First, model 0 is composed of separate analyses for each of the three health measures. Each analysis includes immigrant background, gender and survey year and separately estimates the association between high school completion and birth weight, adolescent general health and psychological distress in adolescence net of the basic demographic variables in the sample. This is because we are interested in the impact of health on educational outcomes controlled for the demographic variables. This can be interpreted as the baseline association between each of the three health variables and high school completion. The result shows that an increase in birth weight of 100 percent increases the probability of high school completion by

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approximately 7 percentage points. Moreover, good general health in adolescence is associated with higher probability of completing high school. Youth who report experiencing "very good health" have 17 percentage point higher probability of completing high school compared to youth who report experiencing poor health. The corresponding number for those who report experiencing "good health" is 10 percentage points. Moreover, the probability of completing high school decreases with increasing psychological distress. An increase of one unit on the 4-point scale represents a decrease by 10 percentage points in the probability of graduating by age 21.

Model 1 simultaneously includes immigrant background, gender, birth weight[iv], general health and psychological distress in adolescence, in addition to survey year. When all the three health variables are included in the same model the relationships between birth weight, general health and psychological distress and high school completion remain significant. The birth weight coefficient was relatively similar in model 1 and model 0, while the coefficients of psychological distress and general health in adolescence were weaker in model 1 compared to model 0. Non-Western immigrant youth on average have 15 percentage points lower probability of completing high school compared to majority youth, net of gender and health status. The corresponding number for the Western immigrant youth was 5 percentage points. In addition, girls are 13 percentage points more likely to complete high school than boys, net of immigrant background and health status.

The inclusion of socioeconomic status (SES) variables in model 2 reduces the impact of adolescent health on high school completion, but still we find a sizeable and significant impact of general adolescent health on high school completion. The negative association between psychological distress in adolescence and high school completion is still significant and is

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comparable in size to the one we saw in model 1. Birth weight ceases to have a significant impact on school completion with the inclusion of SES in model 2.

In model 2 we see that those who have parents with the highest educational level have 25 percentage points higher probability of completing high school than those who have parents with a primary education or less. There is a significant positive association between parental income and parental wealth on youth's probability of completing high school. An increase in parental wealth of 100 percent from the mean increases the probability of high school completion by approximately 5 percentage points. The corresponding number for parental income is 3 percentage points. Finally, in this model students whose parents live together have 8 percentage points higher probability of completing high school compared to students whose parents live apart.

Model 3 introduces the health related behavior variables such as smoking and physical activity, as well as feeling close to family and friends. The variables were introduced in the same model since we know from previous research that social relationship and social ties (friends and relatives) affect health behavior. The results in the present study reveal a negative, significant and strong relationship between smoking and high school completion. Students who smoke every day have 23 percentage points lower probability of completing high school compared to non-smokers. Moreover, we find that engaging in physical activity is positively associated with high school completion, net of the other variables in the model. Those who report having a good family relationship have 5 percentage points higher probability of completing high school compared to those who report that they do not have a good family relationship. Feeling close with friends does not have any significant impact in probability of completing high school in this model.

After introducing the health related behavior variables and relationship with friends and family, we no longer find any significant association between adolescent general health and high

school completion. The negative association between psychological distress and school completion is weaker in model 3 than in model 2, but is still significant.

Model 4 adds school related variables such as study track, future educational aspirations and grades in 10th grade. After the inclusion of school related variables the negative association between psychological distress in adolescence and school completion remains significant and comparable to the estimate in model 3. Students in the academic track have 11 percentage points higher probability of completing high school compared to students in the vocational track. No significant interactions were found between the health variables and study track (results not shown here). Furthermore, youth who plan to attend higher education are somewhat more likely to complete high school compared with youth who do not plan to attend higher education. Finally, as expected, we find a positive and significant relationship between grades and high school completion.

Model 5 adds the variables days absent from school due to pain and feeling comfortable in class, measured in 10th grade. The results reveal a negative and significant relationship between days absent from school due to pain and high school completion. Moreover, youth who feel comfortable in their class have 5 percentage points higher probability of completing high school compared to youth who do not report feeling comfortable in class, net of gender, immigrant status, health status, socioeconomic background and health behavior. Absence due to pain is a measure of school attendance, but in addition the variable also reflects adolescent health status. This means that on the one hand it is a clean measure of absence as it relates to health, but on the other hand it possibly incorporates health effects that otherwise would have been picked up by the other health measures in the model. After introducing absence due to pain and feeling comfortable in class, we

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no longer find any significant association between psychological distress and high school completion.

High school completion in high and low income families

To investigate possible heterogeneity of effects, we ran the same analyses of high school completion for high and low income families separately. Results from the full model are presented in table 2, models 6 and 7. The models include the same battery of controls as in model 5.

As in model 5 for the full sample, the three health variables do not significantly predict graduation net of the other variables in the model. This applies for students from both low and high income families. However, the analysis reveals that the effect of family and school related variables on school completion differ by family income. It is particularly interesting that different sets of variables seem to mediate the relationship between psychological distress and high school completion in the two income groups. Youth in high income families are more likely to complete high school if they have a good relationship to their families and if they do not report feeling close with their friends, net of other factors. When these variables are entered into the model, the effect of psychological distress becomes insignificant for this group (not shown here). In the full model, good family relationship increases the probability of completing high school with 7 percentage points and feeling close to friends reduces the probability with 3 percentage points for students from high income families. For students from low income families these variables are not significantly associated with high school completion, net of other factors.

The analysis also shows that feeling comfortable in class in 10th grade is positively associated with high school graduation by age 21 for low income youth, net of other factors. Low income youth who report feeling comfortable in class have 8 percentage points higher probability

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of completing high school by age 21 compared to low income youth who did not. We also find a negative relationship between days absent from school due to pain and high school completion for youth from low income families. For students from high income families we do not find a significant relationship for either of these variables. It is only when these two variables are entered into the model that the effect of psychological distress becomes statistically insignificant for students from low income families (not shown here).

Finally, the analysis demonstrates that the positive relationships between grades in 10th grade and having enrolled in an academic study program, and high school completion, are stronger for students from low income families than for students from high income families. This implies that good grades and choice of educational track are more important for students from low income families than for students with high income parents in predicting high school completion.

Discussion and conclusion

The aim of this article has been to shed light on the relationship between various health variables in childhood and adolescence and later educational attainment. We also wanted to analyze how other relevant explanatory factors relate to the different health measures, and to see whether the associations differ across socioeconomic groups. In the present study we have used register data to measure infant health combined with survey data containing self-reported measures on adolescent health, as well as longitudinal register data for information about socioeconomic background and educational outcomes.

The descriptive statistics indicated that whereas birth weight and general adolescent health varied significantly for low- and high income students, the measure of psychological distress was similarly distributed in the two groups. The findings from the multivariate analysis provided five

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main insights. First, the association between birth weight and socioeconomic status seem to explain the relationship between birth weight and high school completion in our sample. The estimate for birth weight did not decrease when controlling for health status in adolescence. Theoretically, this means that the negative association between low birth weight and high school completion does not operate through its hypothetical effect on adolescent health. Instead it indicates that lower birth weight in itself is not detrimental for later school completion, but rather that students from lower socioeconomic backgrounds are at higher risk of both being born with lower birth weight and dropping out of school.

Second, the same is not the case for our general adolescent health measure. When we compare students net of gender, immigrant background, birth weight, psychological distress and socioeconomic background, who also have similar smoking and exercise habits and relationships with family and friends, we find that reporting poor rather than better general health in 10th grade is not significantly associated with later high school completion. We knew from the descriptive statistics that there is a significant association between reporting poor or very good general health and socioeconomic background. However, our analysis showed that socioeconomic background alone does not account for the association between adolescent health and high school completion, but seems to do so in combination with health related behavior that also varies on average between high and low income students. We interpret this as indicating that how a student's general health status affects his or her future educational outcomes depend on their behavior, i.e. whether they have close relations with their family members and to what extent they engage in health promoting behavior, all else being equal. The estimate for "feeling close to friends" only becomes significantly negative when we control for grades, study track and highest education considered. We take these variables as indicating a combination of achievement, choice and motivation. Previous research

has found that the impact of friendships on educational attainment depends on the "quality" of the peers in question. We have not been able to control for the academic standing of the respondents' friends, but our results indicate that once we control for the respondents' academic achievement, choice and motivation, (close) friendships seem to be detrimental to educational attainment, albeit weakly. We speculate that the question "feeling close to friends" partly captures an orientation toward adolescent social behavior that may take focus away from school, such as hanging out, going to parties, pursuing romantic relationships etc. (cf. Jones et al., 2011).

Third, the strongest and most persistent health measure in our analysis was psychological distress, measured as a combination of 10 items including questions regarding depression, anxiety, hopelessness and low self-esteem. This confirms Markussen and Seland's (2012) qualitative study, which found that psychological problems were one of the main reasons reported for dropping out of high school. Contrary to what one might expect, the association between psychological distress in 10th grade and high school completion at age 21 did not seem to operate through academic achievement, choices and aspiration, as measured by grades, study track and highest education considered. The negative estimate for psychological distress was not reduced when including these variables in the model. The measure became insignificant only when including absence due to pain and feeling comfortable in class, in addition to all the other variables in the model. The measure of psychological distress we have used in this article is dominated by internalizing problems, such as depression and anxiety. Our results indicate two possible scenarios. One scenario is that these problems affect long term graduation prospects by affecting the students' ability to attend class and their ability to feel at ease when they are at school. Alternatively, students who are frequently absent due to pain and/or feel uncomfortable in class may experience psychological distress as a result. Our analyses are not able to shed light on the direction of this effect, but either way we can

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conclude that the association between psychological distress and absence due to pain and feeling comfortable in class affects students' graduation prospects in the long run.

Fourth, when dividing the sample into students from high and low income families, we found no clear difference in the net effect of birth weight or general adolescent health on high school completion across the two groups. Moreover, when controlling for all the other variables there was no significant association between psychological distress and high school completion in either of the groups. In other words, the control variables in our analysis explain away the association between psychological distress and high school completion for both high and low income students.

Finally, however, we found that the association between psychological distress and high school completion seems to be mediated by different sets of control variables in the two student populations. Whereas psychological distress seems to be mediated by having a close relationship with family and friends among the most affluent students, this was not the case for the lower income students. Among the lower income students it was rather absence from school due to pain and feeling comfortable in class that seemed to mediate the association between psychological distress and high school completion.

Feeling comfortable in class may have a stronger effect on students from low income families because it is less common, and therefore a selective trait. According to widely cited theorists such as Bourdieu (Bourdieu & Passeron, 1977), schools are sites of middle class culture, where students from lower educated and lower income families may feel alienated. Among low income students who experience psychological distress, feeling comfortable in class would therefore be particularly encouraging for future educational success.

Moreover, the findings that feeling close to family is positively associated with graduation among the wealthier students, and that this factor seems to mediate the relationship between

psychological distress and high school completion for these students, support the assumption that higher income families are better equipped to provide the kind of support that is positive for educational achievement. Feeling close to friends on the other hand is negatively associated with later high school completion for these students, net of other factors. If in fact feeling close to friends captures an orientation toward disadvantageous adolescent social behavior that takes focus away from school, it aligns well with recent studies from Norway, which found that spending more time with friends in adolescence can be detrimental for academic choices (Heggebø, 2014). Our finding adds to previous research on the topic by indicating that this negative relationship only occurs for those students who already have high chances of academic success.

Conversely, absence due to pain does not seem to be detrimental to higher income students. The variable absence due to pain does not only capture absences, but partly also adolescent health status (pain). The finding indicates that poor health status measured as absence due to pain might be less detrimental in the long run for the more affluent students. One interpretation of this is that these students' home environments compensate for the loss of school time, such that their absence does not adversely affect their graduation prospects. Moreover, taking into account the high correlation between parental socioeconomic status and high school completion, lower income students who lose out on school work may be doubly disadvantaged due to their generally lower graduation probabilities and their lack of resources in the home to compensate for their time away from school.

To conclude, our findings suggest that socioeconomic status plays a major role in the relationship between infant health and general adolescent health, and later educational outcomes. This is not the case to the same extent for psychological distress. Socioeconomic background in itself does not explain much of the relationship between psychological distress and high school

completion. At the same time, the factors that mediate the relationship between psychological distress and high school completion vary across socioeconomic groups. While students from high income families are more strongly affected by their relationship with family and peers, students from low income families are more affected by school absences due to pain and classroom dynamics (i.e. feeling comfortable in their class).

It seems, then, that the relationship between psychological distress and high school completion can be alleviated by different measures for high and low income students. Our findings indicate that school related efforts, especially close follow-up of students that are absent as well as inclusionary efforts in the classroom, may be particularly helpful for students from low income households that are struggling with psychological distress.

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Table 1, Descriptive statistics for full sample, low income and high income students (divided at median parental income), imputed sample.

	Total sample	Low income	High income	
	Means/ proportions	Means/ proportions	Means/ proportions	Sig diff L vs. H
HS completion by age 21	0.76	0.65	0.87	*
Survey year	2000.53	2000.53	2000.53	
Female	0.50	0.50	0.50	
Norwegian	0.76	0.64	0.88	*
Non-Western	0.16	0.27	0.04	*
Western	0.09	0.09	0.08	
Birth weight (in 500g)	6.94	6.83	7.05	*
Poor health	0.11	0.13	0.10	*
Good health	0.56	0.56	0.55	
Very good health	0.33	0.31	0.35	*
Psychological distress (SCL10)	1.46	1.48	1.45	
Parents have less than HS	0.11	0.21	0.01	*
Parents have high school	0.32	0.43	0.22	*
Parents have undergraduate education	0.34	0.26	0.41	*
Parents have graduate education	0.23	0.09	0.36	*
Parental wealth	0.15	-458.88	459.18	*
Parental income	0.00	-230.28	230.28	*
Parents married/cohabiting	0.67	0.60	0.74	*
Physical exercise	3.25	3.12	3.38	*
Never smoked	0.60	0.58	0.62	*
Quit or smokes sometimes	0.26	0.25	0.26	
Smokes every day	0.14	0.17	0.12	*
Feel close to friends	0.68	0.65	0.72	*
Feel close to family	0.74	0.72	0.76	*
Highest education considered	0.54	0.45	0.63	*
Academic study program	0.73	0.64	0.83	*
Grades in 10th grade	-0.01	-0.24	0.22	*
Absence due to pain	1.67	1.69	1.65	
Well-being in class	0.93	0.92	0.93	
N	5354	2677	2677	

* Significant difference between high and low income students within a 95% confidence interval.

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Table 2, nested LPM-models predicting high school graduation by age 21, full sample (models 0-5) and among high and low income students (models 6-7), standard errors in brackets.

	Full sample						High income	Low income
	Model 0	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**
Survey year	Yes	-0.007 (0.014)	-0.003 (0.011)	-0.004 (0.011)	-0.002 (0.010)	-0.002 (0.009)	-0.003 (0.012)	-0.001 (0.016)
Female	Yes	0.131 *** (0.012)	0.119*** (0.011)	0.125*** (0.011)	0.072*** (0.011)	0.076*** (0.011)	0.047*** (0.013)	0.111*** (0.018)
Non-Western	Yes	-0.145*** (0.018)	-0.025 (0.019)	-0.033 (0.019)	-0.038* (0.017)	-0.039* (0.017)	-0.046 (0.034)	-0.027 (0.020)
Western	Yes	-0.049* (0.021)	-0.063** (0.020)	-0.058*** (0.020)	-0.064*** (0.018)	-0.064*** (0.018)	-0.037 (0.023)	-0.089** (0.028)
Birth weight (log)	0.069* (0.033)	0.077* (0.033)	0.012 (0.031)	0.017 (0.034)	0.005 (0.029)	0.008 (0.029)	0.009 (0.034)	0.000 (0.046)
Good health	0.097*** (0.020)	0.07*** (0.020)	0.049* (0.019)	0.016 (0.019)	-0.01 (0.018)	-0.015 (0.018)	-0.011 (0.024)	-0.018 (0.026)
Very good health	0.165*** (0.021)	0.126*** (0.022)	0.09*** (0.020)	0.027 (0.021)	-0.007 (0.019)	-0.016 0.019)	0.006 (0.025)	-0.035 (0.030)
Psychological distress (SCL10)	-0.102*** (0.013)	-0.079*** (0.013)	-0.064*** (0.013)	-0.027* (0.013)	-0.032* (0.012)	-0.019 (0.013)	-0.014 (0.016)	-0.028 (0.019)
Parents have high school			0.098*** (0.024)	0.09*** (0.023)	0.058** (0.022)	0.058** (0.022)	0.058 (0.070)	0.046 (0.024)
Parents have undergraduate education			0.202*** (0.024)	0.186*** (0.024)	0.09*** (0.023)	0.092*** (0.023)	0.089 (0.069)	0.063* (0.027)
Parents have graduate education			0.253*** (0.025)	0.236*** (0.002)	0.098*** (0.024)	0.099*** (0.024)	0.096 (0.007)	0.093** (0.033)
Parental wealth (log)			0.045*** (0.005)	0.044*** (0.005)	0.031*** (0.004)	0.031*** (0.004)	0.027*** (0.070)	0.028*** (0.006)
Parental income (log)			0.018*** (0.004)	0.018*** (0.004)	0.014*** (0.003)	0.014*** (0.003)	-0.012 (0.007)	0.012** (0.003)
Parents married/cohabiting			0.084*** (0.012)	0.059*** (0.012)	0.043*** (0.011)	0.042*** (0.011)	0.041** (0.018)	0.032 (0.017)
Physical exercise				0.012** (0.004)	0.004 (0.012)	0.005 (0.012)	0.002 (0.015)	0.011 (0.020)
Quit or smokes sometimes				-0.082*** (0.012)	-0.05*** (0.011)	-0.048*** (0.018)	-0.024 (0.015)	-0.077*** (0.026)
Smokes every day				-0.234*** (0.019)	-0.151*** (0.012)	-0.145*** (0.004)	-0.106*** (0.014)	-0.174*** (0.006)
Feel close to friends				-0.018 (0.012)	-0.024* (0.011)	-0.025* (0.011)	-0.033* (0.027)	-0.017 (0.017)
Feel close to family				0.056*** (0.013)	0.047*** (0.012)	0.047*** (0.012)	0.074*** (0.005)	0.023 (0.019)
Highest education considered					0.021 (0.011)	0.022 (0.012)	0.023 (0.013)	0.022 (0.019)
General academic study program					0.105***	0.104***	0.072***	0.117

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					(0.016)	(0.016)	(0.016)	(0.021)
Grades in 10th grade					0.138*** (0.008)	0.135*** (0.009)	0.113*** (0.011)	0.150*** (0.013)
Absence due to pain						-0.013** (0.004)	-0.004 (0.005)	-0.022*** (0.006)
Comfortable in class						0.045*	-0.004 (0.029)	0.08* (0.031)
Constant	-	0.136 (0.276)	0.433 (0.261)	0.396 (0.259)	0.569* (0.246)	0.504* (0.248)	0.574* (0.290)	0.558 (0.385)
N	5354	5354	5354	5354	5354	5354	2677	2677

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

Notes

[i] First generation immigrants are excluded from the analyses due to missing information on birth weight.

[ii] The marginal effects for categorical variables show how $P(Y = 1)$ is predicted to change as the categorical independent variable changes from 0 to 1 holding all other independent variables equal. For continuous independent variables, the marginal effect measures the instantaneous rate of change (Williams, 2011). We used the margins' command in Stata 13.

[iii] The percentage of students in the academic track (*studieforberedende*) is higher in Oslo than in the rest of the country.

[iv] Gestational weeks were insignificant and were therefore excluded from the analyses.