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Educated mothers, healthy infants. The impact of a school reform on the birth weight of Norwegian infants 1967–2005

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ABSTRACT

Birth weight is an important predictor of health and success in later life. Little is known about the effect of mothers' education on birth weight. A few causal analyses have been done, but they show conflicting results. We estimated the effect of mothers' education on birth weight by using data on a school reform in Norway. During the period 1960–1972, all municipalities in Norway were required to increase the number of compulsory years of schooling from seven to nine years. We used this education reform to create exogenous variation in the education variable. The education data were combined with large sets of data from the Medical Birth Registry and Statistics Norway. Since municipalities implemented the reform at different times, we have cross-sectional as well as time-series variation in the reform instrument. In the analyses, we controlled for municipality fixed effects, municipality-specific time-trends and mothers' and infants' year of birth. Using this procedure we found a fairly large effect of mothers' education on birth weight. Increasing mothers' education reduces the likelihood of low birth weight, even in a publically financed health care system. In interpreting these results it is important to keep in mind that we have examined only one channel, which is through birth weight, through which education may explain differences in health. There are other potential channels that should be explored by future research. In particular, it would be of interest to examine whether education has causal effects on the broader determinants of health, such as psychopathology, social capital and networks, and family stress and dysfunction.

Introduction

Infant health is of great importance for health and success in later life. One important indicator of infant health is birth weight. Infants with a low birth weight are at a disadvantage in later life with respect to cognitive, mental and physical development. They are also more at risk of experiencing poor health as adults (Case & Paxson, 2010; Currie & Hyson, 1999; Currie & Moretti, 2007; Shenkin, Starr, & Deary, 2004). More education may improve mothers' appreciation of a healthy lifestyle during pregnancy, thereby increasing the probability of having healthy babies. On this background, we address the causal effect of mother's education on birth weight.

Several empirical studies document a positive correlation between mother's level of education and infant health (for example see: Gortmaker & Wise, 1997; Kramer, Séguin, Lydon, & Goulet, 2000; MacDorman, 2011). Since causal effects can be smaller or larger than these correlations, it remains an open question whether increasing mothers' education is beneficial for infant health. We have identified only four studies, two from the United States, one from the United Kingdom and one from Taiwan, where causal effects of education on birth weight have been estimated (Chou, Liu, Grossman, & Joyce, 2007; Currie & Moretti, 2003; Lindeboom, Llena-Nozal, & Van der Klaauw, 2009; McCrary & Royer, 2011). They show conflicting results.

We have attempted to estimate causal effects of education on birth weight in a country with a long tradition for publically financed health services. Since the early 1960s, Norway has had a comprehensive and universal prenatal care programme for all pregnant women. One might expect that such a prenatal programme would reduce or eliminate the influence of mothers' own resources as a cause for having an infant with low birth weight.

We were able to estimate the effects by using data on a school reform in Norway. During the period 1960–1972, all municipalities in Norway were required to increase the number of compulsory

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years of schooling from seven to nine years. The education data were combined with large sets of data from the Medical Birth Registry and Statistics Norway. Since municipalities implemented the reform at different times, we have cross-sectional as well as time-series variation in the reform instrument. Thus we were able to estimate the effect of mothers' education on birth weight by controlling for municipality fixed effects and trend variables. We found that a higher level of maternal education substantially improved infant health, measured as a reduction in the likelihood of low birth weight in Norway.

Theory and background

An important determinant of low birth weight is inadequate nutrition in the third trimester of pregnancy. It has also been shown that birth weight is influenced by other environmental factors, in particular smoking and alcohol consumption (Brooke, Anderson, Bland, Peacock, & Stewart, 1989; Shu, Hatch, Mills, Clemens, & Susser, 1995). One possible way to reduce differences in birth weight is to increase mothers' level of education. Mothers are the core producers of health capital for their infants – they can influence the birth weight of the infant through their behaviour during pregnancy (Grossman, 1972). Education improves mothers' stock of knowledge. According to Grossman, this stock of knowledge makes educated mothers more efficient producers of health than less educated mothers (Grossman, 2006). This takes two forms. First, educated mothers absorb and process information so that they can make healthy choices during pregnancy (allocative efficiency). For example, more highly educated mothers will have more knowledge about the harmful effects of smoking and alcohol or what constitutes an appropriate diet than less educated mothers. Second, educated mothers "obtain a larger output from a given level of health inputs than the less educated (productive efficiency)" (Grossman & Kaestnar, 1997).

An increase in mothers' educational level will only reduce the likelihood of low birth weight if the education effect is causal. Ordinary least squares estimation (OLS) is likely to lead to biased results, mainly because the estimation does not take account of unobserved variables that are correlated with both education and infant health. The unobservable variables most frequently cited in the literature are ability, morbidity and time preferences. Mothers with a high level of ability will most likely have a high level of education, and at the same time they are also aware of the importance of favourable health behaviour during pregnancy. Hence, to obtain an unbiased estimate, ability has to be controlled for. Poor health of the mother might be transmitted to her offspring – for example hereditary disease. In addition, there may be a positive correlation between the health of the mother and her level of education. In that case OLS estimation will overestimate the effect of mothers' education on infant health. Numerous studies have examined the impact of time preferences for investments in education and health. A finding in several studies is that the positive correlation between education and health is significantly reduced after time preferences have been controlled for (Chapman & Coups, 1999; Cutler & Lleras-Muney, 2010; Farrell & Fuchs, 1982; Ippolito, 2003; Van der Pol, 2011).

Currie and Moretti (2003) used availability to college education as an instrument for maternal education. On the basis of a large sample from the United States, their IV-estimate suggests that education improves birth weight. One additional year of education reduces the probability of low birth weight by 0.010 with a standard error of 0.004. This implies that one year of extra schooling will decrease the prevalence of low birth weight by 10%. Chou et al. (2007) studied the effect of mothers' education on birth weight in Taiwan. In 1968, compulsory school education was extended from six to nine years. This was followed by an increase of 254 new junior high schools in different regions during the period 1968–1973. Chou et al. (2007) exploited the variation across regions in the opening of new schools as an instrument for maternal education. They found that one extra year of schooling led to a decrease in the prevalence of babies with a low birth weight of 5.5%. McCrary and Royer (2011) used school entry dates to isolate exogenous variations in women's educational level. Based on large data sets from Texas and California, they found that one additional year of education increased the probability of low birth weight by 0.014. The direction of this effect is the opposite of what we would expect. Finally, Lindeboom et al. (2009) addressed the United Kingdom case. Compared to analyses carried out in the United States, they relied on a relatively small dataset. They estimated causal effects on infant health by using data on an educational reform in 1947, when the minimum school leaving age was increased from 14 to 15 years of age. The best results were obtained when the sample was restricted to mothers who finished school at the age of 14–15. The estimated causal effect was imprecise. For example, one year of extra schooling for mothers decreased the probability of low birth weight by 0.033 with a standard error of 0.050 (see Lindeboom et al. (2009), Table 6b).

Identification and data

Identification using a compulsory school reform in Norway

From 1960 and onwards a school reform was implemented in Norway (comprehensive descriptions of the reform are given by Aakvik, Salvanes, & Vaage, 2010; Lie, 1973; Telhaug, 1969). The time of implementation was decided by the individual municipalities, but all had to implement the reform by the end of 1972. The reform increased the minimum number of years of schooling from seven to nine years. The school year was from mid August until mid June both before and after the reform. School entry is not spread out over the whole year, but occurs once a year, which is around the middle of August. Before the reform, children started school in the year they became seven, i.e. they were between six and a half and seven and a half years of age when they started school. They finished their compulsory schooling at age 14. Under the new system children still start school in the year they become seven, but finish their compulsory schooling the year they become 16.

For more than a decade Norway had two separate school systems. Which system the child was in depended on which municipality he/she lived in, and in which year he/she was born. The first birth cohort that could start nine years compulsory schooling was born in 1947, and the last cohort to finish in the old system was born in 1958.

This school reform has been used as an instrument variable in several papers by Salvanes and co-workers to study causal effects of education on the following outcomes: intergenerational transmission of education, family size, teenage births, mobility in the labour market, IQ and earnings (Aakvik et al., 2010; Black, Devereux, & Salvanes, 2005, 2007, 2008, 2010; Machin, Salvanes, & Pelkonen, 2012). The current dataset has been designed in a similar way to the design of Salvanes and co-workers (for details see Aakvik et al., 2010; Black et al., 2005). Thus our main analysis was performed on a sample that was restricted to mothers with 9 years or less of education.

The timing of the reform was identified for 706 of the 735 municipalities that existed in 1960. The municipalities implemented the reform at different times as shown in Fig. 1. Similar to Salvanes and co-workers, we used the 1960 census to identify the municipality in which each of the mothers grew up. The mothers would then have been between 2 and 13 years of age, i.e. at an age