Medical Treatments and Social Mobility

Temanummer: Som mor så datter: social mobilitet i Danmark

Economists have long been interested in understanding the relationship between health and socio-economic outcomes. Existing research consistently links poor health during early childhood to worse well-being in the long-run, including health, educational attainment, and labor market outcomes (Almond and Currie, 2011; Almond, Currie, and Duque, 2018; Currie et al., 2010). Growing evidence also indicates that child health shocks affect the socio-economic outcomes of other family members, such as parental labor supply (Gunnsteinsson and Steingrimsdottir, 2019; Breivik and Costa-Ramón, 2022; Eriksen et al., 2021; Adhvaryu et al., 2022), parental health (Burton, Lethbridge, and Phipps, 2008; Adhvaryu et al., 2022), and sibling academic achievement (Black et al., 2021). A natural question then is whether medical care aimed at improving childhood health may alleviate or eliminate these negative long-run consequences.

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Very Low Birth Weight Children and Identification of Causal Effects

Identifying the causal effects of medical interventions on treated persons or on their family members is challenging because treatments are not randomly assigned. People who receive medical treatments may have unobserved traits (i.e., traits that are not recorded in the data and thus not observed by the researcher) that also impact their long-run socio-economic outcomes. Similarly, there may be unobserved factors, such as shared genes, that influence the outcomes of other family members and are also correlated with whether or not targeted children receive medical treatments. In this case, it is unclear if differences between treated and untreated children (or their family members) are due to the treatments or to these unobserved characteristics.

In our paper, titled "Spillover Effects of Early-Life Medical Interventions" (Daysal et al., 2022), we overcome this challenge by using a design that takes advantage of the fact that newborns with very similar weight may be treated differently if their weight is above or below certain thresholds (Almond et al., 2010; Bharadwaj, Løken, and Neilson, 2013). For example, medical guidelines prescribe additional treatments to very low birth weight (VLBW) children (i.e., children weighing less than 1,500 grams, regardless of gestational age) and very premature newborns (i.e., those with a gestational age less than 32 weeks, regardless of birth weight). To illustrate our method, consider two children born after at least 32 weeks of gestation into identical families and with identical traits with one exception: one of them weighs slightly more than 1,500g, while the other one weighs slightly less than 1,500g. Despite their similarity, medical guidelines prescribe treatments only to the child with birth weight slightly below 1,500g. Therefore, any differences in the outcomes of (the family members of) these two children can be attributed to the medical treatments. Our approach is a more general comparison of the outcomes of (the family members of) children with birth weight in a small interval below and above 1,500g. It works in the same way because small variations in birth weight are likely random so children with birth weight slightly above and slightly below 1,500g should have on average very similar observed and unobserved characteristics, including family traits.

We use population level data from Denmark and focus on children born between 1982 and 1993, with a gestational age of at least 32 weeks, birth weight between 1,300-1,700 grams, and who have at least one sibling. The resulting sample includes 2,156 "focal children." We link these children to their parents using information from the birth register, which lists all the mothers and nearly all the fathers. We define siblings as children born to the same mother from different pregnancies, resulting in a sample of 3,311 siblings old enough for us to observe their academic outcomes.

Effects on Treatment-Eligible Children

We first investigate whether the health and academic achievement of treatment-eligible children are affected by early-life medical interventions. Because we examine a relatively large number of outcomes, there is a risk that we find significant effects for some of them just by chance. To reduce this risk, we combine these outcomes into a smaller number of indices. We define four health indices that measure the health of focal children in the short- and long-run: (i) a mortality index that summarizes mortality during the first 28 days and 1 year of life; (ii) a short-term health index describing hospitalizations during each year between the ages of 1-5; (iii) a long-term health index representing hospitalizations and emergency room visits (ER) during each year between the ages of 6-15; and (iv) a disability index summarizing diagnoses by age 10 with intellectual disability, attention deficit hyperactivity disorder (ADHD), behavioral and emotional disorders, cerebral palsy, or epilepsy. We also define two indices that sum up the academic achievement of these children: (i) a test-score index based on course-specific test scores from 9th grade qualifying exams in reading and math; and (ii) an index combining information on enrollment beyond compulsory education, in high school or vocational school at age 18, in an academic track at age 18, in any form of higher education at age 24, and in a university at age 24.

We find substantial health gains from treatment eligibility: VLBW newborns in our sample have 0.508 standard deviations lower mortality in the short-run and 0.324 standard deviations lower hospital and ER visits in the long run. The improved health, however, does not result in a lower chance of disability. Turning to academic achievement, we find that treatment-eligible children have on average 0.314 standard deviations higher test scores in the 9th grade, but they are not significantly more likely to be enrolled in education beyond compulsory schooling. Visual evidence corresponding to these results is provided in Figure 1, reproduced from the original article.

Spillover Effects on Family Members

We next turn to spillover effects on the family. For parents, we define indices for labor market outcomes (combining employment status and number of days worked), annual gross income, and mental health as proxied by antidepressant use. Where possible, we construct them for the short-term (1-5 years after the birth of the *focal* child) separately from the long-term (6-15 years after the birth of the *focal* child). The outcomes for siblings mirror the outcomes for focal children and include (i) a short-term health index summarizing hospitalizations during each year when the *focal* child is 1-5 years old; (ii) a long-term health index combining hospitalizations and ER visits during each year when the *focal* child is 6-15 years old; (iii) a test-score index based on 9th grade math and language test scores; and (iv) an index of enrollment beyond compulsory education summarizing sibling's enrollment in higher education at their own ages 18 and 24.

We find that early-life medical interventions do not affect parental outcomes related to total household resources: parents of children with birth weight slightly below 1,500 grams have similar labor force participation or income compared to the parents of children with birth weight slightly above the 1,500-gram threshold, both in the short-run and in the long-run. However, we do find evidence of improved maternal mental health soon after the birth of the focal child that dissipates as the child ages: antidepressant use by the mothers of VLBW newborns is on average 0.347 standard deviations lower two to five years after the focal child's birth and this effect disappears when the focal child is 6-15 years old. Further investigations indicate that the improvement in maternal mental health is due to both lower focal child mortality and better focal child health. Fathers' mental health does not seem to be impacted by these early-life medical interventions.

We also find that early-life medical treatments have substantial positive spillovers on sibling test scores in both math and language (0.255 and 0.386 standard deviations, respectively). These estimated effects are large when compared to other policy-relevant test score gaps. For example, if we calculate the average difference in test scores between children born in households above the 90th income percentile and those born in households below the 10th income percentile, our results imply that medical treatments can reduce the income-based test score gap at age 16 by 33-69%, depending on the subject. Despite these large test score gains, we do not find evidence of important spillovers on sibling health or enrollment outcomes. Visual evidence of these effects is provided in Figures 2-3, reproduced from the original article.

Channels Through Which the Effects Arise

Our study shows that medical interventions can improve the academic achievement of both treatment-eligible children and their siblings. Understanding how these effects arise is difficult given the complexity of the question as well as the limited nature of register data. We provide some suggestive evidence that better focal child-health may be an important reason for the achievement gains of treatment-eligible children, because we find that the effects on test scores are reduced when we take into account the improvement in long-run focal child health.

In contrast, health related factors do not seem to be important for the sibling academic achievement gains. Our main results suggest that the siblings of newborns with birth weight slightly less than 1500 grams have similar health outcomes to the siblings of focal children with birth weight slightly more than 1500 grams. One potential concern is that birth weight might be correlated between siblings: the siblings of VLBW focal children might have had very low birth weight themselves and so benefitted directly from medical treatments. In this case, our estimates would not represent spillover effects from focal children to siblings, but rather the effects of medical treatments received by the siblings themselves. We show that this is not the case because our results still hold if we exclude from the sample the siblings who were themselves VLBW newborns. In addition, we find that the mortality rates of older siblings soon after their birth, but before the birth of focal children, are similar for siblings of VLBW focal children when compared to focal children with birth weight above 1,500g. Hence, the estimated sibling spillovers are unlikely to be explained by correlated health status within the family.

Instead, we find evidence that suggests two other channels play an important role in these sibling spillovers. The first such channel refers to the interactions within the family. Economists have long emphasized the importance of parent-child interactions in the human capital accumulation of children (Cunha and Heckman, 2007; Cunha, Heckman, and Schennach, 2010; Almond and Currie, 2011). Consistent with these theories, we find that the estimated test score gains of siblings decline by 50% when we take into account the improvement in maternal short-term mental health. Second, changes in the allocation of resources in the household seem to explain some of the spillover effect on sibling test scores. Suppose that there are dynamic complementarities in the production of human capital (Cunha and Heckman, 2007), i.e., that parental investments have higher returns for children with high initial endowment than for children with low initial endowment ("skills beget skills"). Then we should find that the siblings with high initial endowments, i.e., higher birth weight, receive more parental resources and so have better outcomes than the siblings with lower initial endowments (lower birth weight). However, we estimate that the siblings with higher birth weight experience higher test score gains only if they are the siblings of VLBW focal children, those focal children whose academic achievement is improved by medical treatments.

This suggests that parents engage in compensating behavior: they reallocate their resources (time, money, etc.) across their children in order to equalize their academic outcomes.

Medical Interventions and Social Mobility

Our results speak directly to ongoing policy debates concerning the rise in healthcare expenditures. During the past few decades, medical spending has increased much faster for the very young than for the average person. For example, between 1960-1990, spending per person in the US increased by 9.8 percent per year for infants under the age of 1, but by only 4.7 percent per year for people 1-64 years old (Cutler and Meara, 1998). Most of this cost growth is attributed to medical innovations (Newhouse, 1992; Cutler and Meara, 1998). As such, it is crucial to understand the full benefits of early-life medical interventions. Our findings indicate that conventional calculations, which ignore the positive spillover effects that medical treatments for VLBW children have on other family members, underestimate the total benefits of these treatments.

Our study is also relevant to the debate on inequality and intergenerational mobility. It is well known that birth weight has a strong positive correlation with socioeconomic status in adulthood (Black, Devereux, and Salvanes, 2007). In addition, there is also a strong correlation between the birth weight of parents and offspring (Currie and Moretti, 2007). Therefore, health at birth as measured by birth weight is an important factor contributing to the transmission of socioeconomic status (and, thus, inequality) from one generation to the next. Our results show that medical treatments improve the long-run outcomes of both treatment-eligible individuals and their family members, especially siblings. In other words, early-life medical treatments can break the link between health at birth and long-run outcomes. Given the well-documented fact that VLBW children are more likely to be born in families with lower socioeconomic status, this implies that early-life medical interventions have the potential to reduce the transmission of socioeconomic inequality across generations.

References

Adhvaryu, Achyuta, N. Meltem Daysal, Snaebjorn Gunnsteinsson, Teresa Molina, and Herdis Steingrimsdottir. 2022. "Child Health, Parental Well-Being, and the Social Safety Net."

Almond, Douglas, and Janet Currie. 2011. "Human Capital Development before Age Five." In *Handbook of Labor Economics*, edited by Orley Ashenfelter and David Card, 1 edition. Vol. 4B. Amsterdam; New York; New York, N.Y., U.S.A.: North Holland.

Almond, Douglas, Janet Currie, and Valentina Duque. 2018. "Childhood Circumstances and Adult Outcomes: Act II." *Journal of Economic Literature* 56 (4): 1360–1446.

Almond, Douglas, Joseph J. Doyle, Amanda E. Kowalski, and Heidi Williams. 2010. "Estimating Marginal Returns to Medical Care: Evidence from At-Risk Newborns." *Quarterly Journal of Economics* 125 (2): 591–634.

Bharadwaj, Prashant, Katrine Vellesen Løken, and Christopher Neilson. 2013. "Early Life Health Interventions and Academic Achievement." *American Economic Review* 103 (5): 1862–91.

Black, Sandra E, Sanni Breining, David N Figlio, Jonathan Guryan, Krzysztof Karbownik, Helena Skyt Nielsen, Jeffrey Roth, and Marianne Simonsen. 2021. "Sibling Spillovers." *Economic Journal* 131(633): 101–128.

Black, Sandra E., Paul J. Devereux, and Kjell G. Salvanes. 2007. "From the Cradle to the Labor Market? The Effect of Birth Weight on Adult Outcomes." *The Quarterly Journal of Economics* 122 (1): 409–39.

Breivik, Anne-Lise, and Ana Costa-Ramón. 2022. "The Career Costs of Children's Health Shocks." SSRN Scholarly Paper. Rochester, NY.

Burton, Peter, Lynn Lethbridge, and Shelley Phipps. 2008. "Children with Disabilities and Chronic Conditions and Longer-Term Parental Health." *The Journal of Socio-Economics*, Behavioral Dimensions of the Firm Special Issue, 37 (3): 1168–86.

Cunha, Flavio, and James Heckman. 2007. "The Technology of Skill Formation." *American Economic Review* 97 (2): 31–47.

Cunha, Flavio, James J. Heckman, and Susanne M. Schennach. 2010. "Estimating the Technology of Cognitive and Noncognitive Skill Formation." *Econometrica* 78 (3): 883–931.

Currie, Janet, and Enrico Moretti. 2007. "Biology as Destiny? Short- and Long-Run Determinants of Intergenerational Transmission of Birth Weight." *Journal of Labor Economics* 25 (2): 231–63.

Currie, Janet, Mark Stabile, Phongsack Manivong, and Leslie L. Roos. 2010. "Child Health and Young Adult Outcomes." *Journal of Human Resources* 45 (3): 517–48.

Cutler, David M., and Ellen Meara. 1998. "The Medical Costs of the Young and Old: A Forty-Year Perspective." In *Frontiers in the Economics of Aging*, edited by David A. Wise, 215–46. University of Chicago Press.

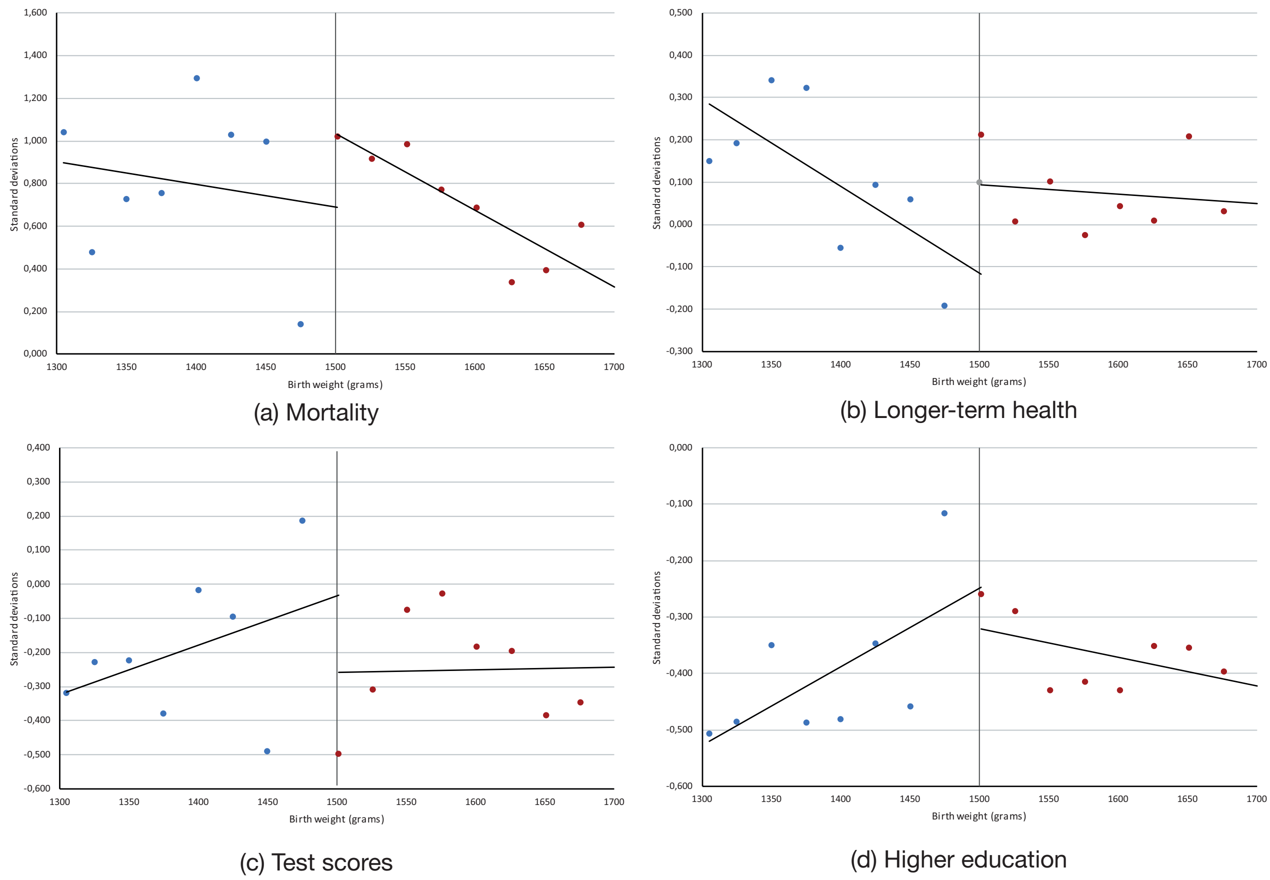
Daysal, N. Meltem, Marianne Simonsen, Mircea Trandafir, and Sanni Breining. 2022. "Spillover Effects of Early-Life Medical Interventions." *The Review of Economics and Statistics* 104 (1): 1–16.

Eriksen, Tine L. Mundbjerg, Amanda Gaulke, Niels Skipper, and Jannet Svensson. 2021. "The Impact of Childhood Health Shocks on Parental Labor Supply." *Journal of Health Economics* 78 (July): 102486.

Gunnsteinsson, Snaebjorn, and Herdis Steingrimsdottir. 2019. "The Long-Term Impact of Children's Disabilities on Families."

Newhouse, Joseph P. 1992. "Medical Care Costs: How Much Welfare Loss?" *Journal of Economic Perspectives* 6 (3): 3–21.

Figure 1: Evolution of selected summary indices of focal children around the VLBW cutoff



(a) Mortality

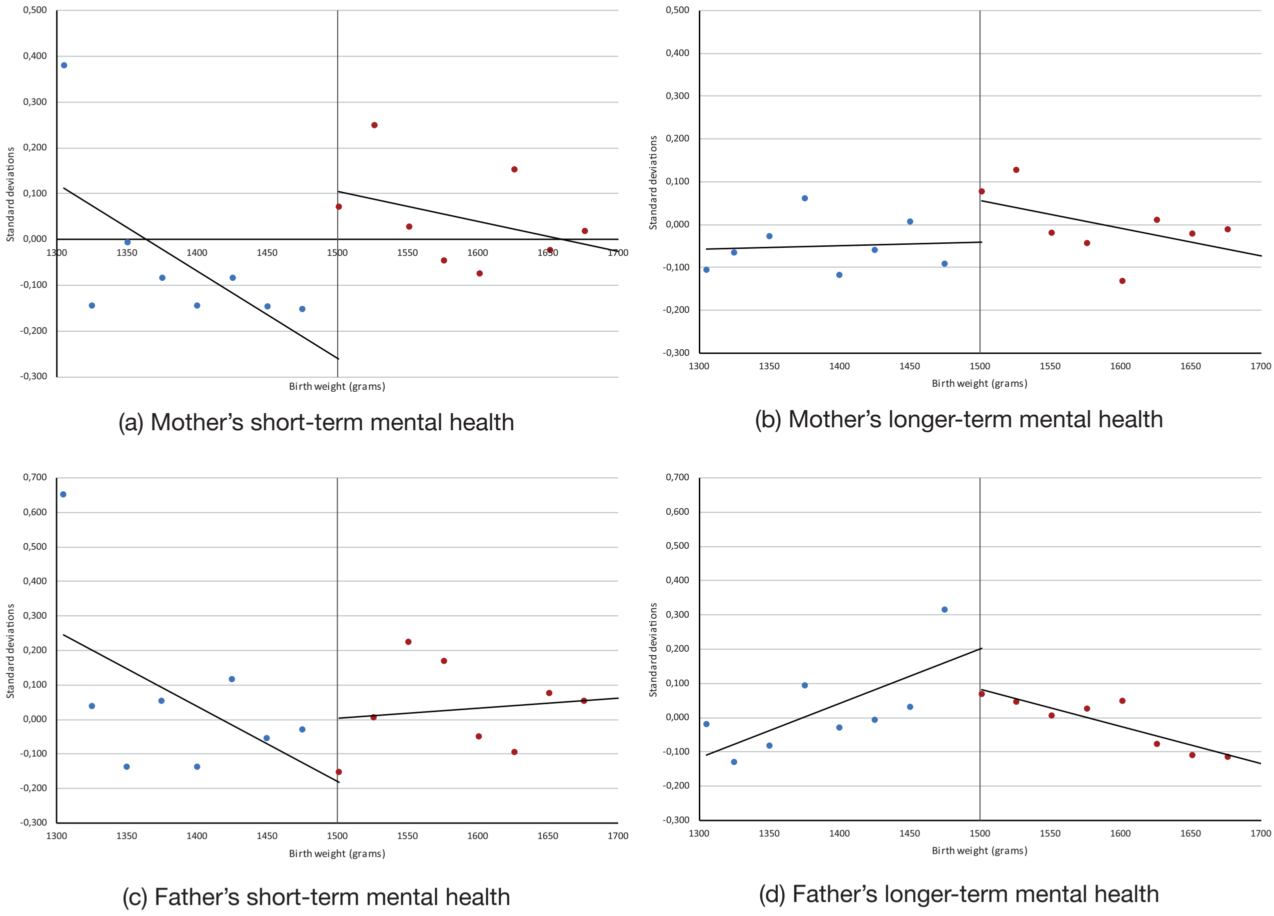
(b) Longer-term health

(c) Test scores

(d) Higher education

Notes: Sample of focal children with gestational age of at least 32 weeks. Each dot represents the average of the summary index indicated in the panel for a 40g bin. Focal children with birth weight of 1,500g are excluded. The lines plot a first-degree polynomial estimated separately on either side of the VLBW cutoff.

Figure 2: Evolution of summary indices of mother's and father's mental health around the VLBW cutoff for focal children



(a) Mother's short-term mental health

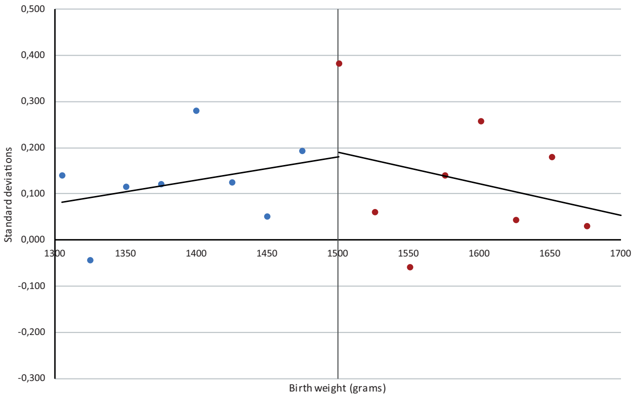
(b) Mother's longer-term mental health

(c) Father's short-term mental health

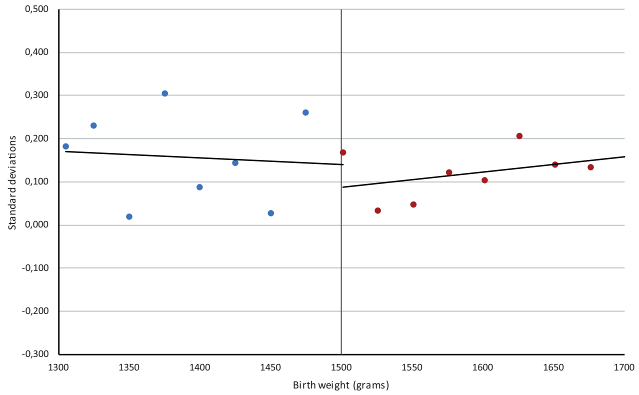
(d) Father's longer-term mental health

Notes: Sample of mothers (Figures a-b) and fathers (Figures c-d) of focal children with gestational age of at least 32 weeks. Each dot represents the average of the summary index indicated in the panel for a 40g bin. Mothers of focal children with birth weight of 1,500g are excluded. The lines plot a first-degree polynomial estimated separately on either side of the VLBW cutoff.

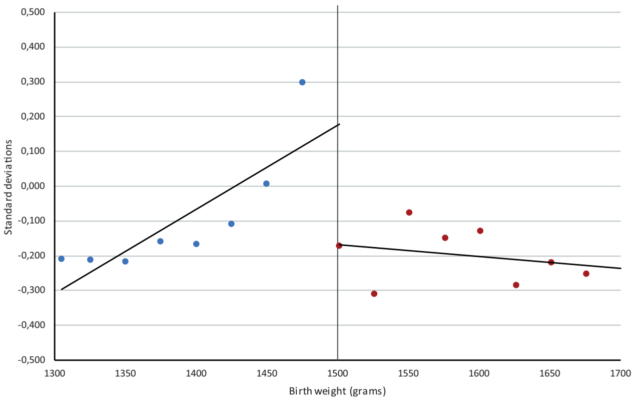
Figure 3: Evolution of summary indices of siblings around the VLBW cutoff for focal children



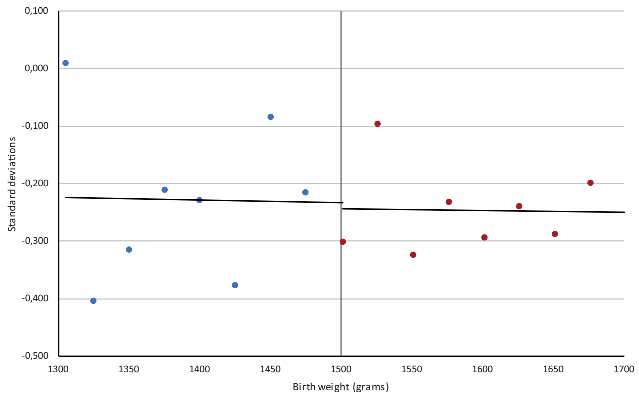
(a) Short-term health



(b) Longer-term health



(c) Test scores



(d) Higher education

Notes: Sample of siblings of focal children with gestational age of at least 32 weeks. Each dot represents the average of the summary index indicated in the panel for a 40g bin. Siblings of focal children with birth weight of 1,500g are excluded. The lines plot a first-degree polynomial estimated separately on either side of the VLBW cutoff.