Selection and Causation in the Parental Education Gradient in Child Health

Lessons from a Large Sample of Adoptees[*]

by

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February, 2020

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Abstract:

We use data from a large sample of adoptees born in Sweden to study to what extent the well-established association between parental educational attainments and child health can be attributed to selection, in the sense that genetic differences leading to different health outcomes may be transmitted between generations, and causation, in the sense that higher education parents may have preferences and/or economic resources to transmit health related behavior, preferences for health and investments in child health. For mortality and two additional health measures based on hospitalization data we find a significant association between the educational attainment of the adopting parents and child health outcomes as adults. These results suggest that growing up in a more resourceful home has long-term effects on health outcomes. Our analysis of the mechanisms behind the results suggest that formation of health related behavior may be important.

[*]Evelina Björkegren gratefully acknowledges financial support from Handelsbanken's Research Foundations; Mikael Lindahl is a Royal Swedish Academy of Sciences Research Fellow supported by a grant from the Torsten and Ragnar Söderberg Foundation, the Scientific Council of Sweden and the European Research Council [ERC starting grant 241161]; Mårten Palme gratefully acknowledges financial support from the Swedish Council of Social Research; and Emilia Simeonova from the Swedish Research Council and the National Science Foundation.

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1. Introduction

The inverse association between parental socioeconomic status and child health has been documented in several previous studies (see e.g. Case, Lubotsky and Paxon, 2002, Currie (2009), Almond and Currie (2011)). However, it is not clear from these studies to what extent this persistence can be attributed to *selection,* in the sense that genetic differences leading to different health outcomes may be transmitted between generations, or to *causation,* in the sense that higher SES parents may have preferences and/or economic resources to transmit health related behavior, preferences for health and investments in child health. Understanding this link is of great importance for our comprehension of how health inequality is formed.

In this paper, we use a large sample of Swedish adoptees for whom we, among other things, observe educational attainments of both biological and adopting parents. We study how these characteristics of the biological parents – related to genetic factors and in-utero health – and the corresponding characteristics of the adopting parents – related to health formation and family circumstance during childhood and adolescence – affect the child's health and mortality later in life.

We also look into the mechanisms driving these relations. First, we study to what extent this associated to health related behaviors formed relatively early in life. We use health outcomes – such as *BMI*, *Physical fitness* and *Smoking* - for the adopted children obtained at the military enlistment, for males, and when giving birth to the first child, for females, through the National Birth Register. Second, we look at to what extent the results are mediated, in the sense that more educated parents affect educational attainments as well as cognitive and non-cognitive skills of their children, which, in turn, affect their health outcomes (the *pathway hypothesis*, see e.g. Deaton, 2003)

We contribute to the understanding of the longstanding questing on the relationship between parental SES and child health by studying a large sample of Swedish adoptees. Our dataset is constructed by matching several different administrative registers containing information on health outcomes and educational attainments for biological and adopting parents and their children. We include all adopted children born between 1932 and 1967 in Sweden, in total about 11,000 individuals. For comparison, we also present results on the same outcomes obtained using the population of about 3.2 million children raised with their biological parents and born in the same time-period as the adoptees.

The main outcome of interest is the health status of the children as adults. We use four main measures of this outcome: (i) mortality up until age 84; (ii) health indices based on hospitalization data from the Swedish inpatient register; (iii) for females in the sample that at some point gave birth to a child we use three health measures obtained from the Medical Birth Register: BMI, height and smoking habits; (iv) for males we use data from the Enlistment test registers on height, BMI and physical fitness. In addition, to study potential mechanisms, we also have measures of cognitive, non-cognitive skills as well as educational attainment of the children.

Our results can be informative on at least two different, but related, research questions. First, to what extent can being placed in families with highly educated parents, or with high parental earnings, improve the children's health prospects as adults and in the end their life expectancy. Second, what is the relative importance of the pre- and post-birth factors for adult health outcomes?

On the first research question our results suggest that there is a relation between parental SES and children's health outcomes independent of pre-birth factors such as inherited genetic differences. The results on mortality shows a strongly significant relation. The results from the two health indices confirms, unambiguously, such relationship. For men, the results from the Enlistment register obtained at age 18 suggest that nutritional differences, reflected in lower BMI, and more physical exercise, reflected in higher scores on the physical tests, for boys with more highly educated adopting parents may be a mechanism behind the results.

On the second question, our results are more ambiguous. On mortality, our results suggest that the mortality differences later in life between children with high and low educated parents can be fully attributed to post-birth factors. However, the two health indices suggest a more equal split between pre- and post-birth factors. A possible background to the difference between the two sets of health measures is lack of statistical power for the mortality measure, since the share of biological parents with high education among adopted children for which we observe date of death for during our follow up window is low.

Our study relates to several strands of the previous literature. There is limited evidence on the causal relationship between parental education and child health. A group of studies have utilized exogenous changes in parental education to estimate causal effects on infant and child health, reaching different conclusions (Currie and Moretti, 2002 McCrary and Royer, 2011;

Lindeboom et al., 2009; Lundborg et al., 2014).[1] Although they are genetically unrelated to their adopted children, the educational attainment of the adopting parents can still be correlated with other parental characteristics that are important in the formation of their children's health. This prevents us from interpreting the association between adopting parents' educational attainments and child health as a causal effect of education per se.

Three studies using adoption data are more closely related to our study. Sacerdote (2007) study 1,650 Korean American adoptees placed by the Holt International Children's Services during 1964-1985. Sacerdote estimates the effect of being placed in a highly educated, small family relative to a large family with low education, on education, health-related behavior (such as smoking and drinking), body-mass index (BMI), and height. The main result is a strong effect on "social" outcomes – such as educational attainments, smoking and alcohol consumption – but no significant effects on the biological outcomes – such as height and BMI. Using data on foreign adopted children and twins in Sweden, Lundborg et al. (2018) show that there is a causal relation between parental education and health, cognitive and non-cognitive skills for males in late adolescence. Osler et al. (2006) studies the relationship between parental social class and child mortality up until age 77 using data on Danish adoptees. They show that adoptees with biological fathers from higher social class have lower mortality, but they do not find any long-term effect of adopting fathers' social class.

Our findings also relate to the literature on intergenerational mobility in general (see e.g. Solon, 1999 and Black and Devereux, 2011, for overviews) and, in particular, the quite small literature on intergenerational persistence in health outcomes (see e.g. Björkegren et al., 2019; Sørensen et al., 1988); Petersen et al., 2005), and Halliday et al, 2018). It is also related to the increasing number of studies using adoptees to distinguish between pre- and post-birth factors. Black et al. (2019) presents results for a number of outcomes, and find pre- and post-birth factors ranging from post-birth factors being much more important (e.g., for wealth) to pre-birth and post-birth factors both being important. Interestingly, for educational transmission, both pre- and post-birth factors are important and sizable (Björklund et al, 2006; Black et al.,

[1] There is also a literature that estimates the causal effect of other parental resource variables on the health of the next generation. For instance, Cesarini et al. (2016) find no impact on health of the next generation from exogenous positive wealth shocks for the parents through winning large sums on lotteries. However, Akee et al. (2012) and Akee et al. (2016) find positive effects of exogenously increasing parental income on child BMI and child behavioral and emotional health.

2019) whereas for health transmission, pre-birth factors are clearly more important (see Björkegren et al., 2019).

The rest of the paper is organized as follows. Section 2 presents the conceptual framework for our econometric models. Section 3 presents the data and descriptive statistics. The main results as well as sensitivity analyses are laid out in Section 4. Section 5 concludes the paper. Finally, the paper contains two Appendices. Appendix A provides a brief historical background and a description of institutions related to the adoption process in Sweden. Appendix B shows results from various sensitivity analyses.

2. Empirical Specifications

We start by estimating the following intergenerational model on the population of individuals

$$H_j^{bc} = \beta_0 + \beta_1 Y_j^{bp} + \upsilon_j^{bc}, \quad (3)$$

where H_j^{bc} represents adult health status for the biological child and Y_j^{bp} the biological parents' educational attainment. Subscript *j* indexes the family in which the child is born and raised and superscripts *bc* and *bp* denote the biological child and parent, respectively; υ_j^{bc} is the child-specific error term assumed to be uncorrelated with Y_j^{bp}. The coefficient β_1 measures the strength of the association between adult health of the child and the educational attainment of the parents and is a combined effect of many different factors such as genetics, prenatal environment and environment during childhood and adolescence, including the causal effect of parent's education.

Using data on the characteristics of adoptees and their biological and adoptive parents, we are able to estimate the following model on the population of adoptees:[2]

$$H_i^{ac} = \alpha_0 + \alpha_1 Y_j^{bp} + \alpha_2 Y_i^{ap} + \upsilon_i^{ac}, \quad (4)$$

where *Y* once more measures human capital inputs that are transmitted from the biological parent *bp*, or the adoptive parent *ap*, to the adopted child *ac* born in family *j* and adopted and reared in family *i*; υ_j^{ac} is a child-specific error term uncorrelated with Y_j^{bp} and Y_i^{ap}.

Conditional on the following key assumptions of the adoption design: 1) Adoptees are conditionally randomly assigned to adoptive families; 2) The adoption should have taken place close to birth so that it is possible to accurately separate pre and post birth effects;[3] 3) The biological parents have no contact with the adopted child post adoption, we are able to estimate the association between adult health status and the observable pre- and post-birth characteristics separately by estimating equation (4) using data on adopted children and their biological and adoptive parents. In general, α_2 does not only capture the importance of the adoptive parental

[2] We follow the strategy to separate pre- and post-birth effects from Björklund et al. (2006). See also Björkegren et al. (2019) for a similar description as we provide in this paper.

[3] If adoption is not taking place very shortly after birth, the postnatal pre-adoption environment (e.g., the quality of the nursery homes) needs to be uncorrelated with the genetic background and the post adoption environment (or has no influence on the health of the adopted child). Alternatively the estimates are still unbiased estimates of the pre- and post-adoption *characteristics.*

educational attainment, Y_i^{ap}, but also everything else in the adoption family that is correlated with Y_i^{ap}.[4] We therefore interpret the estimates as a measure of the importance of transmission channels stemming from the pre- or post-birth influences, respectively.

To test for that adoptees are conditionally randomly assigned to adoptive families, we do three sets of sensitivity analyses adoptees (see further the discussion in Section 4). First, we look at the robustness with respect to changes in the set of confounding parental characteristics included in the model. We also employ the method suggested by Altonji et al. (2005) to get an estimate of how much any unobservable characteristics correlated between the biological and the adopting parents must contribute, relative to the contribution of the observable characteristics, in order to explain away the main results obtained in the study.

Second, we restrict the sample to only include adoptees that moved from their municipality of birth. We cannot directly observe whether relatives or friends of the biological parents adopted some children, but in such cases, children are more likely to stay in the municipality where they were born. Moreover, adopted children who move from their municipality of birth are much less likely to interact with their biological parents post adoption.

In the third sensitivity analysis, we restrict the sample of adoptees to first-borns of their biological mothers. The motivation for this restriction is to exclude adoptees who were given up for adoption because of illness, poverty or other reasons for inabilities to accommodate a large family of the biological parents, which, in turn, will increase the probability that the adopting parents are related to the biological ones. That is, first-borns are more likely to be given away for adoption simply because they are less likely to have been planned by their biological parents or born in established families.

Note also that equation (4) can easily be extended to account for "nature-nurture-interactions" by adding the product of Y_j^{bp} and Y_i^{ap} to this specification (see Björklund et al., 2006). We investigate the importance of such interactions in Section 4.

We also interact Y_i^{ap} with variables M_i^{ac} of the child determined prior to the health outcomes. We first look at how pre- and post-birth factors are related to health behaviors (Section 5.1), and then how these health behaviors and human capital variables of the child mediate the relationship between educational attainment of the adoptive parents and health

[4] For a discussion about the necessary conditions under which α_2 can be interpreted as the causal effect of parents' characteristic on child characteristic, see Holmlund et al. (2011).

outcomes of the child (Section 5.2). We use mediation analysis techniques in the spirit of Fagereng, Mogstad and Ronning (2019), who used data on Korean born adoptees growing up in Norway to estimate mediators of intergenerational wealth transmission, building on work by Heckman et al. (2013) and Heckman and Pinto (2015).

Assuming that adoptees and non-adoptees are drawn from the same distribution, we are also able to decompose an estimate of β_1 into separate entities of pre- and post-birth factors, captured by estimates of α_1 and α_2, which are then interpretable for the population of children. The likelihood of generalizability of the adoption estimates increases if the intergenerational parameter is linear and if the sum of the estimates of α_1 and α_2, using the sample of adoptees, equals an estimate of β_1, obtained in the population of children. We also perform a test of the external validity of the adoption coefficients by estimating these parameters on the sample of families where at least one child has been adopted out from the family and at least one child was not adopted but is instead reared by the biological mother (see section 4).

3. Data and Descriptive Statistics

3.1 Sample Definition

We use data from different national registers in Sweden and include all males and females born in Sweden between 1932 and 1967.[5] We use the Multigenerational Register (see Statistics Sweden, 2012) to identify whether a person was adopted as a child. It also contains a personal identifier of the biological mother and father (if known to the authorities) as well as the adopting mother and father.

Table 1 shows the number of observations for the two populations used in this study – adoptees and, as a comparison, non-adoptees – at different stages of the sample selection process. In total, there are 73,384 adoptees who we can identify in our data. About 36,000 of them were adopted by only one parent, in most cases the husband of the child's biological mother. We excluded these individuals from the analysis. We construct two samples from the remaining population. First, a larger sample, including 21,386 individuals for whom we have information on the biological mother as well as the adopting mother and father. Second, a smaller sample consisting of 10,880 individuals, for whom we also have information on the biological father.

[5]The lower cohort restriction is motivated by data availability and the upper one by the fact that domestic adoptions in Sweden decreased rapidly in the late 1960s.

Table 1. Sample sizes at different stages of the sample selection process.

Born in Sweden 1932-67	Non-adoptees	Adoptees
Non-adopted	3,711,734	
Adopted by at least one parent		73,384
Adopted by both parents		37,502
Biological mother is identified	3,541,345	24,542
Not adopted by own parents		24,498
Adopting parents' age is correct *		22,934
Not died or emigrated first year	3,529,518	22,920
Parents' education is known	3,227,149	21,386
Biological father is identified	3,227,149	10,880

*Adopting mother age 25-47 and adopting father age 25-66 at birth of adopted child.

3.2 Variable construction

3.2.1 Mortality in the Child Generation

Information on date of death is obtained from the national Cause of Death Register (see Socialstyrelsen, 2009a). The Cause of Death Register records dates and International Classification of Diseases, revision 10, (ICD 10) codes for the underlying cause of death for all deaths in Sweden from 1952 and onwards. Our observation period stops in 2016. This implies that for the child generation, we can observe the oldest person in our sample until age 84 and the youngest until age 49.

3.2.2 Hospitalization

Data for our measures of hospitalization are obtained from the national In-patient Register (see Socialstyrelsen, 2009b). The national In-patient Register includes dates for all hospital stays at Swedish hospitals. This register has a national coverage starting in 1987, and we have access to data for the entire period until 2014. Since the first birth cohort included in our data was born in 1932, we observe all its hospital stays from age 55 and until age 82. The In-patient Register includes ICD codes for the maximum of eight different medical causes of each hospital stay.

We use two measures of health from the hospitalization data.[6] The first, labeled "Hospitalization-based health", is simply the residuals from a linear probability model regression of an indicator variable for whether or not the individual has been in hospital care for each year separately during the observation window on year and year of birth indicators. If the person is dead, we treat him or her as missing. In a second step, we average the residuals

[6] These are the same measures as we used in Björkegren et al. (2019) where we analyzed the intergenerational transmission of health and mortality.

for each individual to obtain the measure. This procedure accounts for differences in the probability of hospitalization over the life cycle and we may therefore interpret the resulting variable as a measure of lifetime hospitalization.

The second measure, labeled "Health index", is constructed in three steps.[7] First, for every year, we use a probit model to regress an indicator variable, equal to one if the individual has died within five years and zero otherwise, on the information from the in-patient register for that year (days, visits, and diagnoses) and indicators of year of birth and gender.[8] In a second step, we create a health index ranging between 0 and 1 by predicting the risk of dying within five years. An individual is assigned the value of 1 all years after death occurred, individuals not making any hospital visits are assigned the value of 0. Then, we average over all years. Based on this index, we obtain a percentile rank for each birth cohort and gender separately. The advantage of this measure compared to "Hospitalization-based health" is that it weights the different diagnoses by "severity" based on how likely the person is to die within five years.

3.2.3 Educational Attainments

The number of years of schooling in the parental generation is the key independent variable in our empirical analysis. Our main data source for this variable is the 1970 Census. If the information is missing in that Census year, we use data from the 1990 and 2004 waves of the Swedish Education register. As a third option for observations that are still missing, we use the 1960 Census.[9] Overall, we are able to identify educational attainment for 97 percent of the sample. Education in Swedish registries is recorded at seven different levels, which we translate into years of schooling.[10]

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[7] The first two follow Cesarini et al. (2015).

[8] We use the first two digits in the ICD10 diagnosis codes (one letter and one number), which constitute about 200 different categories. We do this for the first two diagnoses for each hospital stay. In addition, we include linear variables for the number of hospital stays and the total number of days in hospital care. We control for gender and stratify on birth cohort.

[9] The education measure from 1970 is available for the population of individuals given that the individual was born in 1911 or later and was alive and lived in Sweden in 1970. It is used as the main choice because it measures educational attainment for individuals when they are supposed to have finished their education. Education from 1990-2004 will only be utilized for those parents that were not living in Sweden in 1970, so as not to capture educational investments later in life (which was fairly common in the 1980s and 1990s). Education in 1960, which is less detailed compared to the 1970 information, will only be used for those parents that have died before 1970 and/or that were born before 1911. A problem with the 1960 Census is that the coding of educational attainment is different from our other data sources. Therefore, we use data from individuals that are present in both the 1960 and 1970 census, and are 35-45 years old in 1960, to predict years of schooling from the 1960 census for those missing observations.

[10] Pre-comprehensive school compulsory level = 7 years; 2 comprehensive school or junior secondary school = 9 years; vocational school =10.39 years, secondary school = 12.19 years; secondary school + 1 or 2 years = 14; college or university = 16 years; and PhD = 20 years.

3.2.4 Measures of BMI, cognitive and social skills

We use the medical births register to calculate pre-pregnancy BMI for mothers at their first recorded pregnancy. The Army draft register is used to calculate BMI for young men aged 18-19 who went through physical examinations for the Swedish Army draft. The draft was compulsory in Sweden for the cohorts under consideration. We can find information on XX% of all males in our analysis dataset in the army draft register. The draft also included a cognitive skills test, and an assessment of non-cognitive (or social, leadership, and team spirit) skills by trained psychologists. An assessment of non-cognitive skills is given after an interview with a trained psychologist. We observe data from the army draft registry only for men for the birth cohorts 1950-1967. [11]

3.3 Descriptive Statistics

Table 2 contains sample means and standard deviations (within parentheses) for the main outcome and control variables in the sample of adoptees and non-adoptees. Adopting fathers have almost one additional year of education as compared to the biological fathers of the adopted children. The adopting parents are on average ten years older than the biological parents of adoptees.

Table 2. Summary statistics of main outcome and control variables

	Non-adoptees			Adoptees		
	Mean	Std. Dev	N	Mean	Std. Dev	N
Children, all						
Female	0.49	(0.50)	3,227,149	0.48	(0.50)	10,880
Year of birth	1951.78	(9.58)	3,227,149	1956.80	(6.70)	10,880
Share of dead	0.12	(0.32)	3,227,149	0.10	(0.30)	10,880
Hospitalization,	50.03	(28.18)	3,227,149	44.51	(28.97)	10,880
Health index	50.03	(28.15)	3,227,149	45.08	(28.58)	10,880
Education	11.47	(2.69)	3,204,124	11.52	(2.18)	10,812
Children, men						
Non-cognitive	0.00	(1.00)	794,795	-0.09	(1.03)	4,013
Cognitive	0.00	(1.00)	803,957	-0.18	(0.98)	4,061
Physical fitness	0.00	(1.00)	802,792	-0.09	(0.98)	4,050

[11] These include: willingness to assume responsibility, independence, outgoing character, persistence, emotional stability, initiative (see Linqvist and Vestman, 2011). Difficulty accepting authority and violent aggressive behavior are among the negative characteristics psychologists look to identify. Obsession with the army and military topics is considered a negative trait (see Linqvist and Vestman, 2011).

Physical strength	0.00	(1.00)	803,491	-0.03	(1.00)	4,054
BMI	21.47	(2.82)	794,722	21.60	(3.02)	4,018
Height, cm	178.98	(6.54)	795,844	178.28	(6.83)	4,023
Children, women						
BMI	22.48	(3.36)	332,366	22.73	(3.65)	1,520
Height, cm	166.91	(5.93)	400,810	166.41	(5.89)	1,817
Smoke	0.23	(0.42)	456,681	0.36	(0.48)	2,030
Biological mother						
Year of birth	1923.58	(11.92)	3,227,149	1932.74	(8.89)	10,880
Education	8.18	(2.16)	3,227,149	8.18	(1.92)	10,880
Biological father						
Year of birth	1920.06	(12.49)	3,227,149	1929.14	(9.87)	10,880
Education	8.69	(2.77)	3,227,149	8.43	(2.27)	10,880
Adopting mother						
Year of birth				1922.61	(8.85)	10,880
Education				8.62	(2.51)	10,880
Adopting father						
Year of birth				1919.87	(9.23)	10,880
Education				9.38	(3.12)	10,880

Note: Means and standard deviations of main control and outcome variables.

3.4 The Association between Biological and Adopting Parent Characteristics

A possible concern with the interpretation of the coefficient estimates is that of selective placement of adoptees. Table 3 illustrates the correlation in years of education between adopting and biological parents of adoptees.

Table 3. Correlation between biological and adoptive parents' years of schooling (mothers and fathers respectively), standardized by cohort.

VARIABLES	Mothers	Fathers
Years of schooling	0.1572	0.1708

Note: p-values for significance of all estimates below 0.1 percent.

The correlation for years of schooling is quite similar to that reported by Björklund et al. (2006) for children in cohorts born 1962-1966. There are at least two reasons why we would observe a positive correlation for characteristics of biological and adoptive parents. First, this could happen if some adoptions are made by relatives of one of the biological parents. Second, there could be matching on characteristics known to the adoption agency, either because of the demand of parents, or because of a view that an adopted child would be better off in an adoptive family with similar characteristics as the biological parents.

As discussed in Section 4.4, the empirical importance of the first reason – adoptions by relatives – is likely to be very limited since the rule of not allowing people with own biological children to adopt to a large extent precluded parents and siblings of the biological parents from doing that. As further discussed in Appendix A, Nordlöf (2001) estimated these adoptions to be around 1 percent of the total number of adoptions in the Stockholm area. Brandén et al. (2015) confirm this conclusion, although their estimate of the share of adoptions by close relatives is slightly higher at 5.4 percent, applying to the whole country. They are also able to eliminate those adopted by close relatives from their sample and find that the correlation in years of schooling between (unrelated) adoptive and biological parents of adoptees remains virtually unchanged.

The second reason, matching, is likely to be a more important mechanism. If this matching is made on characteristics observable in the data (such as educational attainment or health characteristics), we are able to control for this in the estimations. In a sensitivity analysis, we will investigate this further by including more detailed health and education data of the biological (adoptive) parents and see what happens to the estimate for the characteristics of adoptive (biological) parents (a similar test was made in Björklund et al. 2006). If we do not see any change, which is what happens (see Section 44), we can rule out matching on observable characteristics as affecting our conclusions.

The remaining reason would then be matching on characteristics that are unobservable in the data. Björklund et al. (2006) investigate this issue by deriving the magnitude of the bias (modeled as a combination of selective placement and measurement error), finding evidence that the bias accounts for at most 13 percent of the estimated impact of the adoptive and biological parents' characteristics on adoptees' educational attainment. We return to and further examine this issue in Section 5.4.1.

A second potential threat to the random assignment assumption is that adoptees may be non-randomly assigned to adoptive families based on health endowments at birth. This would be particularly troubling if more educated adoptive parents are able to select healthier children. While we cannot directly test for this because we lack data on health at birth, we believe this is unlikely to happen for several reasons.[12].

[12] As argued in Björkegren et al. (2019): First, the institutional set up at the time was such that adoptive families were approached as soon as a candidate for adoption became available and there was an excess of candidate

4. Results

4.1 Mortality

Table 4 shows hazard ratio estimates for the association between parental educational attainments and child mortality. For the sake of comparison, Columns 1 and 2 show the results for children raised by their biological parents. The results in this sample suggest that an additional year of maternal and paternal schooling is associated with a decrease in child mortality by 2.6 percent, and that the association is slightly stronger for the fathers' educational attainment. The results shown in Columns 3 and 4 reveal that this association can be entirely attributed to post-birth influences. An extra year of education for the adopting parents is associated with a 2 percent decrease in mortality, while there is no protective effect associated with the educational attainments of the biological parents. In Column 5, we also add adopted children with unknown biological fathers. These results confirm that also for this larger group of adoptees, adopting parents, in particular adopting mothers', educational attainment is inversely related child mortality later in life.

Table 4. Cox proportional hazard model estimates of the associations between parental years of schooling and child mortality. Hazard ratios.

	(1)	(2)	(3)	(4)	(5)
	Non-adoptees		Adoptees		
Education, Bio parents	0.974***		1.016		
	(0.000)		(0.010)		
Education, Bio mother		0.978***		1.028	0.993
		(0.001)		(0.019)	(0.012)
Education, Bio father		0.971***		1.006	
		(0.001)		(0.015)	
Education, Ad parents			0.980***		
			(0.007)		
Education, Ad mother				0.967*	0.973**
				(0.017)	(0.012)
Education, Ad father				0.989	0.996
				(0.013)	(0.009)
N	3,227,149	3,227,149	10,880	10,880	21,386

Note: Results from Cox proportional hazard models. Standard errors in parentheses; *** significant at 1%, ** at 5%, * at 10%. Each column represents a separate regression and all regressions include indicators for gender and

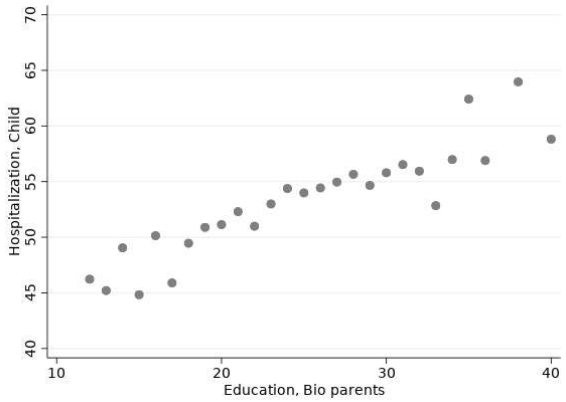
adoptive parents relative to available children. Second, unhealthy infants that were given away by their biological mothers were not offered for adoption (see also Appendix A). Finally, Holmlund, Lindahl and Plug (2008) show that there is no significant correlation between adoptive parents' education, the gender of the adoptee and the biological mother's age at birth – the only two pre-existing characteristics that are available in the data and could potentially proxy for infant health at birth

birth cohort of children, and five-year intervals for parental cohorts. Column (1) and (2) is based on a sample of non-adopted children, column (3) and (4) on adoptees for whom we have information on all parents, and in columns (5) we add adoptees with unknown biological fathers.

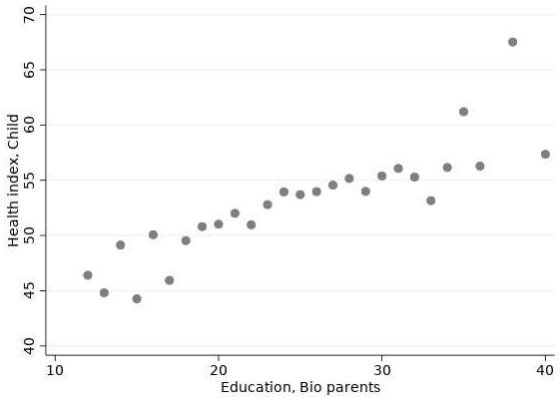
4.2 Health Measures Based on Hospitalization Data

Figure 1 shows the relation between parental education, measured in years of schooling, and child health, measured by our two hospitalization indices. As expected, there is a visible pattern of increasing health by parental education in the samples of non-adoptees. This pattern also applies to both biological and adopting parents in the adoptee sample. The associations are well approximated by a linear relationship.[13]

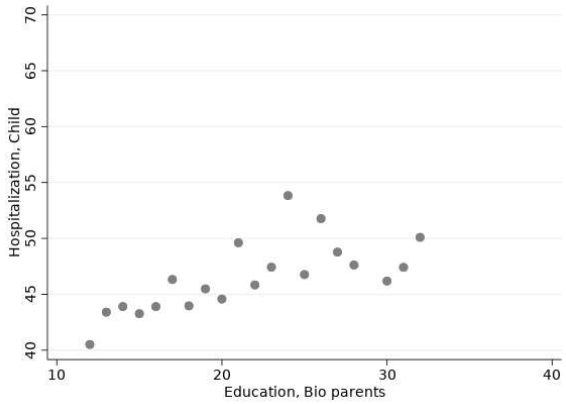
[13] There is a difference in the share with high education among biological and adopting parents. Among the adopted children's biological mothers, 4 % have more than 11 years of education and 2.4 % have 14 years or more. Among adopting mothers 10 % have more than 11 years of education, and 7.9 % have 14 years or more. Thus, the precision of the estimates for this highest educated group of mothers across the biological and adoptive mothers' samples varies significantly.



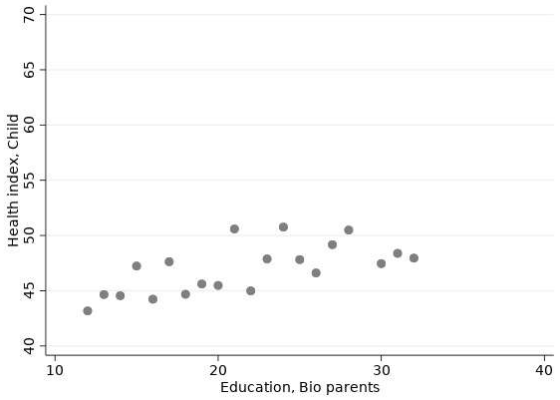
a) Hospitalization, non-adoptees



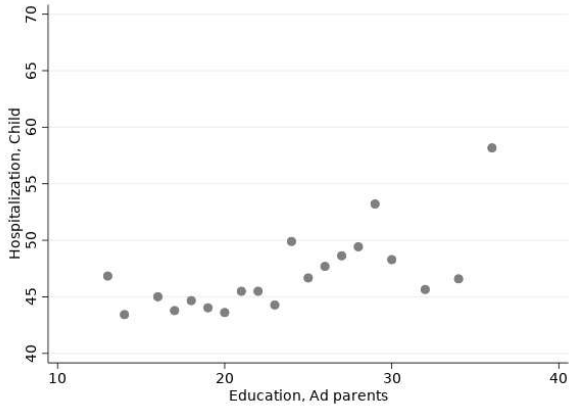
b) Health index, non-adoptees



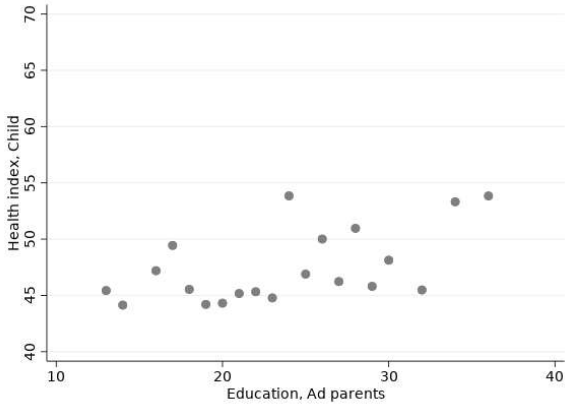
c) Hospitalization, adoptees



d) Health index, adoptees



e) Hospitalization, adoptees



f) Health index, adoptees

Note: The figures plot the relationship between rank child health indices and parental education for non-adoptees and adoptees. Because of small samples in some educational groups, we group these together. 11 years of schooling is plotted together with 12 years, 13 years of schooling is grouped together with 14 years, and 16 years of schooling contains all observations with more than 14 years of schooling.

Figure 1. Mean rank child health (hospitalization based) and parental education

Table 5 shows the results from our linear regression model for the association between parental educational attainments and the ranks of the first measures of child hospitalization. The

results for non-adoptees, shown in Columns (1) and (2), reveal a highly significant association between child health and the educational attainments of the parents. The results for adoptees confirm the significant association between adopting parents' years of schooling and child health obtained in Section 5.1 for mortality as a measure of child health. Moreover, we now find the education of the biological parents to be jointly significant at the 1 percent level. A decomposition of the relative influence of the biological and adopting parents, respectively, gives a close to 50/50 split between biological and adopting parents.

Table 6 presents results for our third health measure. As explained in Section 3, since this index is obtained by predicting age of death from hospitalization data, this measure should be closer to the mortality measure than the pure hospitalization measure used for the results in Table 4. The estimates are, however, very close to those shown in Table 5. The decomposition again gives a close to 50/50 percent split between the biological and the adopting parents.

Table 5. Ordinary least squares estimates of the associations between parental years of schooling and child hospitalization (percentiles rank)

	(1)	(2)	(3)	(4)	(5)
	Non-adoptees			Adoptees	
Education, Bio parents	0.434***		0.254***		
	(0.004)		(0.089)		
Education, Bio mother		0.355***		0.263*	0.521***
		(0.009)		(0.155)	(0.105)
Education, Bio father		0.490***		0.250*	
		(0.007)		(0.129)	
Education, Ad parents			0.244***		
			(0.060)		
Education, Ad mother				0.329**	0.242**
				(0.135)	(0.098)
Education, Ad father				0.178	0.376***
				(0.111)	(0.078)
N	3,227,149	3,227,149	10,880	10,880	21,386

Note: Results from OLS regressions. Standard errors in parentheses; *** significant at 1%, ** at 5%, * at 10%. Each column represents a separate regression and all regressions include indicators for gender and birth cohort of children, and five-year intervals for parental cohorts. Column (1) and (2) is based on a sample of non-adopted children, column (3) and (4) on adoptees for whom we have information on all parents, and in columns (5) we add adoptees with unknown biological fathers.

Table 6. Ordinary least squares estimates of the associations between parental years of schooling and child health index (percentiles rank)

	(1)	(2)	(3)	(4)	(5)
	Non-adoptees		Adoptees		
Education, Bio parents	0.400***		0.210**		
	(0.004)		(0.088)		
Education, Bio mother		0.326***		0.222	0.437***
		(0.009)		(0.153)	(0.103)
Education, Bio father		0.453***		0.205	
		(0.007)		(0.128)	
Education, Ad parents			0.176***		
			(0.059)		
Education, Ad mother				0.279**	0.238**
				(0.134)	(0.097)
Education, Ad father				0.097	0.299***
				(0.110)	(0.078)
N	3,227,149	3,227,149	10,880	10,880	21,386

Note: Results from OLS regressions. Standard errors in parentheses; *** significant at 1%, ** at 5%, * at 10%. Each column represents a separate regression and all regressions include indicators for gender and birth cohort of children, and five-year intervals for parental cohorts. Column (1) and (2) is based on a sample of non-adopted children, column (3) and (4) on adoptees for whom we have information on all parents, and in columns (5) we add adoptees with unknown biological fathers.

4.3. Sensitivity Analyses

4.3.1 Parameter Robustness

Table 7. Parameter robustness with respect to inclusion of different sets of controls in the econometric model. Adoptees only. Dependent variable: Hospitalization.

	(1)	(2)	(3)	(4)
Education, Bio parents	0.3421***	0.2325***		0.2563***
	(0.0865)	(0.0899)		(0.0895)
Education, Ad parents		0.1918***	0.2867***	0.2163***
		(0.0609)	(0.0576)	(0.0596)
Cohorts, Bio mother	Yes	Yes	No	Yes
Cohorts, Bio father	Yes	Yes	No	Yes
Cohorts, Ad mother	No	Yes	Yes	Yes
Cohort, Ad father	No	Yes	Yes	Yes
Health, Bio parents	No	No	No	Yes
Health, Ad parents	No	Yes	No	No
Region, Bio parents	No	No	No	Yes
Region, Ad parents	No	Yes	No	No
N	10,880	10,880	10,880	10,880

Note: Results from OLS. Robust standard errors in parentheses; *** significant at 1%, ** at 5%, * at 10%. Each column represents a separate regression and all regressions include indicators for gender and birth cohort of children. Each column is adding parental characteristics.

4.3.2 Is there any Evidence of "Nature-Nurture Interactions"?

Table 8. Results from models including interactions between measures of educational attainments for biological and adopting parents, respectively.

	(1) Hospitalization	(2) Health index
Bio*Ad parents, education	0.004	0.002
	(0.015)	(0.015)
Education, Bio parents	0.166	0.166
	(0.302)	(0.302)
Education, Ad parents	0.165	0.136
	(0.262)	(0.265)
N	10,880	10,880

Note: Results from OLS regressions. Standard errors in parentheses; *** significant at 1%, ** at 5%, * at 10%. Each column represents a separate regression and all regressions include indicators for gender and birth cohort of children, and five-year intervals for parental cohorts.

4.3.3 Adoptees that Move from their Municipality of Birth

Table 9. Results from econometric models estimated on samples restricted to adoptees that move out from their municipality birth.

	(1) Hospitalization	(2) Health index
Education, Ad parents	0.269***	0.204***
	(0.064)	(0.064)
Education, Bio parents	0.293***	0.242**
	(0.096)	(0.095)
N	9,333	9,333

Note: Results from OLS regressions. Standard errors in parentheses; *** significant at 1%, ** at 5%, * at 10%. Each column represents a separate regression and all regressions include indicators for gender and birth cohort of children, and five-year intervals for parental cohorts. The sample only include adoptees who was adopted by a mother who lived in a different municipality than the biological mother of the adoptee.

4.3.4 External validity

Table 10. Results from econometric models estimated on a sample of the children raised by the biological mothers of the children given up for adoption.

	(1)	(2)	(3)	(4)
	Hospitalization		Health index	
	Non-adoptees	Adoptees	Non-adoptees	Adoptees
Education, Bio parents	0.620***	0.204*	0.635***	0.186*
	(0.051)	(0.107)	(0.051)	(0.105)

Education, Ad parents		0.237***		0.160**
		(0.071)		(0.071)
N	28,817	8,184	28,817	8,184

Note: Results from OLS regressions. Standard errors in parentheses; *** significant at 1%, ** at 5%, * at 10%. Each column represents a separate regression and all regressions include indicators for gender and birth cohort of children, and five-year intervals for parental cohorts. The sample only include children with biological mothers that gave up at least one child for adoption and kept at least one child.

5. Mechanisms

The most important result found in Section 4 was the significant association between the educational attainments of the adopting parents and the health outcomes of the adopted children. To look closer into the mechanisms behind this result we first investigate to what extent this associated to health related behaviors formed relatively early in life. To do this, we use health outcomes for the adopted children obtained at the military enlistment, for males, and when giving birth to the first child, for females, through the National Birth Register. We then look at to what extent the results can be attributed to that more educated parents affect cognitive and non-cognitive skills as well as the child's own educational attainments to be able to distinguish between the so called *pathway hypothesis* and the *life course hypothesis* for the relation between parental SES and child health (see Deaton, 2003).

4.3 Results on early-life health measures associated to health-related behavior

A possible mechanism behind the association between the educational attainments of the adopting parents and the adopted children's health outcomes is that high educated parents transmit better dietary habits and other health-related behavior, such as alcohol consumption and smoking (se e.g. Cutler and Lleras Muney, 2006, for a discussion). These habits may have a long-lasting effect from the adolescence of the child, or, which is probably more conceivable, may form the behaviors of the child that may be reflected in health outcomes later in life.

Table 7 reports the results for seven different regression models with four different health-related outcomes for males and three different outcomes for females, respectively. The measures for males – *BMI, Height, Physical fitness and Physical strength* – are obtained from the military enlistment register. The vast majority of all men in the cohorts born between 1940 and 1967 were enlisted and the tests were obtained at age 18 or 19. The three health measures for females – *BMI, Height and Smoking* – were obtained when the women were registered at a

women's health unit early on in the pregnancy before giving birth to her first child and recorded in the medical birth register. The data source for these variables restricts our sample to women that have given birth after 1973, the starting year of the medical birth register. Women's height and weight are measures early in pregnancy. Smoking is an indicator variable taking the value 1 if the mother responds that she smokes and 0 otherwise, when registered at the childbirth clinic. In addition to our cohort controls we also add controls for mother's age at birth in column (5)-(7).

For the non-adoptees, the results in Table 7 show that there is a significant and strong association between biological parents' education and our seven health measures. Children to more highly educated have on average lower BMI, are taller, are more physically fit and smoke to a less extent. The only unexpected result for non-adoptees shown in Table 7 is the one on physical strength. This result goes away, however, if we include BMI as a control in the regression.

The lower panel of Table 7 shows the results for adoptees. For *BMI,* the results are somewhat contradictory for males and females, since a decomposition analysis would attribute the entire association with parental education to pre-birth factors for females and to post-birth ones for males. A possible background to this result is that the BMI measure is that the measure is obtained later in life for females. It is a well-known results from ACE models that the additive genetic factor is increasing with age in most outcomes. Height is, as excepted, most strongly related to the biological parent's educational attainments for both males and females. The adopting parent's education is, however, also significant for females.

Physical fitness can be attributed to educational attainments of both the biological and the adopting parents. A decomposition of the full effect suggests that about 2/3 of the effect can be attributed to the biological parents versus 1/3 for the adopting ones. Finally, in the female sample, the results suggest that the inverse relation between smoking and parental education can be fully attributed to the adopting parents.

Table 11. Ordinary least square estimates of the association between parental years of schooling and child health measures obtained from enlistment result (males) and from the Medical Birth Register (females), respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Males				Females		
	BMI	Height	Physical fitness	Physical strength	BMI	Height	Smoke
Non-adoptees							
Education, Bio parents	-0.042***	0.148***	0.026***	-0.001***	-0.069***	0.094***	-0.008***
	(0.001)	(0.002)	(0.000)	(0.000)	(0.001)	(0.002)	(0.000)
Observations	794,722	794,946	801,895	802,609	327,985	395,700	450,429
Mean dep. var	21.47	179.00	6.32	5.50	22.48	166.91	0.23
Adoptees							
Education, Bio parents	-0.011	0.145***	0.019***	0.010*	-0.111***	0.130***	-0.004
	(0.015)	(0.034)	(0.005)	(0.005)	(0.029)	(0.045)	(0.003)
Education, Ad parents	-0.030**	0.037	0.009***	-0.001	0.019	0.068**	-0.005**
	(0.012)	(0.024)	(0.003)	(0.003)	(0.019)	(0.027)	(0.002)
Observations	4,018	4,019	4,046	4,051	1,502	1,792	2,003
Mean dep. var	21.60	178.29	6.15	5.44	22.73	166.41	0.36

Note: Results from OLS regressions. Standard errors in parentheses; *** significant at 1%, ** at 5%, * at 10%. Each column represents a separate regression and all regressions include indicators for gender and birth cohort of children, and five-year intervals for parental cohorts. Panel A is based on a sample of non-adopted children, and panel B on adoptees for whom we have information on all parents. Men's outcomes (columns 1-4) is based on conscription data, and women's outcomes (columns 5-7) is based on data from their first birth in the medical birth register. Height is in centimeters, physical fitness and health standardized measures from physical tests made during enlistment. Women's height and weight is measured early in pregnancy. Smoke is an indicator if a woman reported smoking or not in the first trimester.

5.2 *Analysis of Mediating Factors*

Table 12. Mediation analysis.

	(1) Hospitalization, Child	(2) Hospitalization, Child	(3) Education, Child	(4) Non-cognitive	(5) Cognitive	(6) Physical fitness	(7) BMI
Education, Ad parents	0.169*	-0.044	0.069***	0.024***	0.035***	0.010***	-0.029**
	(0.095)	(0.096)	(0.007)	(0.004)	(0.003)	(0.003)	(0.012)
Education, Bio parents	0.468***	0.209	0.085***	0.032***	0.051***	0.018***	-0.012
	(0.143)	(0.143)	(0.011)	(0.005)	(0.005)	(0.005)	(0.016)
Education, Child		0.777***					
		(0.252)					
Non-cognitive		2.498***					
		(0.521)					
Cognitive		2.051***					
		(0.547)					
Physical fitness		-0.067					
		(0.514)					
BMI		-0.927***					
		(0.162)					
N	3,944	3,944	3,944	3,944	3,944	3,944	3,944

Notes: Robust standard errors in parentheses. All models include controls for gender and birth cohorts.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6. Conclusions

Previous studies have shown that there is a strong association between parental educational attainments and child long-term health (see e.g. Smith et al., 1997, and Marmot et al., 2001). In this study we have shown that when this association is decomposed in a pre- and a post-birth component, respectively, the entire association can be attributed to the post-birth one when we look at mortality as health outcome. When we instead analyze the health measures based on hospitalization records, we get a more even split between the pre- and post-birth components.

However, most importantly, our results unambiguously suggest that growing up in home with high educated parents improves the health outcomes of the children as adults.

Our analysis of the mechanisms behind this finding give some support for that formation of health related behavior may be important. For males we find that educational attainments of the adopting parents are negatively associated with BMI as well as physical fitness at age 18 or 19. For females, we find that the education level of the adopting parents is inversely related the probability of smoking at the age when they get their first child.

The mediation analysis shows first that the educational attainments of the adopting parents are associated with the educational attainments as well as the measures of cognitive (measured by IQ tests at the military enlistment) and non-cognitive (measured as ability to lead and cooping with stress) skills. It also shows that most of the association between the educational attainments of the adopting parents and child health can be attributed to these mediating factors.

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Appendix A: Adoptions in Sweden 1940-1967

A.1 The History and Institutions of Adoptions

Adoptions in the period when the children we study in this paper were born were very different from what they are today, in Sweden and in most other Western industrialized countries. At that time, they were dominated by children born in Sweden, and their biological parents were in most cases young and lacked economic resources, or were stigmatized by having an unplanned child, which prevented them from taking care of the baby. International adoptions, although started already in the 1950s, did not overtake domestic adoptions until in the late 1960s. We show the number of Swedish domestic adoptions by year in Figure 1 and as a share of all Swedish-born children in Figure A1.

Domestic adoptions in Sweden have been described in several previous academic works and government documents. Two studies, Bohman (1970) and Nordlöf (2001), use primary sources. Bohman (1970) gives a broad overview and presents results from different empirical comparisons between adoptees and non-adoptees. Nordlöf (2001) focuses on adoptions in the city of Stockholm between 1919 and 1973. She uses archival records from the Stockholm child welfare office (*Barnavårdsnämnden*), which administrated adoptions, to give a description of the adopted children and their families. Several empirical studies using adoptee data, e.g. Björklund et al. (2004) and Oskarsson et al. (2015), also give comprehensive overviews of adoptions in Sweden.

Sweden had its first law regulating adoptions in 1917. This law was changed on several occasions since it was first implemented. However, the original law prescribed several principles that are still in use. One such principle is that the adoption should be "in the best interest of the child", both regarding whether or not the adoption should take place at all and the choice of adopting parents. Another principle was that no payments were allowed between the adopting and the biological parents. Finally, the adopted child should have all the rights regarding inheritance from the adopting parents that their biological children would have had.[14]

The law also prescribed that the adoption should be finalized in a court decision. All administrative work preparing for the adoption, including all contacts with the biological and the adopting parents, was carried out by the child welfare offices (*Barnavårdsnämnderna*). An adoption could be cancelled if both the adopting parents and the child agreed on it when the child had reached the age of majority, or as the result of misbehavior of either party. The latter category included different kinds of abuse of the child as well as general criminal behavior. In 1944, the law was extended to also include major health problems and defects of the adopted child. However, Nordlöf (2001) concludes that cancellations of adoptions were extremely rare in the Stockholm area in the period 1918-1973.

A.2 The Biological Parents

Bohman (1970) and Nordlöf (2001) give a fairly consistent description of the mothers who gave up their children for adoption:[15] they were on average substantially younger than mothers who kept their children; they were, except for a few rare cases, unmarried or divorced; and they did,

[14] The main principle was that the adopted child's rights to inherit his or her biological parents were lost. However, until 1959, some legal connection was kept between the biological parents and the adopted child. These adoptions are sometimes called weak adoptions and entailed that the child was still the heir of her/his biological parents and they were responsible for supporting the child economically if the new adopting parents could not. These legal responsibilities did not imply any further contact between the child and the biological parents. From 1959 onwards, these kinds of weak adoptions do no longer occur and in 1971, all weak adoptions were retroactively made strong, i.e., all legal ties were also cut between the biological parents and the child.

[15] In Section 4, Descriptive Statistics, we return to comparisons between the characteristics of the biological mothers who gave up their children for adoptions and those who did not.

on average, have a lower socio-economic status as compared to the rest of the population, although the differences were quite small. The largest occupational category of these mothers in Nordlöf's study was maids (26 percent), followed by office workers (18 percent) and restaurant workers (15 percent). In most cases, the child was voluntarily given up for adoption with the predominant reason being lack of housing and economic resources for supporting the child. In some very rare cases, it was because the mother died when giving birth or because she suffered from severe health problems.[16]

Bohman (1970) has a description of the biological fathers. Similar to the mothers, they were, on average, younger than those who did not give up their children for adoption; they had a slightly lower average education level, although the difference was quite small; and they had a higher rate of registered alcohol abuse and crime rate.

Nordlöf attributes the rapid decline in domestic adoptions by the end of the 1960s to changes in social policy – including the introduction of housing allowances, the improvement of general housing conditions, increased child allowances and the introduction of childcare. Other important changes in society were the reduced social stigma of having children without being married or being in a steady relationship, the increased availability and usage of contraceptives, and the liberalization of the legislation for abortion.[17]

A.3. The Adopted Child

Most adoptions took place when the child was an infant. The mother had to wait until she had recovered from delivery before she could make the final decision to give the child up for adoption. The child was therefore initially placed in a nursery home and thereafter placed in a prospective adoptive family. The recommendation was that the placement be made before the child was six months old and that the trial period should be between three to six months. If the trial period went well, the adoptive parents would apply to the court for a legal adoption decision.

The children underwent a medical examination before they were adopted. The recommendations for this procedure were described in the *Handbook for Social Workers* (see e.g. Allmänna barnhuset, 1955). Nordlöf (2001) writes that children with physical or mental defects were in general not adopted, but stayed in foster care homes. This was also true for children whose mothers were prostitutes or who were conceived after a rape.

Bohman (1970) finds no significant difference in health at age 10-11 between his sample of adoptees and a control group of non-adoptees of the same age. Oskarsson et al. (2015) interpret this lack of difference as a net effect of two counteracting forces. Adoptees are to a larger extent than non-adoptees born by low SES mothers, which would indicate that they have inferior health. However, as a result of the medical testing before the adoptions took place, children who were eventually adopted are positively selected from this group.[18] In addition, the adoptive parents do often represent higher SES households, which could also have a positive impact on adopted children's health.

We here use our data to show some results where we compare cause of death and health characteristics between adoptees and non-adoptees. Figure A2 shows the number of deaths by year of birth and broken down by the most common causes of death in our sample, which are

[16] In our sample, this is very rare because of the sample restrictions we have made. The restrictions require that parents are present in the Census in the year 1960. Most of our adoptees were born in the period prior to that. However, in the later period, we have about 70 children who have mothers that died close to birth (own birth or adopted sibling's birth). Excluding these children does not affect our results.

[17] A law allowing abortion without any particular reason until the end of week 18 in the pregnancy was passed in 1974. However, it was preceded by a gradual increase in the number of abortions over the previous decade, as the necessary conditions for obtaining a legal abortion were relaxed.

[18] In Section 5 we compare the health status in our sample of adoptees to non-adoptees in the same age group.

circulatory diseases, cancer and all other causes of death.[19] The left-hand panel corresponds to the sample of adoptees and the right-hand panel to the comparison group of non-adoptees. Comparing the death rates in the two panels, it can be seen that it is somewhat higher among adoptees and that the graphs for adoptees are quite noisy as a result of small sample sizes. The share of deaths is quite low for the younger age groups. For the child generation, we therefore use proportional hazard models allowing for right censoring of date of death.

The top panel in Table A1 shows the distribution of all deaths by the main underlying cause of death observed in the sample of adoptees and the comparison group, respectively. The six most common causes of death according to the main chapter in the ICD 10 code are included together with a seventh category, "Other", corresponding to all causes not included in the six most common ones. The last column in Panel A of Table A1 shows the *p*-values for a test of equality between the shares of deaths in the two samples that can be attributed to each of the causes considered. The distributions are quite similar, although adoptees are somewhat less likely to die from cancer and more likely to die from diseases in the digestive organs and from mental disorders.[20]

Panel B in Table A1 shows the shares of the most common causes of hospitalization by main ICD 10 chapter for the groups of adoptees and non-adoptees, respectively. Similarly to the causes of death, the largest differences are in the diagnoses related to problems in the digestive organs and mental disorders.

A.4. The Adopting Parents

The legal requirements for adopting were few; adoptive parents had to be free of tuberculosis, sexually transmitted diseases and be at least 25 years old. In practice, local social authorities followed the recommendation that the adopting family should be young enough to be able to be the biological parents, they had to have adequate housing and they should be married. Furthermore, the father should have a steady income, also implying that the mother should be able to stay at home. The adopting family's suitability for taking care of a child was evaluated by the child welfare offices (*Barnavårdsnämnderna*).

Until 1944, families with own biological children were not allowed to adopt. Nordlöf (2001) documents that it was rare that these families were admitted to adopt also after 1944, since there was always a shortage of children available for adoption and the child welfare offices considered it a disadvantage to have own biological children. This convention did, to a large extent, rule out adoptions in the immediate families of the biological mother or father, such as their mothers or siblings. Nordlöf (2001) estimates such adoptions by close relatives to be only around 1 percent of all adoptions in her sample.

A.5. Matching of Children and Adopting Parents

The social workers were instructed to find adopting parents that fit the child given up for adoption (see e.g. Allmänna barnhuset, 1955). Characteristics such as height and eye color were

[19] Note that the graphs with the share of deaths among adoptees are less smooth than the corresponding graphs for non-adoptees. This is because of the much smaller sample size among adoptees, especially for the early cohorts (for the number of adoptees by birth cohort, see Figure 1).

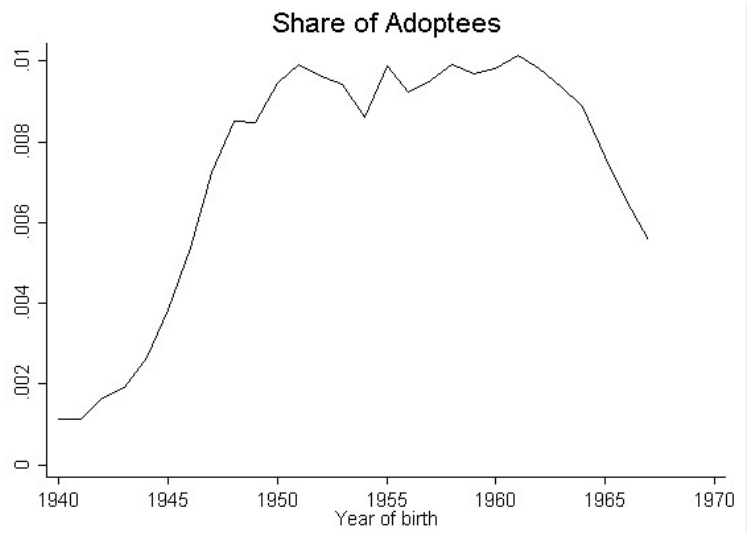
[20] The results in Table 2 are not adjusted for educational attainment or other measure of SES, which could explain the differences. We also know from previous research that adoptees have worse mental health than non-adoptees (see e.g. Miller et al., 2000). Included in digestive causes are K70 (ICD 10), which is an alcohol-related liver disease. The mean of K70 is 0.027 among adoptees, and 0.016 among non-adoptees. This implies that about half of the adoptees' digestive death is alcohol related, and the figure is slightly lower for non-adoptees. This does not explain the entire difference, however.

mentioned in the instructions. However, as pointed out by Björklund et al. (2004), the information available to the social worker about the biological mothers was likely to be quite limited. This was also acknowledged in the instructions, which is reflected in the following quote: "The social worker's ambition to find an adoptive home that fits a specific child particularly well is often unrealistic. The important task is to find good adoptive parents who can be expected to give children in general good conditions."[21]

The prospective adopting parents were able to post requests for characteristics of the child based on heredity. According to Nordlöf (2001), very few used that opportunity in other ways than just stating that they wanted a "healthy child". In very rare cases there were requests for children of mothers with good grades in school. The biological mothers were also able to post requests concerning the prospective adopting parents. Again, very few used that opportunity. Nordlöf (2001) found one request for an "intellectual" and one for an "artistic" family in her material.

From the instructions to the social workers, there are no indications that direct matching on health status between the prospective adopting parents and the child took place.

Figure A1. Share of adoptees of total number of children by year of birth



Note: The figure shows the share of children who were adopted by two parents, relative to non-adoptees, born in year 1940-1967 in Sweden.

Figure A2. Share of individuals in the child-generation sample who died before April 1, 2013. Non-adoptees in the left-hand panel and adoptees in the right-hand panel.

[21] This quotation is originally from Allmänna barnhuset (1969) and was obtained by us from Björklund et al. (2004).

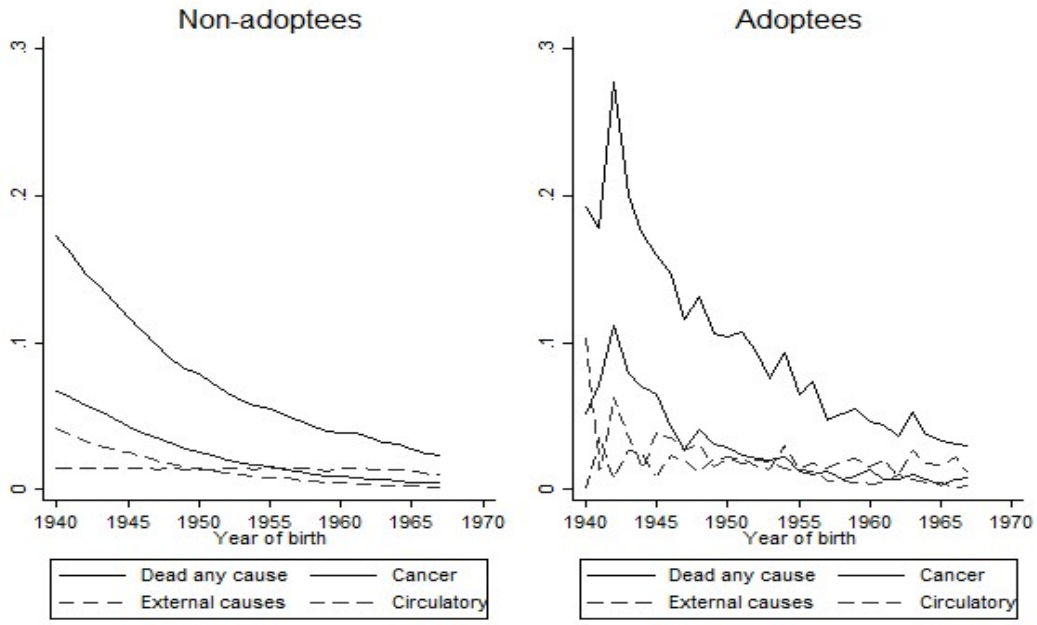


Table A1. Share of deaths and hospitalizations by cause

	Non-adoptees (weighted)	Adoptees (large sample)	*p*-values mean diff
Panel A: Causes of death			
Cancer	0.301	0.254	0.0000
External causes	0.233	0.229	0.7064
Circulatory	0.165	0.181	0.0936
Digestive	0.039	0.059	0.0007
Mental	0.022	0.035	0.0048
Respiratory	0.030	0.032	0.6156
Other	0.210	0.209	0.9772
Share of deaths	0.058	0.077	0.0000
Tot # of deaths	200,350	1,634	
Panel B: Causes of hospitalization			
Cancer	0.095	0.071	0.0000
External causes	0.097	0.099	0.1464
Circulatory	0.092	0.082	0.0000
Digestive	0.097	0.089	0.0000
Mental	0.142	0.202	0.0000
Musculoskeletal	0.065	0.060	0.0000
Genitourinary	0.066	0.057	0.0000
Other	0.346	0.341	0.0017
Mean # hospitalizations/person	0.6037	0.6619	0.0000
Tot # hospitalizations	7,536,949	75,389	

Note: In the third column *p*-values of test for equal share in the group of adopted and non-adopted children are shown. Non-adoptees are weighted by cohort size to be comparable with adoptees.

Appendix B: Additional results

Table B1. Cox proportional competing risk model estimates of the association between parental education and mortality by cause of death.

	(1) Cancer	(2) Circulatory	(3) Preventable	(4) Treatable
Non-adoptees				
Education, Bio parents	0.9807***	0.9799***	0.9650***	0.9601***
	(0.0008)	(0.0012)	(0.0021)	(0.0018)
Mean dep. Var	0.044	0.015	0.007	0.011
Observations	3,227,149	3,227,149	3,227,149	3,227,149
Adoptees				
Education, Bio parents	1.0233	1.0306	1.0199	1.0184
	(0.0195)	(0.0236)	(0.0531)	(0.0313)
Education, Ad parents	0.9610***	0.9917	0.9363*	0.9850
	(0.0146)	(0.0140)	(0.0346)	(0.0280)
Mean dep. Var	0.025	0.018	0.005	0.007
Observations	10,880	10,880	10,880	10,880

Note: Results from Cox proportional hazard models with competing risks. Standard errors in parentheses; *** significant at 1%, ** at 5%, * at 10%. Each column represents a separate regression and all regressions include indicators for gender and birth cohort of children, and five-year intervals for parental cohorts. Panel A is based on a sample of non-adopted children, and Panel B on the sample adoptees for whom we have information on all parents.

Table B2. Cox proportional hazard model estimates of the association between parental education and child mortality excluding children of highly educated parents.

Main table

	(1)	(2)	(3)	(4)	(5)
	Non-adoptees		Adoptees		
Education, Bio parents	0.973***		1.016		
	(0.001)		(0.012)		
Education, Bio mother		0.977***		1.034*	1.034*
		(0.001)		(0.020)	(0.020)
Education, Bio father		0.971***		1.004	
		(0.001)		(0.016)	
Education, Ad parents			0.994		
			(0.010)		
Education, Ad mother				0.997	0.997
				(0.020)	(0.020)
Education, Ad father				0.991	0.990
				(0.015)	(0.015)
N	3,066,782	3,066,782	9,878	9,878	9,878

All models include controls for gender and birth cohorts.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B3. Quantile regression estimates of the relation between parental educational attainments and child hospitalization.

	(1)	(2)	(3)	(4)	(5)	(6)
	25th percentile		50th percentile		75th percentile	
Education, Bio parents	0.586***	0.145	0.406***	0.416***	-0.000	-0.000
	(0.006)	(0.105)	(0.003)	(0.132)	(2.049)	(0.010)
Education, Ad parents		0.349***		0.326***		0.000
		(0.078)		(0.091)		(0.006)
N	3,227,149	10,880	3,227,149	10,880	3,227,149	10,880

Notes: Robust standard errors in parentheses. All models include controls for gender and birth cohorts.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B4. OLS regression estimates of the relation between parental educational attainments and child hospitalization by child gender.

	(1)	(2)	(3)	(4)
	Females		Males	
	Non-adoptees	Adoptees	Non-adoptees	Adoptees
Education, Bio parents	0.418***	0.250*	0.449***	0.262**
	(0.005)	(0.130)	(0.005)	(0.124)
Education, Ad parents		0.223***		0.276***
		(0.086)		(0.083)
N	1,578,905	5,239	1,648,244	5,641

Notes: Robust standard errors in parentheses. All models include controls for gender and birth cohorts.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B5. OLS regression estimates of the relation between parental educational attainments and child hospitalization by child gender.

	(1)	(2)	(3)	(4)
	Females		Males	
	Non-adoptees	Adoptees	Non-adoptees	Adoptees
Education, Bio parents	0.352***	0.213*	0.446***	0.206*
	(0.005)	(0.128)	(0.005)	(0.123)
Education, Ad parents		0.107		0.251***
		(0.085)		(0.083)
N	1,578,905	5,239	1,648,244	5,641

Notes: Robust standard errors in parentheses. All models include controls for gender and birth cohorts.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$