Parental income gradients in mortality during childhood and adolescence: Long-term trends across half a century using Norwegian administrative data

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Abstract: While mortality among children is low in many Western countries, there is less knowledge about socioeconomic differences in child mortality, and how these differences have evolved. In this study, we use data from the Norwegian Medical Birth Registry, the Cause of Death Registry and income data from Statistics Norway, all available from 1967 and onwards, to examine if declines in mortality are shared equal across children from all parental earnings quintiles. To begin, we find a sharp decline in child mortality in all parental earnings quintiles since 1967 up to the 2010s. Throughout the period, however, children in the lowest parental earnings quintile have an elevated risk of early-life mortality. Further, controlling for additional sociodemographic characteristics of the mother (i.e., age at birth, education, marital status, and immigrant background) only slightly reduces the mortality difference by parental earnings.

Introduction

Child mortality rates have declined sharply over the past century in wealthy Western countries, including Norway and are today at an all-time low. Despite these overall declines and the current low numbers, child mortality rates continue to be high on the research agenda. One reason for this interest is a growing concern that income inequalities may be on the rise and that worsening conditions for disadvantages may be responsible for such an increase conferred at an early age may be responsible for this. Debates about widening income inequality has further been fueled by recent evidence pointing to increasing health inequality among adults (Chetty et al., 2016; Warren & Hernandez, 2007). That is, even if measures of overall health has improved it has done so less for disadvantaged socioeconomic groups. Thus, it has been questioned whether the decline in child mortality has been equal across all socioeconomic groups.

In the empirical analyses, we aim to estimate the association between parental income and mortality in childhood and adolescence over time using data from the Norwegian Medical Birth Registry, which contains information on all births from 1967 and onwards, matched with individual-level income data from Statistic Norway. We study child mortality two ways: (1) death before age one and (2) mortality conditional on survival to age one throughout childhood and adolescence. We also examine trends in causes of death by using data from Cause of Death Registry, and relate the results to demographic characteristics and health status of newborns.

Background

A robust finding in research on population health is the substantial socioeconomic differences in health outcomes (Adler & Ostrove, 1999; Warren & Hernandez, 2007). These differences are found among adults (Chetty et al., 2016; Kinge et al., 2019), adolescents (Reiss, 2013), and children (Finch, 2003; Kramer, Seguin, Lydon, & Goulet, 2000) alike. Moreover, socioeconomic differences in health? are not only apparent in countries with a large difference between rich and poor, such as the US, but low socioeconomic status is associated with poorer health also in countries with less income-inequality and with universal access to prenatal, perinatal and other medical care, such as OECD countries (Mackenbach, 2012).

Considering socioeconomic disparities in specifically child mortality is important for many reasons. First, health and mortality among infants is a sensitive indicator of social conditions in the society and thus knowledge about determinants and trends over time will inform us about the social conditions into which children are born (Sidebotham et al., 2014). Importantly, there is accumulating evidence on the malleability of infant and child health (Currie, 2011). For example, infant mortality is linked with business cycles and the introduction of social policies, such as food

assistance programs. The expansion of Medicaid has also been linked with linked to overall lower levels of child mortality beyond infancy (Howell, Decker, Hogan, Yemane, & Foster, 2010).

There are several risk factors linking low socioeconomic status with adverse health outcomes at birth (Aizer & Currie, 2014; Finch, 2003). Education-often used as an indicator of low socioeconomic status-has consistently been linked with better health among adults, but also among their children. The exact mechanism(s) linking higher education with better health is not known, but health behavior is one important factor. For example, behaviors such as smoking, alcohol use, and drug use is related to adverse child health outcomes, and these behaviors are strongly socially patterned, where a higher rate of women with lower levels of education are more likely to use these stimulants more likely to use these stimulants (Grøtvedt, Kvalvik, Grøholt, Akerkar, & Egeland, 2017).

Another literature focus on the possible consequences of stress. Many sources of stress, such as economic hardship, loss of family members and divorce are distributed unequally, so that those with low socioeconomic status are at a higher risk of exposure (Schneiderman, Ironson, & Siegel, 2005). A body of literature has focused on the link between prenatal stress and child outcomes. For example, there is increasing evidence that stress in utero is related to low birth weight and preterm birth (Almond & Currie, 2011; Torche, 2011), which are some of the leading causes of infant mortality. Prenatal depression has also been associated with growth delays in the fetus, premature birth, and low birth weight (Field, 2011). Other studies have shown large socioeconomic differences in some specific mortality diagnoses, such as in intentional injuries, which are consistent with social stress (Howell et al., 2010).

Although, a large body of research has related low socioeconomic status to child health at birth and across childhood, another question is if and how the association between socioeconomic status and child health has changed over time. On many accounts, health behaviors among women have improved. For example, women's educational level has gone up, and trends in overall smoking rates have gone down (Grøtvedt et al., 2017). In many countries, including Norway, there are also national guidelines for pregnancy checkups to ensure that all individuals receive the same services provided free of cost.

Although many health behaviors have improved among pregnant women over time, there has also been an increase in some conditions among women that are related to adverse birth outcomes such as diabetes and high pre-pregnancy weight (Eidem et al., 2011). Recently, there has also been a focus on increasing income inequality and possible implications of this for health and mortality. While prior literature has documented strong associations between poverty and adverse birth outcomes (Kramer et al., 2000), increasing inequality in itself is not necessarily associated with worse outcomes. For example, Aizer and Currie (2014) have shown that even amidst increasing inequality in the US, infant health improved. However, this might reflect initial levels of inequity and strong presence of welfare institutions. Further, less is known about trends in child mortality by socioeconomic status beyond infancy (i.e., later in childhood and adolescence).

Data and methods

We use data from Norwegian administrative registers. Unique personal identifiers allow for linkage between children and parents across registers, and for some cohorts, also to grandparents. We collate data from the Medical Birth Registry with information on all births in Norway, the Cause of Death Registry and income data from Statistics Norway available annually from 1967 to 2015.

Measures of income

Our measure of income comes from yearly reports of pension-generating income, which includes both wages and self-employment income. These data are available on an annual basis from 1967 and onwards. We constructed a parental income measure by using the information on both mothers and fathers income. We used information on income in the one year before birth.

Based on the measure of average parental income we ranked the individuals in 5 quintiles where the lowest bin contains the 20 percent of parents with the lowest income, and the highest quintile contains the 20 percent parents with the highest income. We opt for a rank-based measure, as this is constant relative in time as opposed the nominal income differences or education level in the population for that matter. In addition, we plan to include measures of grandparent's income to ascertain children's social background. Other measures of income will also be used.

Demographic characteristics

In some models, we also include information about the child's gender, whether the child is the first-born child of his or her mother, immigrant background (one or both parents are foreign-born), number of siblings, mother's age at birth, and parental education.

Analytical approach.

In order to examine the association between parental income and child mortality, we estimate the association between parental income quantiles one year before birth and child mortality. For these preliminary analyses, we use linear probability models and examine whether the child died within the first year of life.

Preliminary results

Figure 1 shows the preliminary results between parental income and child mortality within the first year of life from 1968 up to 2015 (for two-year birth cohort intervals). In Panel A, we see that the decline has been substantial overtime for all socioeconomic groups. However, the lowest quintile group still has a more elevated risk of child mortality across all years. In Panel B, we estimate the same trend but compare the lowest parental income quintile (quintile 1) to all other parental income quintiles combined (quintiles 2-5) and include 95% confidence intervals around each point estimate. In both panels, we see the clear pattern that child mortality is substantially higher in the lowest parental income

In Table 1, we present results from multivariate regressions where we compare child mortality in the lowest parental quintile with all other parental income quintiles (reference category) before and after controls for mother's age at birth, mother's education, mother's marital status, and mother's immigrant background. When combining all birth cohorts, we find that the probability of child mortality during the first year of life is about 0.3 percentage points higher in the lowest parental quintile (compared to a probability of about 0.5 in all other parental income quintiles, cf. constant in Model 1). This amounts to an about 60% higher probability of child mortality in the lowest parental quintile. Controlling for mother's age at birth reduces the higher probability of child mortality in the lowest parental quintile to about 0.2 percentage points and adding additional controls does not change this estimates substantially.

Overall, these results show that despite a clear decline in child mortality since the late 1960s in Norway, there is still an elevated risk among children of mother's with the lowest earnings. This elevated risk is not explained by other standard sociodemographic characteristics of the mother. Before the conference, we will assess how child mortality have evolved for later ages (i.e., ages 1-5, 6-10, 11-15, and 16-21). Further, we will examine socioeconomic differences in causes of death (i.e., intentional injuries, child cancer, accidents, and infectious diseases). In the multivariate analyses, we will also take change across birth cohorts into account in more detail.

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(A) Child mortality by parental earnings quintile (no CIs)

Legend:
- ○ Quintile 1 (lowest)
- □ Quintile 2
- ◇ Quintile 3
- ▲ Quintile 4
- + Quintile 5 (highest)
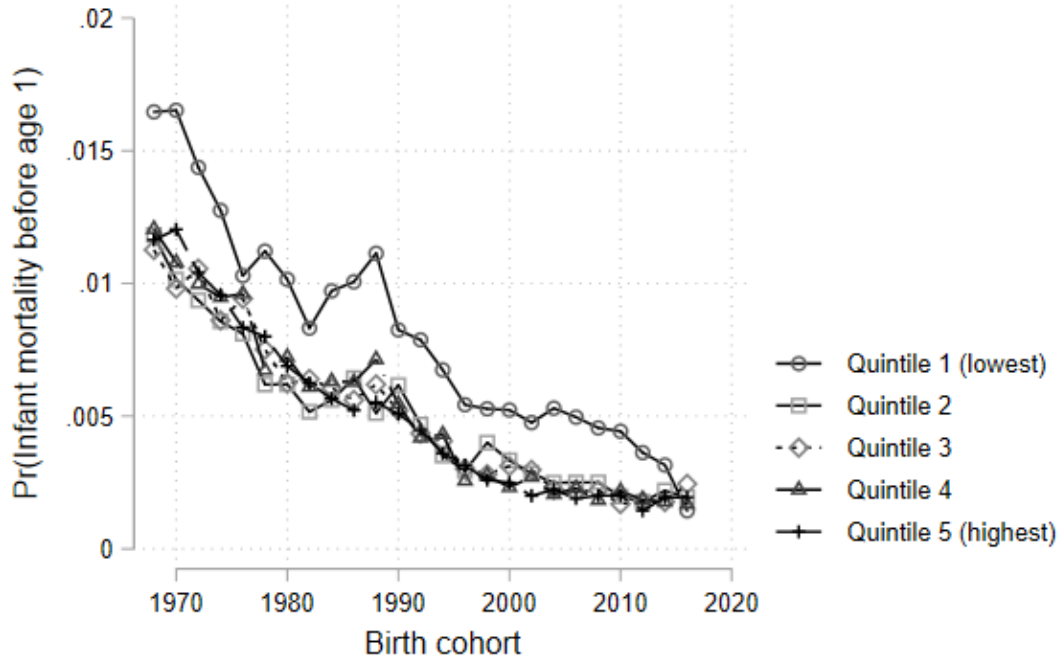
(B) Child mortality, lowest parental earnings quintile vs rest (95% CIs)
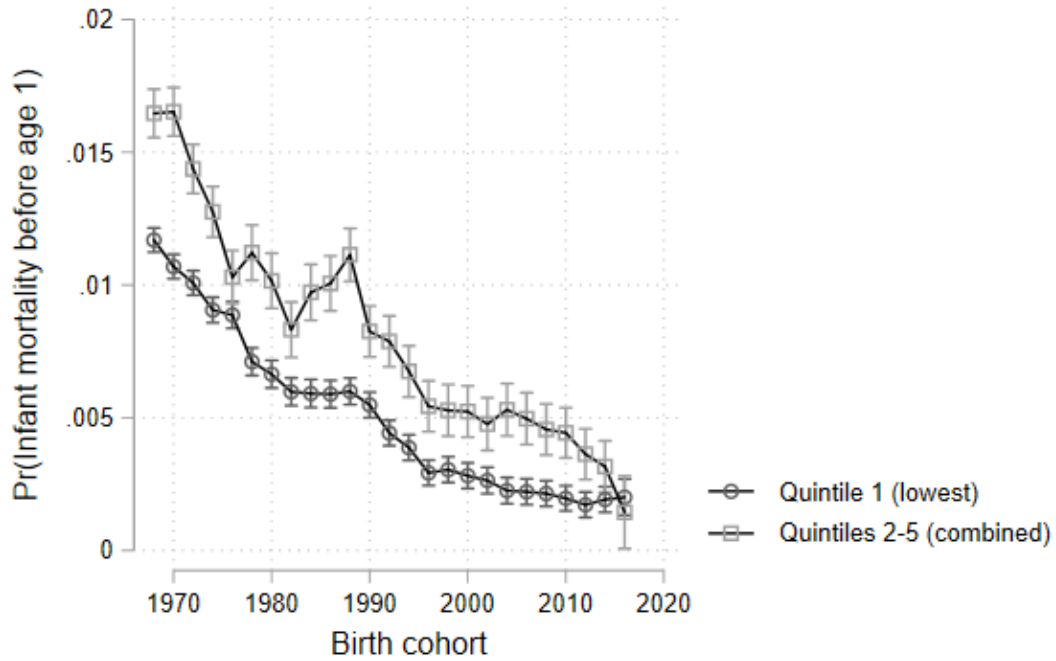

Legend:
- ○ Quintile 1 (lowest)
- □ Quintiles 2-5 (combined)

Table 1: The association between parental income and child mortality (before age 1)

	Model 1	Model 2	Model 3	Model 4	Model 5
Parental income quintile (ref. quintiles 2-5)					
Lowest income quantile	0.00308***	0.00216***	0.00206***	0.00190***	0.00202***
	(0.00011)	(0.00012)	(0.00013)	(0.00013)	(0.00013)
Mother's age at birth		-0.00204***	-0.00064***	-0.00065***	-0.00064***
		(0.00007)	(0.00008)	(0.00008)	(0.00009)
Mother's age at birth, squared		0.00003***	0.00001***	0.00001***	0.00001***
		(0.00000)	(0.00000)	(0.00000)	(0.00000)
Mother's educational attainment at birth (ref. = basic)					
Primary education			0.00130*	0.00152*	0.00081
			(0.00063)	(0.00063)	(0.00065)
Lower secondary education			0.00163*	0.00176**	0.00102
			(0.00064)	(0.00064)	(0.00066)
Some upper secondary education			-0.00054	-0.00014	-0.00085
			(0.00063)	(0.00063)	(0.00065)
Full upper secondary education			-0.00024	0.00005	-0.00069
			(0.00070)	(0.00071)	(0.00072)
University, BA			-0.00071	-0.00040	-0.00112
			(0.00063)	(0.00063)	(0.00065)
University, MA			-0.00133*	-0.00104	-0.00173*
			(0.00065)	(0.00066)	(0.00067)
University, PhD			-0.00222*	-0.00198	-0.00255*
			(0.00104)	(0.00104)	(0.00105)
Mother's marital status					
Married				-0.00124***	-0.00129***
				(0.00010)	(0.00010)
Co-habitant				0.00039*	0.00034
				(0.00019)	(0.00019)
Divorced				0.00121*	0.00119*
				(0.00052)	(0.00052)
Mother's immigrant background (ref. = native-born majority)					
First-generation immigrant					-0.00555***
					(0.00142)
Second-generation immigrant					-0.00079***
					(0.00022)
Constant	0.00520***	0.03637***	0.01280***	0.01313***	0.01371***
	(0.00005)	(0.00106)	(0.00138)	(0.00141)	(0.00142)
R-squared	0.00026	0.00062	0.00060	0.00069	0.00070
N	2 848 159	2 848 159	2 848 159	2 848 159	2 848 159