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Evidence from Germany

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Marcus Tamm*

The Effect of Poverty on the Health of Newborn Children – Evidence from Germany

Abstract
This paper analyses the association between health outcomes of newborn children and mother's poverty status during pregnancy. We use a new questionnaire accompanying the GSOEP which collects abundant information on health outcomes. The findings indicate that there is generally no effect from poverty to health, except on the probability of preterm birth. Furthermore, we find some indication of intergenerational transmission of health status.

JEL classification: I12, I39, J13.

Keywords: Poverty, child birth, doctor visits

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1. Introduction

At first glance, German child poverty rates do hardly look disconcerting. Fluctuating around 6–8% for many years, they have been moderate compared to other industrialized countries. Yet, they have been rising during the past few years. Most importantly, there are some problem groups which are extremely affected by poverty. Children in lone parent households even display rates up to 40% (Corak et al. 2005). Therefore public concern exists, especially regarding future prospects of the affected children. This paper analyzes one factor which might be influenced by poverty during childhood, child health.

Child health and especially health during early childhood are of particular relevance for research because these periods of human development also exert an important influence on later stages of life, not only on health but on a whole range of outcomes (e.g. Case et al. 2005; Doblhammer 2004; Lindeboom et al. 2005). Additionally, medical assistance necessary to treat newborn children with health problems, for example low birth weight, generates high expenses for society (e.g. Almond et al. 2004). Hence, knowing the underlying causes of health problems might open up opportunities for policy interventions designed to reduce them.

Health has always been regarded as one of the most important sources of human well-being, not only because of its direct effects on happiness but also due to the indirect effects. One indirect effect works through the influence health might have on the productivity of individuals and therefore their capacity to generate income. Hence, in the economic literature health has often been compared to investment goods like education. This is one way how income and health are related.

But clearly the relation between income and health is not unidirectional (e.g. Smith 1999). While health tends to affect the ability to accumulate income, income might as well influence health outcomes. The economic literature suggests that health status or the probability to be in good health are subject to individual characteristics like age, gender, or genetic factors and to health investments like preventive or curative medical inputs, or a health-promoting style of life (e.g. Grossman 1972). In fact, income might have an effect either by facilitating access to medical inputs or by being associated with other health-improving aspects of life. This is the effect addressed in our paper.

That income seems to be highly correlated with health status, however, does not help in identifying the direction of causality from income to health or vice versa. Furthermore, in addition to any causal links, there might be unobservable "third" factors which make some people healthier and wealthier at the same time. Thus, identifying the causal effect of income or poverty on health is rather demanding. Ideally one would like to isolate variations in in-

come which reflect the same long-term traits as health status from those fluctuations which are exogenous to health status. To this end, one would need the whole history of health inputs, other socioeconomic factors and inherited endowments. Yet, these are generally not available, and alternative convincing identification strategies have to be found.

In this paper we concentrate on parental income and child health which allows us to eliminate or at least reduce the link from health to income which characterizes adult health. This is a clear advantage of using child health compared to adult health. For the same reason we only use income from the year before the child was born, since the child's health status might affect parental labor market attachment and therefore household income, too. Yet, since income generally is not assigned randomly and our data doesn't cover a time span long enough to include periods with substantial exogenous variation in income (as e.g. in Frijters et al. 2004), there might remain unobservable traits which simultaneously influence parental income and their capacity to bear healthy children. We try to capture (part of) these by including information on parental behavior and also try to proxy unobserved "third" factors, such as inherited endowments, by including information on parental health. Of course, since there might be further unobservable factors, the remaining income effect might not be causal. However, the analysis will help to point towards pathways why income and health are correlated.

Our findings indicate that poverty increases the probability of preterm birth but has no effect on other health outcomes of newborn children. The number of doctor visits and days in a hospital during the first three months after birth is unaffected by poverty, too. For some health outcomes, we see that children whose mother has been in good health status during pregnancy are better off. The malign effects of unfavorable behavior, here proxied by smoking, is once more confirmed and being the firstborn child seems to lead to lower health outcomes as well. Surprisingly, individuals who are insured in a private health company display a considerably higher number of doctor visits.

The outline of the paper is as follows. The next section provides a short survey on the empirical analysis of income effects on health. In section 3 our data is described and section 4 provides the results of our estimates. This section is subdivided into two parts, the first is concerned with health outcomes of newborn children and the second part analyzes doctor and hospital visits of these children during the first three months after birth. Section 5 concludes with a tentative discussion of policy implications.

2. Income Effects on Children's Health – The State of the Literature

It is well documented that children living in poor families experience a higher risk to attain poor outcomes in various aspects of life. These outcomes comprise children's cognitive, social and emotional development, school achievements, health and overall well-being. This risk variation would contribute to the inequality of opportunities for children and intergenerational transmission of poverty if it reflected a causal mechanism. The presumption of such a causal link is one of the main arguments why especially families with children should be protected by the welfare system.

A good survey on empirical evidence for a whole range of child outcomes is provided in Mayer (2002). She mainly focuses on the United States but also mentions studies on other industrialized countries. Until quite recently, there was relatively little research on health effects of income, especially compared to other outcomes like cognitive development or school achievement. Yet, an influential study by Case et al. (2002) boosted economic research in this field. Generally, results on the effect of income on health are mixed, in some cases income appears to be significantly damaging, in others not. This holds for a whole variety of possible health outcomes.

For a long time, a positive relationship between income and health has been documented in many studies, however, few of them controlled for other socioeconomic factors or parental background, nor used strategies in order to identify causal relations. Only some recent exceptions try to uncover potential pathways of income effects on child health.

Concentrating on the association between income and malnutrition in the United States, Korenman/Miller (1997) analyze the prevalence of low height-for-age (stunting) and low weight-for-height (wasting). They control for different indicators of poverty, accounting for depth, duration and timing of poverty during the life cycle and estimate several models trying to build confidence in this causal inferences, e.g. by controlling for former health outcomes, by using information on the parents' health, and by using fixed-effects estimators based on differences between cousins. On the one hand, poverty significantly augments the prevalence of stunting. In this case, the timing of poverty does not play a significant role. On the other hand, wasting is not significantly affected by income in this analysis.

Case et al. (2002) find significant income effects on self-assessed health of children (as reported by their parents). The effect is more pronounced for older children and persists along the entire income distribution. Especially low long-run household income is associated with a lower health status of children. The effect diminishes when parental education and health are included as covariates but it does not vanish. Mother's health exerts an important influ-

ence on child health. This might suggest that health is transmitted between generations, i.e. some parents have healthier children and higher income, both because of their better health status. But tests with adoptive parents cast doubt on this simple genetic story of intergenerational health transmission. In addition, controlling for health-related behaviors does not have any major impact on the income effect.

The above results are also confirmed for Canadian children despite their coverage in an universal health insurance system. Currie/Stabile (2003) additionally find that health shocks have similar long-term effects on children with high and low socioeconomic status but that children with low socioeconomic status are more likely to experience health shocks at each point during childhood. They conclude that the income effect is, thus, not likely to work through a better provision of palliative care by higher income families. Replicating the study by Case et al. (2002) with British data, Currie et al. (2004) also find a significant effect of income on self-assessed health, though smaller than in the US, but not on more objective measures of child health.

Burgess et al. (2004) focus more on the pathways of transmission of income to child health. They find little evidence for unfavorable behavior being the mechanism behind the observed correlation, whereas mothers' health seems to be of more importance. Including the corresponding variables reduces the effect of income considerably, which for some measures of child health even becomes insignificant. The single most important determinant of child health appears to be mothers' mental health before childbirth, either being transmitted genetically, having an influence on how efficient mothers are in producing child health or resulting in differences in utilization of medical help for children.

The influence of income on health appears to become more important with increasing age (e.g. found by Case et al. 2002 and Currie, Stabile 2003, however not by Burgess et al. 2004 and Currie et al. 2004). This seems to be associated with the arrival of new chronic health conditions and not with a persistent reflection of health at birth. The importance of chronic conditions is also found in Case et al. (2005) who show that several outcomes in adulthood (health, educational attainment and employment) are still influenced by child health. For adult health, chronic conditions during later childhood are much more important than health problems at birth. Yet, health conditions at birth increasingly gain in importance the older people get.

For Germany there is hardly any analysis reporting more than just correlations. One example is Geyer et al. (2002) who find that socioeconomic status and some diseases and/or the duration of hospital stays resulting from these diseases are correlated. For instance, children with lower socioeconomic status

have more infections of the respiratory organs and display longer hospital stays with this infection and with infections of the upper respiratory tract.

Most of the above-mentioned studies focus on older children and take initial endowments of child health, like low birth weight, as given. In this paper we try to fill this gap. We focus on health outcomes directly related to birth which, thus, represent initial endowments. The link between these initial endowments and income is separated into several possible pathways. For this analysis we use a completely new data set supplementing a well-known German household panel, the GSOEP. In the next section we first describe our data base and then go on estimating models for various health outcomes of newborn children.

3. Data

In the empirical analysis we use data from the *German Socio-Economic Panel* (GSOEP). The GSOEP is a representative longitudinal study of private households in Germany (Haisken-DeNew, Frick 2003). It collects information on households and all their members older than 16 years of age. Information collected includes household socioeconomic composition, occupational biographies, employment, income and earnings, as well as health and life satisfaction indicators. For the first time in wave 2003, GSOEP includes a special questionnaire for mothers having born a child within the last year. This new questionnaire collects information on the mother and on the newborn child.

In the case at hand, the unit of observation is the newborn child. In waves 2003 and 2004 there are 565 newborn children in the data. On the one side, we have information on the health status of the child. Health information is available on the birth weight, the height at birth, the head circumference at birth, the gestational week, any confirmed disorders of the child, the number of times medical assistance has been used within the first 3 months after birth, and the duration of hospital stays. On the other side, we can merge information on the biological mothers and other members of family, e.g. their age, education, labor market and health status, and family income.

In order to asses the influence of income on child health we use several income measures, i.e. equivalent household income and an indicator of poverty. Household income is equal to the sum of labor income including income from self-employment, asset income, income from private and public transfers and pension income summed over all household members. From these we subtract tax payments and social security contributions to derive net household income. Equivalent household income is then obtained by dividing net household income by the square root of the number of household members. This is the hypothetical income attributed to each member of the household. Poor in-

Table 1

Basic Characteristics for Entire Sample

	Mean	Std. Dev.	# Observations
Child information			
Child is a girl, in %	48.7		565
Birth in pregnancy week	39.0	2.5	551
Birth weight, in grams	3318	580	564
Birth height, in cm	51.0	3.1	563
Head circumference, in cm	35.5	3.6	511
Doctor visits during first 3 months	1.53	3.06	554
Visits to a hospital during first 3 months, in days	1.87	8.28	557
Child is first child of the mother, in %	44.6		565
Age of child at survey, in months	7.1	3.9	563
Child delivery in hospital, in %	97.3		565
Child was "planned", in %	70.4		565
Family information			
Mother was poor the year before, in %	7.4		457
Mother was poor two years before, in %	7.8		451
Mother's age	30.9	5.5	557
Mother's education, in years	12.6	2.7	530
Mother in good general health the year before, in %	70.5		508
Mother in good physical health during pregnancy, in %	72.9		561
Mother in good mental health during pregnancy, in %	83.8		560
Mother smoked the year before, in %	22.1		285
Mother worked full time the year before, in %	33.1		523
Mother worked part time the year before, in %	34.4		523
Mother did not work the year before, in %	32.5		523
Father lives in household, in %	91.8		564

dividuals are defined as those with annual equivalent income equal to 50% or less than the median equivalent income.

Table 1 reports basic characteristics on the newborn children and their mothers. Information is given for the entire sample together with the number of non-missing observations. Virtually all children were delivered in a hospital and on average have been born 7 month before the interview. 49% of them are girls and 92% live in a household together with the mother and the father. The average mother is 31 years of age at the time of the interview and was educated for 13 years. Most newborn children (55%) are not the first child of their mother and 7% of the mothers were poor in the year before the child was born.

The health information on children is used to construct indicators for poor health. Children with a birth weight of less than 2500 grams have *low birth weight*, those with less than 48 cm height at birth are *small*, those with a head circumference smaller than 33 cm have a *small head size* and those who are

Table 2

Children's Health Status Separately for Poor and Non-Poor Mothers

	All children		Mother non-poor		Mother poor		t-test: Poor minus non-poor
	Share/ number	Std. Dev.	Share/ number	Std. Dev.	Share/ number	Std. Dev.	
Low birth weight	0.088	0.283	0.083	0.276	0.147	0.359	–1.27
Preterm birth	0.152	0.360	0.136	0.343	0.364	0.489	–3.51
Small	0.103	0.305	0.102	0.303	0.121	0.331	–0.35
Small head size	0.089	0.284	0.087	0.283	0.103	0.310	–0.29
Disordered	0.042	0.200	0.043	0.202	0.029	0.171	0.37
Medical assistance (times)	1.637	3.191	1.635	3.167	1.654	3.566	–0.03
Visits to hospital (in days)	1.955	8.592	1.897	8.570	2.704	9.003	–0.47

Author's calculations, GSOEP-Data. – Calculations for medical assistance and visits to hospital only based on children older than 3 month.

born before the 37th gestational week are *preterm births*. *Disordered* children are those with one or more confirmed regulatory or neurological disorders, disordered motor functions, chronic illnesses or other disorders. For children where complete information on family income is available the health indicators are reported in table 2. In the first column results are given for the entire sample. In the other columns the information is separately given for children in poor and non-poor families. Here and during most of the study, the family's poverty status refers to the calendar year before the child was born and most of the mothers were pregnant[1].

The most prevalent indicator of poor health is *preterm birth* (15% of all children). The least prevalent health problems are *disorders*. 4% of all children are affected by disorders, only one of the affected children was born into a poor family. Due to health problems during the first 3 months after birth, children needed medical assistance 1.6 times on average and went to hospital for 2 days. In the last column of table 2 a t-test on the difference between poor and non-poor children indicates that children with preterm birth are significantly more prevalent in poor families. There, more than a third was delivered before the 37th gestational week. For all other health problems, we see that both groups are equally affected.

Clearly, these are only correlations. Other factors that are both associated with poverty and good or bad child health might overstate or hide the effect of income on health. Therefore, we will also present several multivariate regressions trying to separate the effect of income. We will start with a basic model where poverty (income) is the only explanatory variable together with gender, an indicator for foreign households and some characteristics of the mother.

[1] Since income information is available on a yearly basis, we have to refer to calendar years. The calendar year before the child was born generally is the year in which its mother was pregnant. Of course, this is not true if the child was born within the last 3 months of a year.

Mother's characteristics incorporated into the analysis are her age and educational status. Since this basic model does not rule out the existence of unobservable characteristics, which influence family income and children's health at the same time, we additionally include further characteristics of the mother in a second model, e.g. her health status. Additionally we test several long-run indicators of income. In the following section the regression results will be presented in detail.

4. Results

This section provides the estimation results of our empirical analysis of newborn children's health in Germany. We start by estimating a model for binary outcomes where different health indicators are separately explained by the child's gender, the citizenship of the household head, the poverty status of the child's mother in the calendar year before the child was born, and further characteristics of the mother. The binary outcome model we use is the complementary log-log model, which is preferable to a Logit or Probit model when the outcome is rare, as is the case in our analysis[2]. The underlying cumulative distribution function is based on an extreme value distribution leading to the conditional probability $\Pr(y=1|x)=1-\exp(-\exp(x'\beta))$. For the information on *medical assistance* comparable specifications are estimated using count data models. These estimates are provided in the second part of this section. In order to check for sensitivity of our results we also use equivalent household income instead of mother's poverty status (some of the latter results are reported in the appendix).

Binary Health Indicators:
In our basic model we include information on the child's gender and poverty status and also on several characteristics of the mother which might have influenced the child's development during the childbearing period. Apart from mother's age we include her educational level. If parents' education is omitted from the list of covariates this may bias the income coefficient, because income and education generally are highly correlated. High parental (especially mother's) education may lead to better knowledge on health-relevant information which might result in a more protective environment for children's health and often is associated with a healthier style of life.

As can be seen in table 3, in the first basic model only few of the explanatory variables are significant. The child's gender does not influence any of the newborn's health indicators, nor does mother's education. None of the children born into a foreign household suffers from *low birth weight*. Furthermore, foreign children are significantly less often affected by *small head size* (–9 per-

[2] None of our results rests on the specific distributional assumption. By and large results are similar when using e.g. a Probit model.

Table 3

Complementary log-log Results for Health Indicators and Poverty Status (Basic Model)

	Low birth weight		Preterm birth		Small	
	Marg. effect	Std. error	Marg. effect	Std. error	Marg. effect	Std. error
Poor year before	0.1003	0.0952	0.2402	0.0962***	0.0021	0.0597
Girl	0.0235	0.0320	0.0197	0.0339	0.0350	0.0291
Foreign household	dropped		0.0416	0.0490	–0.0316	0.0352
Mother's age	–0.0029	0.0033	0.0025	0.0033	0.0007	0.0029
Mother's education	0.0066	0.0067	0.0021	0.0071	–0.0004	0.0061
Observations	356		426		434	
LR-statistic	4.86		10.61*		2.32	

	Small head size		Disorder	
	Marg. effect	Std. error	Marg. effect	Std. error
Poor year before	–0.0016	0.0512	–0.0032	0.0308
Girl	–0.0038	0.0237	0.0082	0.0154
Foreign household	–0.0883	0.0221**	–0.0194	0.0159
Mother's age	–0.0015	0.0025	0.0040	0.0013***
Mother's education	0.0012	0.0050	–0.0043	0.0032
Observations	401		435	
LR-statistic	8.52		8.95	

Author's calculations, GSOEP-Data. – *** indicates significance of the underlying coefficient at 1% level, ** at 5% level, * at 10% level.

centage points) and *disorders* are more prevalent among children of older mothers. The latter effect appears quite low compared to the others. On average the probability to give birth to a child with disorders increases by only half a percentage point per year of mother's age, which, however, leads to a 4 percentage points difference between mothers becoming pregnant at age 35 instead of age 25[3]. Confirming the results from table 2, the probability of *preterm birth* is significantly higher by 24 percentage points in poor families. For all other health indicators poverty is insignificant even at the 10% level.

Clearly, children's health might not only be affected by these observable factors but also by parental health. This might be due to inherited diseases or a less beneficial environment in mother's womb during pregnancy. Alternatively, parental health might be a "third factor" which affects family income and is inherited by children at the same time. Therefore, in the following specification, we also include two indicators of mother's physical and mental health during pregnancy. These indicators of good mother's health are derived from questions on self-assessed health and equal one if the mother reported a good or very good mental/physical state during the last third of pregnancy. Furthermore, we include an indicator for children who are the first child of the mother. On the one side, mothers with more than one child are clearly more experienced with pregnancy. On the other side, there might be a selection process,

[3] We additionally tested specifications also including the square of mother's age. Age squared was always insignificant and, thus, is dropped in the specifications presented in the text.

Table 4

Complementary log-log Results for Model Controlling for Mother's Health

	Low birth weight		Preterm birth		Small	
	Marg. effect	Std. error	Marg. effect	Std. error	Marg. effect	Std. error
Poor year before	0.0537	0.0639	0.2129	0.0908***	–0.0034	0.0490
Girl	0.0317	0.0237	0.0218	0.0323	0.0415	0.0258
Foreign household	dropped		0.0476	0.0485	–0.0217	0.0324
Mother's age	–0.0001	0.0026	0.0041	0.0034	0.0030	0.0027
Mother's education	0.0020	0.0051	–0.0017	0.0070	–0.0034	0.0054
M's good physical status	–0.2151	0.0510***	–0.0948	0.0445**	–0.1051	0.0401***
M's good mental status	0.0319	0.0235	0.0232	0.0412	0.0312	0.0297
Firstborn child	0.0678	0.0315**	0.0715	0.0404*	0.0841	0.0337***
Observations	352		422		430	
LR-statistic	38.10***		19.01**		17.30**	
	Small head size		Disorder			
	Marg. effect	Std. error	Marg. effect	Std. error		
Poor year before	–0.0139	0.0267	–0.0070	0.0194		
Girl	0.0016	0.0166	0.0055	0.0116		
Foreign household	–0.0576	0.0178*	–0.0198	0.0106		
Mother's age	0.0007	0.0019	0.0034	0.0012***		
Mother's education	–0.0027	0.0036	–0.0030	0.0024		
M's good physical status	–0.1306	0.0400***	–0.0265	0.0190*		
M's good mental status	0.0158	0.0182	–0.0509	0.0316**		
Firstborn child	0.0644	0.0265***	0.0133	0.0153		
Observations	398		431			
LR-statistic	37.06***		21.62***			

Author's calculations, GSOEP-Data. – *** indicates significance of the underlying coefficient at 1% level, ** at 5% level, * at 10% level.

only those mothers not having had any health-related problems with their first child opt for further children and thus represent a selected sample of women.

The results in table 4 indicate that healthy mothers have significantly healthier children. This holds for all health indicators analyzed here. It is mainly mother's good physical status which is associated with a reduction of the probability of children having *low birth weight, preterm birth, small* height or *small head circumference* by between 9 and 22 percentage points. Mental health is significant only for disorders (–5%)[4]. As expected, being the mother's firstborn child is not favorable to health. These children are more often born with *low birth weight, small* height and *small head circumference* and have a marginally higher probability for *preterm birth.* The inclusion of mother's health and of the firstborn indicator does not change any of the other coefficients, in particular being poor remains significant for *preterm birth*. Note, as opposed to the last specification in table 3 the LR-statistics now indicate that all models have significant explanatory power.

[4] If mothers learn about the health status of their child before delivery, mothers' mental health might not be exogenous. In the case of disorders, which among others comprise physical and mental disabilities and chronic illnesses, this could be a problem.

In order to check whether the results are influenced by our definition of poverty, we also estimate these models replacing poverty by equivalent income and its square. As before, only preterm birth is significantly affected by income (table 8 in the appendix). Here we find that income has a positive coefficient and its square a negatively one, giving an inverted u-shaped relation. The turning point of this function is located at above 41 000 € per year, i.e. at more than two times the median income. All other characteristics by and large don't change compared to the preceding specification.

Further tests with more general indicators for mother's health show that good or very good self-assessed general health in the year before birth has no effect, except for *disorders*. There, the negative marginal effect of mental health drops from –5 to –3 percentage points and general health becomes significant (–5%). Without any major significant effect are mother's weight and height, mother's body mass index (BMI), father's BMI and father's general health status (not reported)[5]. The inclusion of mother's type of insurance, i.e. private vs. compulsory health insurance, does not have any effect.

In order to point towards pathways why income and health are correlated, we now include additional variables like mother's labor market participation or smoking. These results are not reported in the tables but available upon request. Discriminating between working full time, working part time and not working on the labor market, we do not find any difference between these three states. This holds independent of using labor market status during the first, second or third trimester of pregnancy. Smoking, however, is significantly associated with the probability to give birth to a child with *low birth weight* (+10%) and with *small* height (+14%)[6]. Yet, these variables are quite likely to be endogenous and thus any results should not be interpreted as representing causal effects. For example the decision to work full-time might reflect financial endowments of the household and thus is jointly determined with income. A comparable argument holds for smoking, which often goes hand in hand with other unfavorable unobserved characteristics. Therefore, we do not argue that smoking reflects the causal effect of addiction to cigarettes but is seen as a proxy for health-damaging behavior.

Another mechanism why income and health are correlated might be differences in the ability to purchase and consume certain goods. Most influential in this context might be housing conditions. We thus include information on whether the family lives in a residence with central or floor heating, with bal-

5 BMI and weight are measured in the year 2002, only. This (i) provides us only with a crude measure of mother's "natural" weight and BMI, because for most of the women these are measured at some time during pregnancy and (ii) reduces sample size considerably.

6 Smoking is only reported in 2002, such that sample size reduces considerably when controlling for this information.

cony or terrace, or with a garden, whether the condition of the building is good and, if not so, whether this is due to financial restrictions, and whether it is located in a good neighborhood and, if not so, whether the choice of neighborhood is due to financial restrictions. Furthermore, we also include information on whether the mother generally is unable to purchase a vacation of at least one week each year due to financial restrictions. For *preterm birth*, the negative effect of poverty remains significant at the 10%-level at least but reduces to 13–16 percentage points when controlling for residence with a garden or for living in a bad neighborhood[7]. These in turn are associated with an increase of the likelihood of preterm birth of 7 (residence without garden) and 30 percentage points (bad neighborhood), respectively.

Experiencing some kind of (emotional) shock or situations of stress during pregnancy might also be damaging for the yet unborn child and the probability of shocks/stress might be correlated with poverty status[8]. Shocks might be the loss of the partner, e.g. by separating from one another, or unexpected events in the labor market, as for example a job loss. Here, we only tested for changes in the family environment. The proxy variable "living together with a partner at the time of the interview" is insignificant in all cases and does not change any of the other results. Another "shock" might also have been "pregnancy by accident". At least among those children getting to see the light of day we do not observe any negative health effect for those not having been "planned" (as reported by the mother).

Because poverty is a dynamic and heterogeneous process, not only current poverty status is relevant for explaining health or other outcomes, but also the whole poverty history might be relevant. In the case at hand, the observed children are generally less than 1 year old such that the relevant period should only be current poverty or the mother's experience during pregnancy. Nevertheless, we are able to also control for longer time horizons and check the effects of mother's poverty status and equivalent household income two years before childbirth. This leads to a reduction of sample size but hardly any change in levels of significance for the other variables. Only in two cases changes in the effect of income are worth mentioning. When also controlling for poverty two years before childbirth, poverty one year before birth becomes significant at the 10%-level for *low birth weight* (16 percentage points

7 Since there is item non-response on housing information, the sample is smaller than the one reported in tables 3 and 4. The marginal effect of poverty on preterm birth without controlling for housing conditions is already lower in this sub-sample at approximately 18 percentage points.

8 There are some empirical studies in the epidemiological literature dealing with the relationship between stress and preterm birth. For Germany, Dudenhausen/Kirschner (2003) find some positive correlations between very high stress during pregnancy and preterm birth. However, live events like death of a friend or family member, conflicts with the partner, family strains or problems at the work place have no significant effect in this study.

higher probability) and poverty two years before childbirth is significant for *small* height (+30 percentage points).

Summing up, we find that good mother's health during pregnancy results in best chances for having healthy children. Financial endowments of the mother during pregnancy do not affect most health outcomes, except preterm birth. The probability of this outcome is more than 20 percentage points higher among poor mothers. Including a whole range of other covariates generally does not lead to a reduction of the observed difference. Only when controlling for housing conditions these take up part of the negative effect of poverty.

Medical assistance:
The information on doctor visits and on days in a hospital represent indirect indicators of child health, which are broader than the specific indicators presented in the first part of this section. Furthermore, medical assistance provides information on access to health services. Clearly, both variables are count data. Since more than 52% of the newborn children never had any *visit to a doctor* during the first 3 months after birth, which was due to health problems and not due to regular check-ups, zero counts are prevalent. For *days in a hospital* the rate of non-users is even at 90%. There is also a clear indication of overdispersion which conflicts with the assumptions of the Poisson distribution, which generally is a starting point analyzing count data. Alternative options are to apply either a zero inflated Poisson or negative binomial model or a hurdle model (e.g. Greene 2003; Winkelmann 2000), as it is implemented below.

The Poisson model is a model which generally is used to fit models of the number of counts of an event but it implies a very restrictive assumption, mean and variance of the dependent variable are equal. Another assumption is independence of events through time, i.e. visiting the doctor once should not have an influence on the probability of subsequent events. This might not be appropriate for medical visits because a single spell of illness might lead to several doctor visits related to one another. An alternative to the Poisson model is the negative binomial model. Here, variance and mean are allowed to differ and overdispersion can be overcome.

Yet, both models assume that the observations with zero counts are generated by the same underlying process. I.e. in principle each observation should potentially have the chance to experience the event. This might not apply to our setting. Just for the moment, imagine that the outcome number of doctor visits can be interpreted as a result from two regimes, e.g. to be sick or not to be sick. Those who are not sick do not go to the doctor. Only sick children go there, but some of the sick also have zero visits. Hence, in this case the zero visits are governed by two different processes. This can be dealt with by using zero inflated Poisson (ZIP) or zero inflated negative binomial (ZINB) models.

An alternative to zero inflated models is a hurdle approach. There, the two regimes and the underlying decision processes may even be less related to one another than in the zero inflated models, such that the outcome in governed by a two-stage decision. In the first stage, the patient decides on visiting the doctor or not. After the first visit has been initiated the number of further visits (second stage decision) is then governed by the doctor and no longer exclusively influenced by the patient. In this case, the second stage decision might be influenced by additional or even a completely different set of explanatory variables. The hurdle model is estimated by combining a model for binary outcomes (e.g. a Probit model) with a truncated at zero count model (Poisson or negative binomial).

In order to test the above-mentioned models among each other several tests have been developed. The Poisson model is a special case of the negative binomial model and can be derived from it by setting the overdispersion parameter to zero. Therefore a likelihood-ratio test on the overdispersion parameter equal to zero can be used to discriminate between the models. Under the null hypothesis Poisson is consistent and efficient and under the alternative hypothesis negative binomial remains consistent whereas Poisson doesn't. The same arguments and tests apply to ZIP vs. ZINB models. By contrast, since Poisson and ZIP, negative binomial and ZINB, and any of these and a hurdle model are non-nested models, an appropriate test between the models cannot rely on testing a set of parameters but has to test for different distributions. The Vuong test (Vuong 1989) identifies which of the conditional models is closest to the true conditional distribution, but does not require that either of the two models be correctly specified.

For both number of doctor visits and days in a hospital we estimate several specifications restricting the sample to those children who were older than 3 months at the time of the interview. On the one hand, we distinguish the models by sets of explanatory variables which are included as covariates, and, on the other hand, by the underlying distributional assumptions of the process. In all cases, a negative binomial model is preferred to the Poisson and a ZIP model is preferred to the Poisson without zero inflation. Unfortunately, the ZINB model failed to converge for some specifications of number of doctor visits[9]. Yet, for those with a solution the ZINB is preferred to the ZIP and to the negative binomial. For days in hospital the ZINB is always preferred to the ZIP and to the negative binomial. Furthermore, the hurdle model, which is specified as a Probit for the first stage decision and a truncated negative binomial for the second stage, is preferable to the ZIP, too. Finally, the Vuong test is indecisive between ZINB and hurdle, where both provide estimates. Taking these tests as evidence for a mixing or two-part specification, we focus the de-

[9] Problems of convergence in ZINB models have also been reported by e.g. Grootendorst (1995) and Gerdtham (1997).

Table 5

Hurdle Models for Number of Doctor Visits

First stage: initial doctor visit (Probit model)	Model 1		Model 2		Model 3	
	Marg. effect	Std. error	Marg. effect	Std. error	Marg. effect	Std. error
Poor year before	0.0839	0.1089	0.0754	0.1098	0.0756	0.1103
Girl	0.0646	0.0531	0.0594	0.0535	0.0528	0.0540
Foreign household	–0.1858	0.0682**	–0.1835	0.0690**	–0.1768	0.0699**
Mother's age	–0.0039	0.0053	–0.0053	0.0059	–0.0069	0.0059
Mother's education	0.0013	0.0110	0.0022	0.0114	0.0039	0.0115
M's good physical status			–0.0080	0.0631	0.0097	0.0640
M's good mental status			–0.1211	0.0784	–0.0957	0.0810
Firstborn child			–0.0237	0.0605	–0.0301	0.0611
Disorder					0.3427	0.1057**
Second stage: number of visits (truncated negative binomial model)	Incidence rate ratio	Std. error	Incidence rate ratio	Std. error	Incidence rate ratio	Std. error
Poor year before	0.8189	0.3808	0.8847	0.4347	0.7282	0.3263
Girl	0.5598	0.1356**	0.5302	0.1305**	0.5393	0.1189***
Foreign household	0.6124	0.2359	0.6047	0.2346	0.5895	0.2109
Mother's age	1.0096	0.0261	0.9895	0.0264	0.9735	0.0233
Mother's education	0.9548	0.0468	0.9517	0.0488	0.9645	0.0438
M's good physical status			0.8595	0.2494	0.9602	0.2585
M's good mental status			0.8895	0.3101	1.0156	0.3306
Firstborn child			0.5643	0.1460**	0.5611	0.1349**
Disorder					3.6160	1.3816***
Alpha	2.7055		2.3347		1.5606	
LR-statistic (alpha=0)	235.84***		223.13***		178.42***	
Observations	358		356		356	
Zero observations	171		170		170	
Wald test (full model)	9.13		11.92		17.78**	
Vuong test (vs. ZIP)	3.23***		3.21***		3.22***	
Vuong test (vs. ZINB)	§		§		0.02	

Author's calculations, GSOEP-Data. – *** indicates significance of the underlying coefficient at 1% level, ** at 5% level, * at 10% level. § indicates that ZINB model did not converge. Calculations only based on children older than 3 months.

tailed discussion on the hurdle estimates. Whenever appropriate, we also report on differences between hurdle and ZINB.

First we report the results for *number of doctor visits*. Here, the basic hurdle model (model 1) is comparable to the basic models for the binary health indicators above. I.e. our explanatory variables are the child's gender, nationality, mother's age, education, and her poverty status in the year before childbirth. Results for this hurdle model are reported in the first two columns of table 5. The top panel of the table presents the marginal effects of the Probit model together with their standard errors. The Probit model captures the process governing the decision on the first visit. Here, only the citizenship of the household head is significant. For children in foreign households, the probability to visit a doctor at least once is lower by 19 percentage points, ceteris paribus. This might indicate that foreign children are healthier or that foreigners are somehow restricted in access to medical services.

The bottom panel of the table reports the incidence rate ratios for the second stage decision on the frequency of visits. The baseline is an incidence rate ratio of one. Values greater than one indicate higher number of events and values smaller than one a lower number compared to the baseline. E.g. in model 1, having been poor during pregnancy reduces the number of doctor visits by 18% compared to a child living in a non-poor family, yet being insignificant in this case. In model 1, only the indicator for girls is significant. Their number of visits is lower by 44%, once having had a first visit. Note, conditional on visiting a doctor at least once the average number of doctor visits is 3.4.

In model 2 we additionally control for mother's health status during pregnancy and an indicator for firstborn children. Being the mother's first child reduces the number of doctor visits of the child by 44%. This finding is quite surprising, since firstborn children were shown to generally display a lower health status and mothers of firstborn children are often regarded as extremely cautious with their child's health. All other factors, i.e. mother's education, age, health, and the family's poverty status have no influence.

In table 6 we present estimates for comparable specifications (models 1 and 2) analyzing *days in a hospital*. As with number of doctor visits, we find that children in foreign households are less likely to ever visiting a hospital (–10 percentage points). Children of older or physically healthy mothers also have a lower chance to go there. The frequency or duration of the stay, however, is not influenced by these factors. Poverty status and all other factors do not influence the decision on initial contact, nor the number of days in hospital.

Clearly, the number of doctor visits and, even more, days in a hospital are not independent of the health indicators analyzed in the first part of this section. While *disorder* is the health indicator with the lowest correlation with *days in a hospital* (table 7), it is the only health factor which significantly contributes to explaining *doctor visits*. As expected, disorder leads to a higher number of doctor visits (table 5, model 3). Compared to model 2, in model 3 we also include an indicator for children having disorders. Disorder is highly significant for both parts of the model. For these children the probability of at least one visit rises by 34 percentage points and, conditional on having visited the doctor at least once, the number of doctor visits almost quadruples. All other factors remain virtually the same.

For days in a hospital, we do not separately control for each of the health indicators but include a multidimensional indicator being equal to one, if the child has at least one of the negative health outcomes analyzed above, zero otherwise. Having at least one of the negative health outcomes both increases the probability of at least one day in hospital by 13 percentage points and almost triples the number of days, conditional on being there at least one day (table 6, model 3). In the ZINB specification of model 3 foreigner becomes insignificant in the first stage decision.

Table 6

Hurdle Models for Days in a Hospital

First stage: initial contact to hospital (Probit model)	Model 1		Model 2		Model 3	
	Marg. effect	Std. error	Marg. effect	Std. error	Marg. effect	Std. error
Poor year before	0.0231	0.0633	0.0156	0.0593	0.0004	0.0510
Girl	–0.0016	0.0281	0.0007	0.0275	–0.0070	0.0276
Foreign household	–0.1030	0.0218***	–0.1017	0.0212***	–0.0975**	0.0210
Mother's age	–0.0056	0.0028**	–0.0054	0.0030*	–0.0046	0.0031
Mother's education	–0.0042	0.0062	–0.0049	0.0062	–0.0077	0.0064
M's good physical status			–0.0673	0.0392*	–0.0310	0.0360
M's good mental status			0.0372	0.0304	0.0407	0.0276
Firstborn child			0.0019	0.0313	–0.0135	0.0306
Health problems					0.1310	0.0445***
Second stage: number of days (truncated negative binomial model)	Incidence rate ratio	Std. error	Incidence rate ratio	Std. error	Incidence rate ratio	Std. error
Poor year before	2.6780	2.0929	2.1562	1.9222	2.4263	1.8533
Girl	0.7359	0.2680	1.0066	0.4461	0.7910	0.3142
Foreign household	0.2447	0.3158	0.3717	0.5265	0.1969	0.2613
Mother's age	1.0251	0.0376	1.0455	0.0388	1.0527	0.0355
Mother's education	1.1303	0.1072	1.1020	0.1171	1.0425	0.1015
M's good physical status			0.8268	0.3792	1.0841	0.4590
M's good mental status			1.3652	0.8299	0.9832	0.5246
Firstborn child			1.9050	0.8834	1.7264	0.6982
Health problems					2.7320	1.0207***
Alpha	0.9602		0.8550		0.6359	
LR-statistic (alpha=0)	312.14***		272.79***		198.38***	
Observations	359		357		328	
Zero observations	35		35		34	
Wald test (full model)	11.96**		14.65*		24.67***	
Vuong test (vs. ZIP)	3.51***		3.41***		2.78***	
Vuong test (vs. ZINB)	–0.62		0.01		–0.13	

Author's calculations, GSOEP-Data. – *** indicates significance of the underlying coefficient at 1% level, ** at 5% level, * at 10% level. Calculations only based on children older than 3 months.

Further results not reported in the tables show that the inclusion of long run poverty or of additional information on parental health (mother's BMI, father's health status) does not exert any effect and that all of the results remain virtually the same using equivalent income instead of poverty status. Once they made an initial doctor visit with their child, mothers living without a partner go there twice as often as comparable mothers with a partner do, while those with an unplanned pregnancy go there half as often. For days in hospital, we also find a somewhat higher number of days for mothers without a partner.

Another interesting result unfolds when including mother's type of health insurance[10]. Children whose mother has a private health insurance display a sig-

10 German health insurance is a two-tier system. Most people are covered by compulsory insurance, only self-employed workers, civil servants and high income earners are allowed to switch to private insurance, but don't have to. In our sample only 9% of the mothers are covered by private health insurance.

Table 7

Correlations between Days in Hospital, Doctor Visits and Health Indicators at Child Birth

	Days in hospital	Low birth weight	Preterm birth	Small	Small head size	Disorder	Poor year before	Doctor visits
Days in hospital	1							
Low birth weight	0.4395***	1						
Preterm birth	0.3398***	0.5199***	1					
Small	0.3610***	0.5730***	0.4677***	1				
Small head size	0.3507***	0.6091***	0.4421***	0.4407***	1			
Disorder	0.0850	0.0215	–0.0205	0.0161	–0.0241	1		
Poor year before	0.0365	0.0574	0.0428	–0.0373	0.0149	0.0011	1	
Doctor visits	0.3503***	0.0924*	0.0584	0.0543	0.0991	0.3310***	0.0234	1

Author's calculations, GSOEP-Data. – *** indicates significance at 1% level, ** at 5% level, * at 10% level. Calculations only based on children older than 3 months.

nificantly higher number of doctor visits conditional on having at least one visit. They go there 3 times more often than their counterparts whose mother is insured in the compulsory system (table 9 in the appendix). This extremely high effect might stem from two different mechanisms. Either it might really be related to the type of insurance or it might be spurious correlation induced by the positive correlation between private insurance and very high income. Since our poverty indicator splits the income distribution at a very low level, and income might have different effects at different levels of the distribution, private insurance might take up the effect of very high income. Yet, this is questionable because the insurance effect does not disappear when using equivalent income and its square instead of the poverty indicator (not reported).

Thus, the observed effect is more likely to be linked to the type of insurance per se. Privately insured people might either put a higher value to health and thus the effect might reflect differences in preferences. On the other hand, the effect might result from better access to medical services. Although the compulsory system claims to cover all necessary treatment, a doctor might be more apt to ask privately insured clients to visit him more often, for good reason or not. The latter explanation seems quite appealing since the type of insurance only affects the number of visits, conditional on at least one visit, but not the initial decision to go there. This might reflect the different ways the German insurance system regulates the remuneration of doctors. Generally, privately insured clients pay more for the same treatment than compulsory insured clients do. However, the available data does not allow for discriminating between the pathways through which type of insurance affects doctor visits. For days in a hospital, we do not find any comparable effect.

5. Conclusions

This paper provides new insights into health outcomes of newborn children in Germany and their relation to poverty status. Concentrating on children allows us to eliminate the link from health to income. Furthermore, the data enables us to use information on parental health as proxy for unobserved "third" factors or for factors which are passed on from parent to child, i.e. inherited endowments. This helps in identifying pathways of the effect of poverty on health.

The data consists of more than 500 newborn children and reports several health outcomes as well as the number of doctor visits and days in a hospital during the first three months after birth, which were due to health problems and not due to regular medical check-ups. It is based on a completely new questionnaire supplementing the German Socio-Economic Panel (GSOEP). In our sample, approximately 7% of the mothers were living in relative poverty in the year before childbirth.

The findings indicate that there is no significant relation between poverty status and most health outcomes of newborn children. However, preterm birth is significantly more likely by more than 20 percentage points among poor mothers. Furthermore, mother's health status has a significant effect on a couple of aspects of child health, at least mother's health during pregnancy. I.e. there is clear indication of intergenerational transmission of health factors to newborn children. Yet, it is not clear if these are due to inherited endowments or if it is the healthy environment in mother's womb which is beneficial for the child. Contrary to Burgess et al. (2004), we find that mother's physical health is more important than mental health, except for disorders of the child.

Being the firstborn child seems to lead to lower health outcomes. It is associated with low birth weight, small height and small head circumference. Unfavorable behavior, in our analysis proxied by smoking, reduces child outcomes as well. Since smoking (and other health-damaging behavior) is still quite common among pregnant women, policy interventions with a focus on altering such behavior might be promising in reducing poor health outcomes of children. Analog to other studies, we do not find that including information on behavior reduces the effect of poverty on preterm birth.

On the other hand, controlling for housing conditions reduces the effect of poverty somewhat. Nonetheless, an increase of the likelihood of preterm birth by 13–15 percentage points is still substantial. Thus, additional monetary aid for nascent mothers in financial hardship might be a way of reducing societal costs and long-term disadvantages for children at risk. Although it is not entirely clear whether the observed effect is truly due to monetary endowments, backing nascent mothers might be more economical than other interventions because both the target group is well defined and the period of aid is limited.

Surprisingly, being insured in a private health company augments the number of doctor visits of the newborn child considerably. Ascertaining the underlying reasons has to remain an issue for future research. Other factors leading to more doctor visits are being the firstborn child and having other poor health outcomes at birth.

The sometimes limited explanatory power of the estimated models might not only be due to insufficient model specification but also due to the still small number of observations on newborn children. Since the new questionnaire "Mother and Child" will be surveyed in all future waves of the GSOEP, future research will be able to check these first preliminary results. Of course, the low explanatory power is also an indicator of high unforeseeable hazard which is not in the sphere of influence of human behavior. Deeper insight, also on the long run effects on health, is hopefully achieved by follow-up interviews on these children, as is planned by the GSOEP team.

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Appendix

Table 8

Complementary log-log Results for Health Indicators and Equivalent Income
Model Controlling for Mother's Health

	Low birth weight		Preterm birth		Small	
	Marg. effect	Std. error	Marg. effect	Std. error	Marg. effect	Std. error
Income year before	–1.81E-06	3.39E-06	–9.65E-06	3.74E-06**	–1.25E-06	3.72E-06
Income² year before	1.27E-11	5.39E-11	1.16E-10	4.70E-11**	8.96E-12	6.07E-11
Girl	0.0308	0.0237	0.0242	0.0326	0.0407	0.0259
Foreign household	dropped		0.0401	0.0472	–0.0235	0.0320
Mother's age	0.0004	0.0028	0.0052	0.0035	0.0035	0.0028
Mother's education	0.0021	0.0051	–0.0014	0.0073	–0.0027	0.0056
M's good physical status	–0.2198	0.0511***	–0.1010	0.0451**	–0.1042	0.0399***
M's good mental status	0.0331	0.0232	0.0224	0.0420	0.0311	0.0298
Firstborn child	0.0763	0.0333**	0.0981	0.0427**	0.0894	0.0355***
Observations	352		422		430	
LR-statistic	37.85***		16.67*		17.58**	

	Small head size		Disorder	
	Marg. effect	Std. error	Marg. effect	Std. error
Income year before	1.70E-06	2.54E-06	–1.04E-06	1.44E-06
Income² year before	–1.80E-11	3.87E-11	1.86E-11	1.70E-11
Girl	0.0019	0.0167	0.0080	0.0126
Foreign household	–0.0565	0.0180*	–0.0200	0.0110
Mother's age	0.0002	0.0020	0.0033	0.0013***
Mother's education	–0.0028	0.0036	–0.0036	0.0027
M's good physical status	–0.1289	0.0398***	–0.0257	0.0195
M's good mental status	0.0152	0.0182	–0.0448	0.0308**
Firstborn child	0.0573	0.0268**	0.0157	0.0169
Observations	398		431	
LR-statistic	37.60***		23.60***	

Author's calculations, GSOEP-Data. – *** indicates significance of the underlying coefficient at 1% level, ** at 5% level, * at 10% level.

Table 9

Number of Doctor Visits and Type of Insurance (Hurdle Models)

First stage: initial doctor visit (Probit model)	Model 2'		Model 3'	
	Marg. effect	Std. error	Marg. effect	Std. error
Poor year before	0.0744	0.1101	0.0748	0.1106
Girl	0.0625	0.0535	0.0560	0.0540
Foreign household	–0.1816	0.0691**	–0.1746	0.0700**
Mother's age	–0.0052	0.0059	–0.0069	0.0059
Mother's education	–0.0009	0.0124	0.0008	0.0125
M's good physical status	–0.0029	0.0633	0.0153	0.0642
M's good mental status	–0.1132	0.0790	–0.0863	0.0817
Firstborn child	–0.0223	0.0605	–0.0289	0.0611
Disorder			0.3458	0.1054**
Private insurance	0.0753	0.1055	0.0743	0.1065
Second stage: number of visits (truncated negative binomial model)	Incidence rate ratio	Std. error	Incidence rate ratio	Std. error
Poor year before	0.8600	0.3822	0.7232	0.2979
Girl	0.5598	0.1255**	0.5454	0.1120***
Foreign household	0.6038	0.2160	0.5979	0.1993
Mother's age	0.9889	0.0236	0.9749	0.0214
Mother's education	0.8840	0.0469**	0.9013	0.0434**
M's good physical status	0.9770	0.2620	1.0421	0.2600
M's good mental status	0.9046	0.2896	1.0481	0.3151
Firstborn child	0.6441	0.1546*	0.6159	0.1381**
Disorder			3.2478	1.1267***
Private insurance	3.1876	1.2610***	2.8865	1.0473***
Alpha	1.5793		1.1472	
LR-statistic (alpha=0)	174.75***		138.74***	
Observations	355		355	
Zero observations	169		169	
Wald test (full model)	11.96		17.95*	
Vuong test (vs. ZIP)	3.08***		3.06***	
Vuong test (vs. ZINB)	–0.14		0.03	

Author's calculations, GSOEP-Data. – *** indicates significance of the underlying coefficient at 1% level, ** at 5% level, * at 10% level. Calculations only based on children older than 3 months.