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Health shocks and the intergenerational transmission of inequality

Evidence from Andhra Pradesh, India

Sowmya Dhanaraj

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Abstract: This paper explores the intergenerational effects of parental health shocks using longitudinal data from the *Young Lives* project conducted in Andhra Pradesh, India. It is found that health shocks to poorer parents reduce investments in children thereby reducing their future earnings, and perpetuating poverty and inequality. The paper discusses important dimensions like the timing of health shocks and pathways through which they affect human capital investment, differential effects of paternal and maternal shocks on different cohort groups, roles of cognitive abilities of children and quality of schooling in human capital accumulation.

Keywords: parental health shocks, school enrolment, grade attainment
JEL classification: O15, O12, I30

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*PhD candidate at IGIDR, Mumbai. Email: sowmya@igidr.ac.in

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1 Introduction

Health shocks entail economic costs such as medical expenditure and loss of income to households.[1] Depending on the economic resources possessed (physical, human, social and financial capital), households use different coping strategies including savings, transfers, credit and sale of assets to avoid any shortfall in consumption caused by these economic costs. But when households adopt costly coping strategies (due to less developed or imperfect financial markets), they trade off 'short-term consumption needs against longer-term economic viability' (Bird and Prowse 2008: 6). This in turn has implications for investments in future productivity, vulnerability to future shocks, intergenerational transmission of poverty and inequality, etc. Thus, understanding the economic consequences of health shocks and their coping strategies helps inform public policy.

Empirical research finds that the ability of the households to insure consumption against health shocks depends on household resources like human and physical capital (Gertler and Gruber 2002), access to financial markets (Islam and Maitra 2012), social capital or networks of family, friends, etc. (De Weerdt and Dercon 2006). Thus, poorer households in developing countries may find smoothing consumption over time and space very costly since they neither possess their own economic resources nor have access to well-developed credit and insurance markets. Hence, they may adopt strategies like withdrawing children from school and sending them to work to cope with the financial burden (Jacoby and Skoufias 1997). Thus, health shocks to poorer parents might damage the economic welfare of children through reduction in investments in their human capital and thereby their potential earnings. However, empirical work has paid little attention to the intergenerational effects of health shocks.

In this study, we evaluate the impact of parental health shocks on investment in the human capital of children, for the southern state of Andhra Pradesh in India. We use the recent longitudinal data from the *Young Lives* project that aims at studying childhood poverty in two birth cohorts (younger and older) over a 15-year period across four countries. We find evidence of temporary delay in primary school enrolment for the younger cohort while schooling attainment is reduced for the older cohort due to adverse health shocks to their parents. Based on the findings of the study, we draw policy implications for designing safety nets to retain children in school at the upper primary and secondary levels.

This study is organized as follows. Section 2 discusses the theoretical framework and empirical evidence on the impact of health shocks on human capital investment. Section 3 gives an illustration of the longitudinal data and methodology used. Results of the analysis are presented in Section 4 and the conclusions in Section 5.

2 Literature review

2.1 Theory

The effect of parental health shocks and other income shocks on investment in the human capital of children can be predicted using the theoretical framework of Becker and Tomes

[1] The economic costs depend on type and severity of illness, whether the household sought any treatment (outpatient or inpatient), the type of service provider (public or private) used by the household, whether working members of the household have protection against loss in income due to absence from work, and whether the household is covered by insurance etc.

(1986). The study postulates that when financial markets are complete, households can separate consumption and investment decisions and the latter depends solely on rates of return (Jacoby and Skoufias 1997). In such a scenario, human capital investments in children do not depend on their parents' assets, earnings or consumption because parents can achieve an optimal level of investment by borrowing against the future earnings of children. Thus, if the child's ability or endowment is known a priori, then the home investment in his/her education is

$$x = g(E, s, r) \tag{1}$$

where E is the child's endowment, s is the public expenditure on education and r is the future rate of return. But when the financial markets are far from perfect, the separability assumption of consumption and investment decisions does not hold and expenditure on children's education depends on family resources as follows:

$$x = g(E, s, Y, w, \varepsilon) \tag{2}$$

where Y is the parent's earnings and assets, w, the generosity towards children and, ε is uncertainty about the luck of children.

The usual mechanisms of consumption smoothing across space and time are limited for households in low- and middle-income countries due to the absence of well-developed credit and insurance markets (Jensen 2000). In such a situation, households might resort to withdrawing children from school. This is because a decrease in household's own consumption raises its marginal utility relative to marginal utility of resources invested in children which in turn reduces the expenditure on children (Becker and Tomes 1986). Thus the expected impact of income shocks like parental health shocks on investments in children is potentially large in developing countries.

Apart from financial resources, there are also other pathways through which human capital investments in children are affected when their parents face health shocks.[2] Health shocks to parents might also reduce the time they invest in the education production function. For instance, parental involvement in a child's education and care-giving may decline when one or both parents face serious illness or death. Also, children's time may be diverted to household and market production activities as the opportunity costs of children's time increases. In addition to these, psychological effects associated with parental death/illness (stressful events that affect the child's development) may affect the human capital accumulation process (Haveman and Wolfe 1995). Thus, parental health shocks can impact the quality and quantity of investment in children's education through multiple channels.

2.2 Evidence

Empirical research focuses on cumulative effects rather than specific pathways through which parental health shocks influence schooling investments in children (Gertler et al. 2004). Much of this work is concentrated on the impact of HIV/AIDS-related adult mortality on children's schooling outcomes for African countries. Millions of children orphaned in Africa after the spread of the AIDS epidemic have been looked after by extended families and community networks (Case et al. 2004). Therefore, studies have investigated if there are differences in schooling provided to orphans and non-orphans that may require targeting policies to improve

[2] Haveman and Wolfe (1995) in their review of the economic literature on children's attainments have explained the process of school attainments by drawing upon the more general framework of Leibowitz (1974).

the education outcomes of orphans. Measures of human capital investment/accumulation used in these studies include: (1) education expenditure; (2) current enrolment status; (3) school attendance/participation; (4) years of completed education; (5) dropout/transition from primary to upper primary and secondary school; (6) time spent in learning and other activities; and (7) the cognitive and non-cognitive skills attainment of the children. These measures capture different aspects (input, output and outcome indicators) of human capital accumulation. Empirical studies using panel survey data find that parental death, especially the mother's death, reduces children's school participation and completed years of schooling (Table 1).

Table 1: AIDS-related adult mortality and human capital of children: Empirical evidence from Africa

Study	Country	Results
Ainsworth et al. (2005)	Tanzania	Enrolment in primary school is delayed but no adverse effects on completion of schooling
Yamano and Jayne (2005)	Rural Kenya	School attendance drops significantly by death of an adult in poor households
Beegle et al. (2006b)	Tanzania	Maternal orphans have significantly fewer years of schooling in the long run
Case and Ardington (2006)	South Africa	Maternal orphans are less likely to be enrolled and have completed fewer years of schooling
Evans and Miguel (2007)	Kenya	There is a substantial drop in school participation/attendance after parental death

Source: Author's compilation.

Very few studies have analysed the effect of parental health shocks on the human capital of children for countries that have not suffered from any epidemic.[3] Issues related to estimation bias arising out of unobserved factors (like child health and cognitive ability, other income shocks experienced by the households) have not been adequately addressed in the literature. In addition to this, the impact of parental health shocks can be different across different age groups of children. For instance, we expect parental health shocks to terminate the schooling of older children since the opportunity costs are higher for these children compared to the younger ones. Using an empirical strategy that takes into account the above-mentioned issues, we investigate the impact of parental health shocks on enrolment into primary education for the younger cohort and the impact on transition from primary to secondary education for the older cohort.

3 Data and empirical strategy

This study uses the longitudinal dataset of the *Young Lives* project conducted in Andhra Pradesh, India. We use the first three rounds of the survey that were completed in 2002 (R1), 2006 (R2) and 2009 (R3). The sample consists of two age groups of children: younger cohort of 2,011 children born in 2001-02 and an older cohort of 1,008 children born in 1994-95.[4] The survey has rich information on the health status, school enrolment and attainment, cognitive and non-

[3] For instance, using Indonesia's national socioeconomic survey, Gertler et al. (2004) found that a parent's recent death has a large effect on child enrolment. In a novel attempt, Chen et al. (2009) link the administrative data on birth and death registration with the college entrance test records for the entire population to find the effect of unexpected parental death on college enrolment. They find that maternal death has more significant effects on children's education than paternal death. Sun and Yao (2010) report that primary school-age children are affected by the major illness of prime-age adult while middle school children are not affected. They used a 15-year-long panel dataset of Chinese farm households.

[4] These children will be referred to as *Young Lives* children in the rest of the paper. The survey gives more detailed information on *Young Lives* children compared to other children in the household.

cognitive abilities of *Young Lives* children. Dhanaraj (2014) gives a summary of income shocks—in particular, health shocks faced by households and type of responses to these shocks.

The effect of parental health shocks on the human capital of children is evaluated separately for the younger and older cohorts.[5] In the case of younger cohort, 99.2 per cent of the children were enrolled in primary or pre-primary education in R3 when they were eight years old, which is higher than the enrolment rates of the older cohort in R1 (97.4 per cent) when they were of the same age. This clearly shows the expansion in primary education in Andhra Pradesh during that period. Children are typically enrolled in the first grade when they are 5-6 years old. Thus, younger cohort children who were all above seven years of age in R3 are expected to be enrolled in Grade 2 in R3.[6] However, 6.5 per cent of the children were not enrolled or still enrolled in pre-primary school and 12.1 per cent were attending Grade 1 in R3 (Table 2).

Table 2: Age-specific grade enrolment of younger cohort

Age (years)	Not enrolled	Pre-primary	Grade 1	Grade 2	Grade 3	Grade 4 or above	Total
6.9-7.5	10	50	103	217	302	40	722
7.5-8.0	5	48	111	224	374	238	1,000
8.0-8.5	1	10	20	34	79	63	207
Total	16	108	234	475	755	341	1,929

Source: Author's compilation.

To investigate if there is a temporary delay in initiation into primary education for children of the younger cohort due to parental health shocks, we use the following outcome variables. The first variable is an indicator variable that takes the value 1 if the child is enrolled in grade 2 or above and 0 otherwise. The second child schooling outcome variable is age-specific grade attainment constructed as follows:

$$\text{Age} - \text{specific grade attainment} = \frac{\text{Grade enrolled} - 1}{\text{Age in years} - 6}.$$

This variable takes the value 1 if the child has completed the grade appropriate for the age. The variable takes values more than 1 if the grade completed is higher than that expected for the child's age and vice versa. Figure 1 shows the box plot of age-specific grades attained by children, which demonstrates that enrolment is delayed for children affected by parental health shocks.

[5] Only *Young Lives* children are included in the analysis; school attainments of other children in the household are not studied. This is for two reasons. (1) *Young Lives* is a random sample of households with an 8-year old child or one-year old in a particular sentinel site rather than a random sample of all households in that site. (2) Detailed information on important control variables such as cognitive abilities and the health status of children are available for *Young Lives* children only.

[6] The minimum age of the younger cohort as at the beginning of the school academic year (June) in 2009 (R3) is 6.95 years and the maximum is 8.4 years.

Figure 1: Age-specific grade attainment of younger cohort

Source: Author's compilation using unit-level data from *Young Lives* survey.

In the case of the older cohort, 97 per cent of children were enrolled in a primary school in R1, which dropped to 75 per cent when the children transitioned from primary to upper primary or secondary schools in R3 (Table 3). In order to investigate if transition rates are lower among children whose parents experienced serious illness or death, we construct the following outcome variable: the variable takes value 1 if the *Young Lives* child is enrolled in school in R3 (conditional on school enrolment in R1) and 0 otherwise.[7]

Table 3: School participation of older cohort in R1 and R3

Older cohort	R1 (2002)		R3 (2009)	
	Number	%	Number	%
Currently in school	982	97.42	756	75.00
Dropped out of school	23	2.28	219	21.72
Never attended school	3	0.30	1	0.00
Attrition	-	-	32	3.17
Total	1008	100	1008	100

Source: Author's calculation based on unit-level data from *Young Lives* survey.

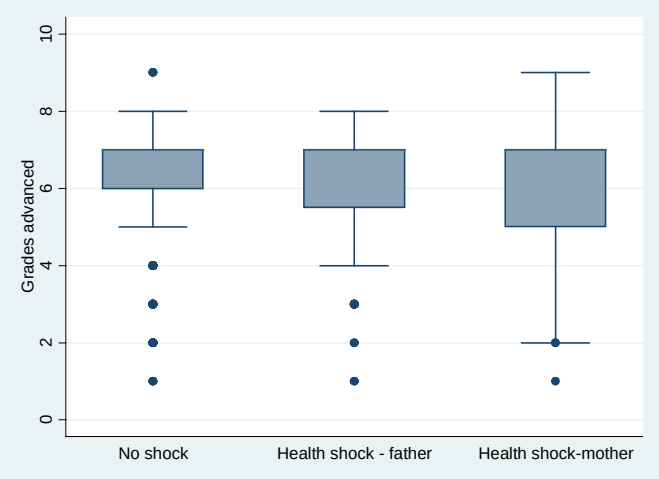
But dropping out of school need not imply lower educational attainment if children may continue education once the household recovers from a shock. So we use another outcome variable—grades advanced between R1 and R3.[8] We construct this variable as a difference between grade completed in R3 and grade completed in R1 conditional on enrolment in school in R1. Figure 2 shows the box plot of grades advanced by children of the older cohort by parental health status. It demonstrates that the median of grades advanced by children whose

[7] Only those children who were enrolled in school in R1 are included because estimates of impact of shocks are likely to be over-estimated if they are not conditioned on enrolment (Dillon 2013).

[8] Other variables of human capital investment that can be used from the dataset include education expenditure, time spent in learning activities and school attendance. Education expenditure data is not used due to the possibility of high measurement errors associated with attributing expenditures measured at household level to specific persons and differences in costs of schooling for private and government schools among other issues. The *Young Lives* survey also reports the time use pattern of children in the week preceding the survey but this may not be a good indicator of impact of parental health shocks on the human capital of children in the short- or medium-term. This is also the case with attendance data recorded for the week preceding the survey.

mother or father faced health shocks between R1 and R3 is significantly lower than that of children whose parents did not experience any serious health shock.

Figure 2: Grades advanced by the older cohort between R1 and R3



Source: Author's compilation using unit-level data from *Young Lives* survey.

In order to estimate the effect of parental health shocks on children's school participation (for both cohorts), we use a conditional logit model with community fixed effects for dichotomous outcome variables (Equation 3). Conditional logit procedure controls for community-level factors like access to schools and health centres and other factors that may influence children's education in a community (Gertler et al. 2004).[9]

$$Prob(E_{ij} = 1) = \mathrm{G}(X_{ij}\beta) \qquad (3)$$

where $E_{ij} = 1$ if child i of community j is enrolled in school in R3, and 0 otherwise; X_{ij} is a set of child and household characteristics, $G(.)$ is the cumulative logistic distribution function. In the case of continuous outcome variables (age-specific grade attainment and grade advancement for the younger and older cohort, respectively), we use least squares regression analysis with community fixed effects.

The key regressors of interest are self-reported parental health shocks (serious illness or death of father or mother of *Young Lives* child) during R1-R2 and R2-R3. Other explanatory variables are grouped into the following categories: (1) Child characteristics including age, gender, birth order and number of siblings of the *Young Lives* child; (2) Household characteristics including years of schooling of mother and father, initial wealth quartile group and whether household belongs to socially disadvantaged groups like SC (Scheduled Castes), ST (Scheduled Tribes) and Muslim categories. We use initial household characteristics (from R1) because factors like wealth itself might be influenced by health shocks to adults.

In the case of the younger cohort, a child's enrolment in primary school can be affected by the parents' perception of the quality of the nearest primary school, which is accounted for in the analysis (Ainsworth et al. 2005). In the case of older cohort (who are already in school), continuation of school education or advancement in grades crucially depends on the learning

[9] Conditional logit analysis retains only those communities where both dropouts and currently enrolled children are present.

ability of the child (Evans and Miguel 2007). This is captured to some extent by including the initial cognitive ability of the child (as measured in R1 through tests on numeracy, reading and writing skills) as explanatory variables.[10] We restrict the sample of the younger and older cohort to children with both parents alive in R1. To some extent, this removes any persistent effects of parental health shocks that occurred before R1. Appendix Table 1 shows the summary statistics of all the explanatory variables.

There are two important problems with empirical investigation of the effects of parental health shocks on the human capital of children.

(1) Unobserved time-invariant factors. Health shocks are not random events; households facing health shocks may have certain characteristics (social status, parental ability) that also determine a child's human capital. Failure to control for these characteristics may generate biased estimates (Yamano and Jayne 2005). This is captured to some extent by including the education levels and socioeconomic groups of parents as well as the cognitive ability of the child as explanatory variables. But this may or may not completely eliminate the issue of potential endogeneity.[11] To check for endogeneity issues, we perform the following empirical tests, following the methodology used in Beegle et al. (2006a).

Firstly, we check whether health shocks are persistent—that is, correlated over time using the following dynamic panel regression model:

$$h_{ijt} = \lambda h_{ijt-1} + \eta X_{ijt} + \delta_j + \varepsilon_{ijt} \quad (4)$$

Second, we check if children with low school participation are also more likely to have parents who face health shocks—that is, if lagged non-participation in school predicts parental health shocks:

$$Prob(h_{ijt} = 1) = f(s_{ijt-1}, X_{ijt}) \quad (5)$$

where h_{ijt} takes value 1 if one or both parents of a *Young Lives* child reported facing health shocks in R3 (R2) and 0 otherwise; s_{ijt-1} takes value 1 if the child is not enrolled in school in R2 (R1) and 0 otherwise;[12] X_{ijt} is a set of household characteristics as reported in R3 (R2).

(2) Unobserved time-varying factors. Other events might have occurred during the same period that influence parental health outcomes as well as the school attainment of children (Evans and Miguel 2007). Examples include local weather and crop shocks, parental job loss, child morbidity, etc. Hence, we control for other self-reported income shocks like job loss, crimes, livestock and crop loss experienced by households. To account for illness shocks to a child, we

10 Data on parental perception of school quality (upper primary or secondary school) are not available for the older cohort.

11 Few studies address this issue by using child fixed effects.

12 In the case of the younger cohort, s_{ijt-1} takes the value 1 if the child is not enrolled in pre-school or school and 0 otherwise. While two rounds of observations (R2 and R3) are used in the case of the older cohort, only one round of observations (R3) is used for the younger cohort since none were enrolled in school in R1 when they were one year old.

use a dummy variable indicating negative change in the z-scores of the Body Mass Index (BMI) of the child between R1 and R3.[13]

4 Findings

We begin by checking for the persistence of health shocks using equation (4); the coefficient estimates are presented in Appendix Table 2. The coefficient on the lagged term of health shocks is not statistically significant indicating that health shocks are transitory in nature (controlling for other household characteristics). Next, we check the exogeneity of parental health shocks and child school enrolment using the regression specification in (5). The results, presented in Appendix Table 3, demonstrate that lagged participation in school does not predict parental health shocks for either cohort.[14] Therefore, we proceed to investigate the effect of parental health shocks on investment in children's education for the two cohort groups.

4.1 Younger cohort

Table 4 shows the estimates for the younger cohort for two different outcome variables—primary school enrolment and grade attainment. The initiation of children into primary school education is significantly delayed by parental health shocks faced during R1-R2, which is the early childhood stage. In particular, we find that health shocks to the mother delay enrolment and age-specific grade attainment (Appendix Table 4). Other factors that have a significant influence on enrolment in primary education are as follows: Female children are more likely to be enrolled in school at an appropriate age while the contrary is the case for the eldest child. The more years of schooling attained by the mother, the higher the chances of grade attainment at the appropriate age. Migration of the household and unavailability of quality primary school in the community have a significant negative effect on primary school enrolment. But the coefficients on initial wealth groups to which the households belong, though significant, have signs contradictory to the expected results. Among the estimates not presented in the table, other income shocks, especially economic shocks like household job loss, reduce the age-specific grade attainment of the child.

[13] Other alternative variables indicating child ill-health are also used in the analysis. These include negative changes in weight-for-age z-scores of the child, whether the child faced any serious injury between R1 and R3, whether the child has long-term health problems like poor vision or respiratory problems, etc.

[14] We observe that this particular specification cannot completely rule out all forms of endogeneity bias.

Table 4: Parental health shocks and child human capital—younger cohort

Variables	Age-specific grade enrolment Coefficient	se	Age-specific grade attained Coefficient	Se
Parental health shocks R1-R2	-0.663**	0.282	-0.104**	0.042
Parental health shocks R2-R3	0.118	0.315	0.051	0.045
Age of the child	0.063**	0.031	-	-
Female	0.707***	0.237	0.190***	0.030
Birth order -1	-0.273	0.260	-0.061*	0.035
Siblings	-0.004	0.124	-0.021	0.017
Drop in BMI *z*-scores (R1-R3)	-0.194	0.251	0.020	0.033
Father—years of schooling	0.001	0.027	-0.003	0.004
Mother—years of schooling	0.039	0.037	0.011**	0.005
Wealth quartile II (R1)	0.184	0.327	-0.033	0.046
Wealth quartile III (R1)	-0.355	0.339	-0.142***	0.049
Wealth quartile IV (R1)	-0.121	0.499	-0.033	0.067
Regular salaried job (R1)	-0.503	0.324	-0.018	0.046
SC	0.914**	0.371	0.111**	0.045
ST	-0.263	0.424	-0.001	0.063
Muslim	0.016	0.506	-0.058	0.071
Household migrated (R1-R3)	-0.357	0.424	-0.170***	0.065
Nearest primary school quality—bad	-0.471	0.288	-0.151***	0.052
Constant	-	-	1.043***	0.072
Observations	1,184		1,901	
Pseudo or adj. R^2	0.099		0.183	

Notes: *, **, *** indicate significance at the 10%, 5% and 1% levels, respectively. Regressions include community-fixed effects and other income shocks faced by households during R2-R3.

Source: Author's calculation based on unit-level data from *Young Lives* survey.

4.2 Older cohort

Table 5 presents the logit and least square estimates of the effect of parental health shocks on the schooling attainment of the older cohort. Health shocks to parents when the children transition from primary to the upper primary and secondary stages lead to high dropout rates and reduce the advancement in grades significantly. Illness or death of a father who is the breadwinner of the family in most cases has a significant impact while maternal ill-health does not have much effect (Appendix Table 4). Dropout rates are found to be high among older and female children. Dropout rates rise and grade attainments fall with increasing number of siblings. Father's and mother's years of schooling significantly improve the odds of children continuing education at upper primary and secondary levels. Similarly with wealthier households; children belonging to the top-most (initial) wealth quartile groups have a higher probability of continuing to secondary education. Dropout rates are also higher among Muslim households while significantly lower for SC households. The child's initial cognitive ability (low reading and writing skills) is also a significant predictor of his/her schooling attainment. Migration of the household into a different community negatively impacts the child's education at least temporarily.

Table 5: Parental health shocks and child human capital—older cohort

	Conditional enrolment		Grade advancement	
Variables	Coefficient	Se	Coefficient	Se
Parental health shocks R1-R2	-0.134	0.287	0.047	0.124
Parental health shocks R2-R3	-0.735**	0.294	-0.255*	0.138
Age of the child (months)	-0.135***	0.032	-	-
Female	-0.485**	0.239	-0.103	0.101
Birth order -1	0.194	0.253	-0.021	0.105
Siblings	-0.487***	0.123	-0.129**	0.052
Drop in BMI *z*-scores (R1-R3)	0.350	0.239	-0.052	0.103
Father—years of schooling	0.076*	0.039	0.005	0.015
Mother—years of schooling	0.099*	0.056	0.016	0.019
Wealth quartile II (R1)	0.676**	0.308	0.235	0.146
Wealth quartile III (R1)	0.821**	0.362	0.498***	0.158
Wealth quartile IV (R1)	1.732***	0.663	0.331	0.230
Regular salaried job (R1)	0.189	0.462	0.156	0.161
SC	0.781**	0.321	- 0.160	0.144
ST	-0.450	0.529	-0.151	0.234
Muslim	-1.501***	0.559	-0.148	0.241
Reading—Nothing (R1)	-1.313***	0.469	-1.162***	0.230
Reading—Letters only (R1)	-0.495*	0.274	-0.242*	0.126
Writing—Nothing (R1)	-0.609*	0.331	-0.463***	0.159
Writing—With difficulty (R1)	-0.092	0.275	-0.036	0.123
Numeracy—Incorrect (R1)	-0.146	0.388	-0.107	0.192
Household migrated (R1-R3)	-1.424**	0.621	-0.385	0.305
Constant			6.683***	0.231
Observations	694		865	
Pseudo/Adj. R^2	0.268		0.219	

Notes: *, **, *** indicate significance at the 10%, 5% and 1% levels, respectively. Regressions includes community-fixed effects and other income shocks faced by households during R2-R3.

Source: Author's calculation based on unit-level data from *Young Lives* survey.

5 Conclusions

We find evidence that poor households in Andhra Pradesh try to smooth consumption against health shocks at the cost of reduced investments in child human capital due to imperfect credit and insurance markets. This has important implications for the intergenerational transmission of poverty and inequality. In an earlier work using *Young Lives* data, we find that households that are low on socioeconomic status are more vulnerable to health shocks (Dhanaraj 2014). These in turn reduce the future economic well-being of their children through reduced school participation, thus perpetuating poverty from one generation to the next. Policy interventions to retain children in school should be explored for the state of Andhra Pradesh. (The state had a Gross Enrolment Ratio of 100.76 in the primary level that dropped to 79.12 in the upper primary level according to DISE (2011)). Safety nets such as conditional cash transfer programmes like that of Progressa in Mexico that have a condition of school attendance can help mitigate the intergenerational economic consequences of parental health shocks (De Janvry et al. 2006).

In this study, we contribute further to the understanding of the impact of adverse health shocks by throwing light on dimensions like timing of the shocks and the pathways through which they operate, the age group to which children belong and the difference in paternal and maternal shocks. In the case of younger children, there is a temporary delay in enrolment into primary education, while in the case of the older cohort, schooling attainment is permanently reduced by 0.26 years due to parental health shocks. In early childhood, maternal shocks are more

important, mainly affecting children's human capital development through time devoted to childcare. In the later stage, income channels are more important since paternal health shocks reduce schooling attainment while maternal shocks do not have significant impact. This is because the opportunity costs of children's time are higher in older age; hence children are withdrawn from school to partly substitute for adult labour and compensate for income loss due to a father's illness or death. We also account for child ability and other income shocks like job loss in our study and find that omission of these factors will lead to over-estimation of the effect of health shocks.

Appendix

Appendix Table 1: Summary statistics

Variable	Younger cohort		Older cohort	
	Mean	Std. Dev.	Mean	Std. Dev.
Outcome variables				
Enrolment (age-specific/conditional)	0.820	0.385	0.788	0.409
Grades (age-specific/advanced)	0.969	0.421	6.260	1.499
Parental health shocks				
Parental health shocks R1-R2	0.165	0.371	0.217	0.412
Parental health shocks R2-R3	0.146	0.353	0.165	0.371
Child characteristics				
Age of the child (months)	91.387	3.758	179.670	4.240
Female	0.462	0.499	0.499	0.500
Birth order -1	0.562	0.496	0.340	0.474
Siblings	1.572	1.035	1.888	1.083
Child health (-ve change in *z*-scores of BMI)	0.626	0.484	0.460	0.499
Household characteristics				
Father—years of schooling	5.010	5.298	4.010	4.924
Mother—years of schooling	3.336	4.510	2.365	3.905
Regular salaried job	0.148	0.355	0.147	0.355
SC	0.182	0.386	0.211	0.408
ST	0.147	0.354	0.099	0.299
Muslim	0.069	0.253	0.066	0.248
School quality/child's cognitive ability				
Nearest primary school quality—bad (R3)	0.108	0.310		
Reading—Nothing (R1)			0.065	0.246
Reading—Letters only (R1)			0.279	0.449
Writing—Nothing (R1)			0.180	0.384
Writing—With difficulty (R1)			0.516	0.500
Numeracy—Incorrect (R1)			0.089	0.284
Migration/Other income shocks				
Household migrated (R1-R3)	0.060	0.237	0.029	0.167
Crop loss (R1-R3)	0.319	0.466	0.356	0.479
Livestock loss (R1-R3)	0.127	0.333	0.145	0.352
Job loss (R1-R3)	0.050	0.218	0.050	0.217
Crime (R1-R3)	0.089	0.285	0.071	0.258

Source: Author's calculation based on unit-level data from *Young Lives* survey.

Appendix Table 2: Persistence of health shocks

Variables	coefficient	se
Lagged health shock	0.1013	0.0737
Head age	-0.0178	0.0190
Age squared	0.0002	0.0002
Female	0.8970***	0.1126
Primary education	-0.0640	0.0805
Regular salaried	-0.1274	0.1035
Wealth quartile II	0.0008	0.0902
Wealth quartile III	-0.0749	0.0983
Wealth quartile IV	-0.1306	0.1272
SC	0.2280**	0.0899
ST	0.1539	0.1360
Muslim	0.1973	0.1451
Dependency ratio	-0.0294	0.0602
Disability	0.3480***	0.1067
Elderly	0.6425***	0.0777
Old cohort	0.1518**	0.0733
Round 3	-0.7619***	0.0684
Observations	5,839	

Notes: Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Source: Author's calculation based on unit-level data from *Young Lives* survey.

Appendix Table 3: Exogeneity of parental health shocks and child school participation

	Younger cohort		Older cohort	
Variables	Coefficient	se	Coefficient	se
Lagged non-participation in school	-0.240	0.228	0.246	0.247
Head age	-0.034	0.047	0.013	0.039
Age squared	0.000	0.001	-0.000	0.000
Female	1.117***	0.257	1.003***	0.181
Primary education	-0.233	0.178	-0.113	0.168
Regular salaried	0.146	0.217	0.034	0.204
Wealth quartile II	0.256	0.195	-0.139	0.179
Wealth quartile III	-0.348	0.229	-0.149	0.191
Wealth quartile IV	-0.340	0.274	-0.284	0.245
SC	0.325	0.206	0.071	0.187
ST	0.017	0.294	-0.052	0.307
Muslim	0.184	0.318	-0.070	0.315
Dependency ratio	0.064	0.110	-0.026	0.142
Disability	0.414*	0.224	0.956***	0.201
Elderly	-0.062	0.162	0.187	0.158
Round 3			-0.361***	0.140
Observations	1677		1,902	

Source: Author's calculation based on unit-level data from *Young Lives* survey.

Appendix Table 4: Parental health shocks and child human capital

Variables	Younger cohort		Older cohort	
	Grade enrolment	Grade attainment	Conditional enrolment	Grade advancement
Father (R1-R2)	-0.177	-0.075	-0.152	0.016
	(0.380)	(0.052)	(0.338)	(0.150)
Mother (R1-R2)	-0.928***	-0.120**	-0.018	0.057
	(0.349)	(0.055)	(0.386)	(0.160)
Father (R2-R3)	0.206	0.036	-0.836**	-0.227
	(0.430)	(0.056)	(0.361)	(0.166)
Mother (R2-R3)	0.260	0.040	-0.568	-0.227
	(0.388)	(0.058)	(0.388)	(0.184)
Constant		1.043***		6.674***
		(0.072)		(0.232)
Observations	1,184	1,901	694	865

Source: Author's calculation based on unit-level data from *Young Lives* survey.

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