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Health shocks and inter-generational transmission of inequality: Evidence from Andhra Pradesh, India

Sowmya Dhanaraj[1]

Abstract
Empirical research highlights that degree of consumption smoothing against income shocks like illnesses depends on household resources like physical and human capital and access to credit and insurance markets. In such cases, poorer households in developing countries may adopt costly self-insurance strategies which in turn perpetuate poverty and inequality. This study explores the inter-generational effects of health shocks using longitudinal data of Young Lives project conducted in the southern state of India, Andhra Pradesh for two cohort groups of children (younger and older). It is found that health shocks to poorer parents reduce investments in human capital of children thereby reducing their future earnings, and perpetuating poverty and inequality. There is a temporary delay in primary school enrollment in the case of younger cohort, while schooling attainment is reduced by 0.26 years for older children. This paper further contributes to the literature on important dimensions like role of timing of the shocks and the pathways through which they affect human capital investment, differential effects of paternal and maternal shocks on different cohort groups, ability of the children and quality of schooling.

Keywords: parental health shocks, school enrollment, grade attainment
JEL code: O15, O12, I30

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[1] PhD candidate at IGIDR, Mumbai. Email: sowmya@igidr.ac.in

1. Introduction

Income shocks like natural disasters and crop losses are important factors associated with movements of households in and out of poverty (Morduch, 1994). They also affect the health and nutrition status of household members (Foster, 1995), alter households' investments in human capital (Jacoby and Skoufias, 1997), influence their livelihood strategies and welfare trajectories (Ellis, 1998) etc. Some of these shocks are covariate in nature - common to all households in a community - like drought and flood while others are idiosyncratic in nature- specific to individual households like job loss and illness. This study deals with the welfare impact of particular type of idiosyncratic income shock, namely health shocks, at the household level.

Health shocks entail economic costs like medical expenditure and loss of income[2] to households. Depending on the economic resources possessed (physical, human, social and financial capital), households use different coping strategies like 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). This in turn has implications for investments in future productivity, vulnerability to future shocks, inter-generation transmission of poverty and inequality etc. Thus, understanding the economic consequences of health shocks and their coping strategies helps informs public policy.

Empirical research find 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 and thereby adopt strategies like withdrawing children from school and sending them to work to cope with the financial burden. In such a case, health shocks to poorer parents might reduce 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 inter-generational effects of health shocks.

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

In this study, we evaluate the impact of parental health shocks on investment in human capital of children, for the southern state of Andhra Pradesh in India. We use the recent longitudinal data of *Young Lives* project that aims to study childhood poverty of 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 the 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 level.

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. An illustration of the longitudinal data is given in Section 3. Section 4 defines the variables and methodology used. Results of the analysis are presented in Section 5 and the conclusions in Section 6.

2. Literature Review

2.1 Theory

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

$$x = g(E, s, r) \quad (1)$$

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 seperability assumption of consumption and investment decisions does not hold and expenditure on children's education depends on family resources as follows:

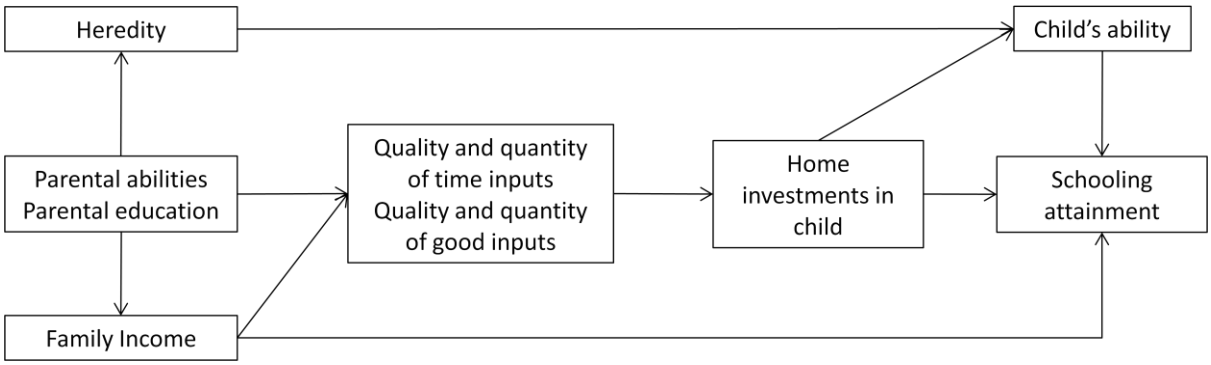
$$x = g(E, s, Y, w, \varepsilon) \quad (2)$$

where Y is the parent's earnings and assets, w, the generosity towards children and, ε is the 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 impact of income shocks like parental health shocks on investments in children is expected to be 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 (Figure 1)[3]. Health shocks to parents might also reduce their time inputs into education production function. For instance, parental involvement in child's education and care-giving may reduce when one or both parents face serious illness or death. Also, children's time may be diverted to household and market production activities as 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.

Figure 1: Home investments in children



Source: Haveman and Wolfe (1995)

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.,

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

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 AIDS epidemic have been looked after by extended families and community networks (Case et al. 2004). Therefore, studies have investigated if there are differences between orphans' and non-orphans' schooling that may require targeting policies to improve education outcomes and thereby future living standards of children. 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) drop-out/transition from primary to upper-primary and secondary school, (6) time spent in learning and other activities and, (7) 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 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 in 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 lesser 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 substantial drop in school participation/attendance after parental death

Very few studies have analysed the effect of parental health shocks on human capital of children for countries that have not suffered from any epidemic[4]. Issues related to estimation bias arising out of unobserved factors (like child health and cognitive ability, other income shocks experienced by the households) has not been adequately addressed in the literature. In addition to this, the impact of parental health shocks can be different across different age

[4] For instance, Gertler et al., (2003) using Indonesia's national socio-economic survey found that parent's recent death has a large effect on child's enrolment. In a novel attempt, Chen et al. (2009) link the administrative data on birth and death registry 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 major illness of prime-age adult while middle school children are not affected. They used 15-years long panel dataset of Chinese farm households.

groups of children. For instance, we expect parental health shocks to terminate schooling of older children since the opportunity costs are higher for these children compared to the younger ones. Using empirical strategy that takes into account the above-mentioned issues, we investigate the impact of parental health shocks on enrolment into primary education for younger cohort and that on transition from primary to secondary education for older cohort.

3. Data

We use the longitudinal dataset of *Young Lives* project that aims to study childhood poverty over a span of 15 years in four countries (Ethiopia, India, Peru and Vietnam) through household and child surveys. In India, the survey is conducted in the state of Andhra Pradesh and three rounds have been completed in 2002 (R1), 2006 (R2) and 2009 (R3). The sample consists of two age-groups of children: younger cohort of 2011 children born in 2001-02 and older cohort of 1008 children born in 1994-95. The attrition rate from Round 1 to Round 3 is 3.6%; it reduces to 2.2% if attrition due to child-deaths is excluded (Galab *et al*., 2011).

The sampling method used in the survey is as follows: Andhra Pradesh has three agro-climatic regions – Telangana, Rayalaseema and Coastal Andhra. One poor and one non-poor district were chosen from each region[5] and twenty sentinel sites (*taluk*) were then chosen from these districts. Those households with a child born in 2001-02 (numbering 100) and those with a child born in 1994-95 (numbering 50) were randomly selected from each sentinel site[6]. This longitudinal dataset gives a profile of households' assets, livelihoods, consumption, socio-economic characteristics, income shocks faced by households and type of responses to these shocks[7]. It also has rich information on the health status, school enrolment and attainment, cognitive and non-cognitive abilities of *Young Lives* children.

4. Empirical Strategy

The effect of parental health shocks on human capital of children is evaluated separately for younger cohort and older cohort[8]. In the case of younger cohort, 99.2% of the children were

[5] Poor and non-poor districts and mandals were selected based on a set of development indicators. In addition to the six districts, Hyderabad district, capital of Andhra Pradesh was also included. For details of the sampling method, refer Galab *et al*. (2011).

[6] 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.

[7] The study asked sample households if they faced any income shock that affected the economy of the household negatively or reduced the economic welfare and the type of household response to each shock.

[8] Only *Young Lives* children are included in the analysis, school attainments of other children in the household are not studied. This is due to two reasons: 1) *Young Lives* is a random sample of "households with a 8-year old child or one-year old" in a particular sentinel site rather than random sample of all households in that site. 2)

enrolled in primary or pre-primary education in R3 when they were eight years old which is higher than the enrolment rates of older cohort in R1 (97.4%) 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[9]. However, 6.5% of the children were not-enrolled or still enrolled in pre-primary and 12.1% were attending Grade 1 in R3 (Table 2).

Table 2: Age-specific grade enrollment of younger cohort

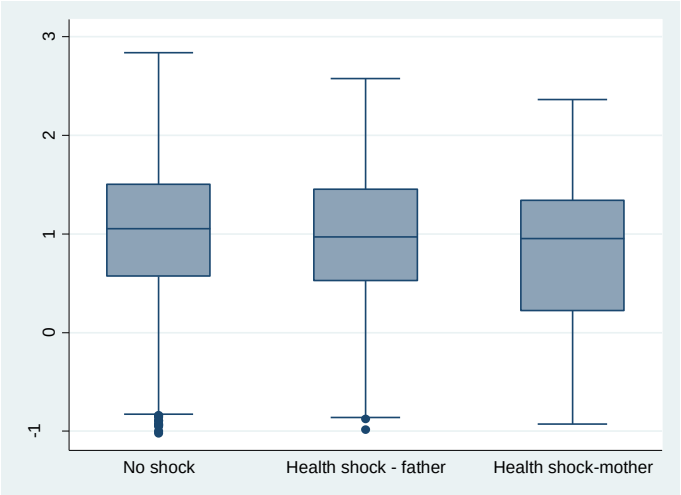
Age (years)	Not-enrolled	Pre-primary	Grade 1	Grade 2	Grade 3	Grade 4 or above	Total
6.9-7.5	10	50	103	217	302	40	722
7.5-8.0	5	48	111	224	374	238	1,000
8.0-8.5	1	10	20	34	79	63	207
Total	16	108	234	475	755	341	1,929

To investigate if there is a temporary delay in initiation into primary education for children of younger cohort due to parental health shocks, we use the following outcome variables. The first variable is an indicator variable that takes value 1 if the child in 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 value 1 if child has completed grade appropriate for the age. The variable takes values more than 1 if grade completed is higher than that expected of the child's age and vice versa. Figure 2 shows the box plot of age-specific grades attained by children which demonstrates that enrolment is delayed for children affected by parental health shocks.

Detailed information like cognitive abilities and health status of children which are important control variables are available for *Young Lives* children only.

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

Figure 2: Age-specific grade attainment of younger cohort



In the case of older cohort, 97% of children were enrolled in a primary school in R1 which dropped to 75% 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.[10]

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

Older cohort	R1 (2002)		R3 (2009)	
	Number	Percentage	Number	Percentage
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

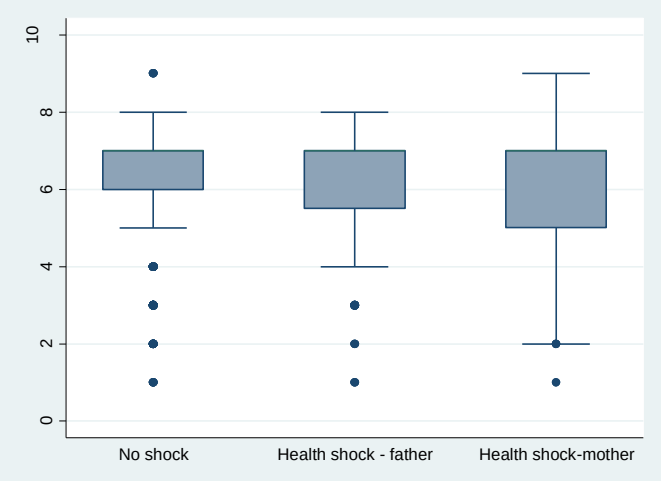
But dropping out of school need not imply lower educational attainment if children may continue education once the household recovers from shock. So we use another outcome variable[11] – grades advanced between R1 and R3. We construct this variable as a difference

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

[11] 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. 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 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.

between grade completed in R3 and grade completed in R1 conditional on enrolment in school in R1. Figure 3 shows the box plot of grades advanced by children of older cohort by parental health status. It demonstrates that the median of grades advanced by children whose mother or father faced health shocks between R1 and R3 is significantly less than that of children whose parents did not experience any serious health shock.

Figure 3: Grades advanced by older cohort between R1 and R3



In order to estimate the effect of parental health shocks on children's school participation (for both younger and older cohort), we use conditional logit model with community fixed effects for dichotomous outcome variables (Equation 13). Conditional logit procedure controls for community-level factors like access to schools and health centers and other factors that may influence children's education in a community (Gertler et al. 2004)[12].

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

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 cumulative logistic distribution function. In the case of continuous outcome variables (age-specific grade attainment and grade advancement for 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 following categories: 1) Child characteristics which include age, gender, birth order and number of siblings of the *Young Lives* child. 2) Household

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

characteristics which include years of schooling of mother and father, initial wealth quartile group and whether household belongs to socially disadvantaged groups like SC, ST 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 younger cohort, child's enrolment in primary school can be affected by the parents' perception of quality of the nearest primary school which is accounted for in the analysis (Ainsworth et al., 2005). While, in the case of older cohort (who are already in school), continuation of school education or advancement in grades crucially depends on the learning ability of the child (Evans and Miguel, 2004). 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.[13] We restrict the sample of younger and older cohort to children whose both parents were alive in R1. To some extent, this removes any persistent effects of parental health shocks that occurred before R1. Appendix I shows the summary statistics of all the explanatory variables.

There are two important problems with empirical investigation of effects of parental health shocks on 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 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 education levels and socio-economic 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[14]. To check for endogeneity issues, we perform the following empirical tests, following the methodology used in Beegle et al. (2006).

Firstly, we check whether health shocks are persistent, i.e., correlated over time using the following dynamic panel regression model:

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

Secondly, we check if children with low school participation are also more likely to have parents who face health shocks, i.e., if lagged non-participation in school predicts parental health shocks,.

[13] Data on parental perception of school quality (upper primary or secondary school) is not available for older cohort.

[14] Few studies address this issue by using child fixed effects.

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

where h_{ijt} takes value 1 if one or both parents of *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 R2 (R1) and 0 otherwise[15]; 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 school attainment of children (Evans and Miguel, 2004). 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 child, we use a dummy variable indicating negative change in z-scores of Body Mass Index (BMI) of the child[16] between R1 and R3.

5. Findings

5.1 Younger cohort

We begin by checking for persistence of health shocks using equation (4); the coefficient estimates are presented in Appendix II. The coefficient on lagged term of health shocks is not statistically significant which indicates that health shocks are transitory in nature (controlling for other household characteristics). Next we check exogeneity of parental health shocks and child school enrolment using regression specification in (5). The results, presented in Appendix III, demonstrate that lagged participation in school does not predict parental health shocks for both the cohorts.[17] Therefore, we proceed to investigate the effect of parental health shocks on investment in child's education for the two cohort groups.

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 mother delays the enrolment and age-specific grade attainment (Appendix VI). Other factors that have a significant influence on enrollment in primary education are as follows. Female children are more likely

[15] In the case of younger cohort, s_{ijt-1} takes 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 older cohort, only one round of observations (R3) is used for younger cohort since none were enrolled in school in R1 when they were one-year old.

[16] 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 and respiratory problems etc.

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

to be enrolled in school at an appropriate age while contrary is the case for the eldest child. Higher the years of schooling attained by the mother, higher the chances of grade attainment at the appropriate age. Migration of household and unavailability of quality primary school in the community has a significant negative effect on primary school enrollment. 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 job loss faced by the household reduces the age-specific grade attainment of the child.

Table 4: Parental health shocks and child human capital – Younger cohort

	Age-specific grade enrollment		Age-specific grade attained	
Variables	coefficient	se	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-squared	0.099		0.183	

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

Table 5 presents the logit and least square estimates of effect of parental health shocks on the schooling attainment of older cohort. Health shocks to parents when the children transition from primary to upper-primary and secondary stage lead to high drop-out rates and reduce the advancement in grades significantly. Illness or death of the father who is the breadwinner of the family in most cases has a significant impact while maternal ill-health does not affect

much (Appendix VI). Drop-out rates are found to be high among the older and female children. Higher the number of siblings, higher the drop-out rates and lower the advancement in grades. Father's and mother's years of schooling significantly improve the odds of children continuing education at upper-primary and secondary level. Similar is the case of wealthier households, i.e., children belonging to top-most (initial) wealth quartile groups have higher probability of continuing to secondary education. Drop-out 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 enrollment		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-squared	0.268		0.219	

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

6. 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 inter-generational transmission of poverty and inequality. In an earlier work using *Young Lives* data, we find that households that are low on socio-economic status are more vulnerable to health shocks (Dhanaraj, 2014). These in turn reduce their future economic well-being of children through reduced school participation, thus perpetuating poverty from one generation to 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 like conditional cash transfers programs like that of Progressa in Mexico which have a condition on school attendance can help mitigate the inter-generational economic consequences of parental health shocks (De Janvry et al., 2006).

In this study, we contribute further to the understanding of impact of adverse health shocks by throwing light on dimensions like timing of the shocks and the pathways through which they affect, the age group to which children belong and difference in paternal and maternal shocks. In the case of younger children, there is a temporary delay in the enrollment into primary education, while in the case of older cohort, schooling attainment is permanently reduced by 0.26 years due to parental health shocks. In early childhood, maternal shocks are more important which mainly affects child's human capital development through time devoted to childcare. In the later stage, income channels are more important since paternal health shocks reduce the schooling attainment while maternal shocks do not have significant impact. This is because 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 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.

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Appendix I – Summary Statistics

Variable	Younger cohort		Older cohort	
	Mean	**Std. Dev.**	**Mean**	**Std. Dev.**
Outcome variables				
Enrollment (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

Appendix II – 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	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix III – 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	

Appendix IV – Parental health shocks and child human capital – Younger cohort

Variables	Younger cohort		Older cohort	
	Grade enrollment	Grade attainment	Conditional enrollment	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