


RESEARCH PAPER

Household expenditure and child health in Vietnam: analysis of longitudinal data

Trong-Anh Trinh^{1*} , Preety Srivastava¹ and Sarah Brown²

¹School of Economics, Finance and Marketing, RMIT University, Melbourne, Victoria, Australia and

²Department of Economics, University of Sheffield, Sheffield, UK

*Corresponding author. E-mail: tronganh.trinh@rmit.edu.au

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Abstract

While the relationship between socioeconomic status and child health has been studied extensively in developed countries, evidence is limited for developing countries. This study makes an important contribution by examining the relationship between child health and household socioeconomic status in Vietnam, using household expenditure as an alternative measure. This also allows us to explore the mechanisms via which income affects child health, in which household consumption arguably plays a crucial role. We employ different measures of health that allow us to examine both long-run and short-run effects, and two alternative instrumental variables, the unemployment rate and rainfall deviation, to address the potential endogeneity of household expenditure. We find evidence of a strong positive impact of household expenditure on child health and the findings are consistent across age groups. Specifically, a 10% increase in expenditure will result in a weight gain of 213–541 g in a “typical” child. We also explore the effect of a range of exogenous adverse economic shocks on children’s health.

Key words: BMI; child health; household expenditure; socioeconomic status; Vietnam

JEL classification: C3; D1; I1

1. Introduction

It is well-recognized that the primary goal of development policy is to improve the living standards and well-being of individuals and households in developing countries. There is an extensive literature in economics and other social sciences that has explored the relationship between socioeconomic status and household outcomes in developed countries, particularly child health [Fay *et al.* (2005), Ghuman *et al.* (2005), Boyle *et al.* (2006), Paxson and Schady (2007), Wehby and McCarthy (2013), Rubio-Codina *et al.* (2015)]. Understanding the relationship between socioeconomic status and child health is of vital importance since poor health in childhood is associated with lower educational attainment, inferior labor market opportunities, and worse health outcomes later in life [Currie (2009)]. Public policies have the potential to address such issues through early intervention implemented to reduce

inequalities in child health and this may further help mitigate the intergenerational transmission of poverty, which is of utmost concern for developing countries. Our paper makes a unique contribution to this literature by using household consumption expenditure as a measure of socioeconomic status to examine its effect on child health in Vietnam.

Research has shown that improving child health outcomes in low-income countries is challenging because of nutrition problems and poor health care services [Nguyen (2016)]. Also, there is a considerable disparity in the health of children living in poor households relative to those from wealthier households, especially in rural areas. Therefore, it is reasonable to hypothesize that the social gradient in child health will be steeper in developing countries. Nonetheless, very few studies to date have investigated this relationship in developing countries [exceptions include Cameron and Williams (2009), Miller and Urdinola (2010), Fichera and Savage (2015)].¹ The main impediment to conducting such studies in developing countries is the lack of reliable data.

A range of measures have been used to capture individuals' or households' socioeconomic status, including income, wealth, education, employment, and consumption [Montgomery *et al.* (2000), Australian Bureau of Statistics (2011)]. Most existing studies that investigate the health–wealth nexus or the income–health gradient have used an index of wealth or income as a measure of socioeconomic status [Sastry (2004), Fay *et al.* (2005), Filmer (2005), Currie *et al.* (2007), Khanam *et al.* (2009)]. While household income is frequently available in household surveys in developed countries, it is not a common feature in their counterpart developing countries because of lack of reliability, and the cost and time involved in data collection. Large income fluctuations and in-kind income, which are common features in developing countries especially where agriculture is the main source of employment, can potentially bias income reporting [see, e.g., Montgomery *et al.* (2000), Rutstein and Johnson (2004)]. The wealth index, on the other hand, has gained popularity in developing countries in recent years given that they are calculated using easy-to-collect data on household ownership of selected durable assets, such as a car, refrigerator, television or bicycle; materials used for housing construction; and types of water access and sanitation facilities [Rutstein and Johnson (2004), Howe *et al.* (2009)]. Yet, there are several potential limitations with the use of a wealth index as a measure of socioeconomic status or living standards [Howe *et al.* (2009), Filmer and Scott (2012)]. Firstly, the set of indicators used to construct the wealth index are chosen on the basis of availability and convenience rather than on theoretical grounds [Gwatkin *et al.* (2007)]. Secondly, access to water or electricity, a main component of the wealth index construction, is often a community rather than a household-level characteristic [Knodel and Wongsith (1991)], making it less likely to be a unique and relevant indicator of a household's standard of living. Lastly, a household's ownership of selected items could result from preference rather than financial constraints and does not necessarily reflect living standards [Perry (2002)].

In the absence of household income in our dataset and the limitations of the wealth index discussed above, we use household expenditure as a measure of living standards, which makes an important and unique contribution to the literature. We advocate this

¹For example, using Tanzanian data, Fichera and Savage (2015) find that a 10% increase in income reduces the number of health symptoms by 0.02 (from a mean of 0.9), and increases the number of vaccinations of children under the age of 6 by approximately 0.1 (from a mean of 2.3 per child).

measure on the following two grounds. Firstly, while the health–income relationship is well documented, the mechanisms via which income affects child health, in which household consumption arguably plays a crucial role, remain unclear. Our study serves to shed light on this pathway. Secondly, we argue that household expenditure can by itself be a better measure of standard of living than household income. It is common for households in developing countries to draw their income from multiple sources, and as mentioned before, these sources are highly variable from season to season, especially in countries which rely largely on agriculture. As such, household income will be measured accurately only if it takes into account the primary and secondary employment and nature of payment for each adult household member [Montgomery *et al.* (2000), Rutstein and Johnson (2004)]. In contrast, expenditure is considered more stable than income as households tend to “smooth” their consumption by borrowing or saving in times of temporary income fluctuations [Howe *et al.* (2009)]. For example, some studies have found significant measurement error in reported income, to the extent that expenditures reported by families with low income are often multiples of their reported incomes [Rogers and Gray (1994), Sabelhaus and Groen (2000)].

The data we use in this paper comes from the Young Lives Project, a longitudinal study administered by the University of Oxford. This dataset has been used extensively in the literature [Krishna *et al.* (2016), López Boo (2016), Humphries *et al.* (2017)]. Vietnam provides an interesting case to examine the relationship between household socioeconomic status and child health. Child health is a significant issue in Vietnam with more than 23% of children less than 5 years old reported as under normal height, and about 12% of children reported under-weight [Nguyen (2016)]. Furthermore, the incidence of underweight children and stunted growth is higher in lower socioeconomic households. Hence, there is an urgent need for intervention policies in Vietnam to effectively tackle such children’s health issues. While the government has expanded its universal health insurance coverage to children from vulnerable households by giving them free access to health services, there is no evidence of any health improvement in this population [Nguyen (2016)].

One significant concern in the analysis of child health and socioeconomic measures such as income, and which also applies to expenditure, is the endogeneity which could arise from two sources. Firstly, poor households are less likely to be able to provide adequate consumption and healthcare services to their children, but, in turn, poor child health may reduce parental earnings [Currie (2009)], thereby resulting in reverse causality. Secondly, both child health and income are determined by unobserved factors, such as parents’ time preferences [Fichera and Savage (2015)] or poor genetics [Burgess *et al.* (2004)], resulting in omitted variable bias. While the issues of endogeneity or spurious relationship have been discussed in the relevant literature, none of the early studies has explicitly dealt with it. More recent studies have addressed endogeneity using the generalized method of moments (GMM) [Khanam *et al.* (2009)]; and the Instrumental Variable (IV) approach [Doyle *et al.* (2007), Kuehnle (2014)]. The GMM approach, which uses lagged variables of health, requires a relatively long panel of data on child health and related variables, which is often not available in developing countries. The IV approach relies heavily on valid instruments for the endogenous variable. To examine the impact of household expenditure on child health, we use the two-stage (2SLS) approach and we adopt the IV approach to deal with the endogeneity of expenditure and exploit two instruments, namely the unemployment rate and rainfall.

In terms of health measures, we use a range of health indicators, namely, body mass index (BMI), BMI-for-age Z-score (BMI-Z) and Height-for-age Z-score (HAZ), with height representing the long-run nutritional and health status of the child and BMI, being regarded as more of a short-run health metric. A Z-score is a child's BMI (or height) expressed as a number of standard deviations from the mean BMI (height) of children of the same age and gender in a healthy population. The reference population used in the survey is the US population, as recommended by the World Health Organization (WHO). In comparison to self-reported health that has been used in previous studies [e.g., Case *et al.* (2002), Apouey and Geoffard (2013), Kuehnle (2014)], there is less subjectivity in the reporting of anthropometric indicators. Nonetheless, we also use self-reported health to test the robustness of our findings. Our main results suggest a strong positive relationship between household expenditure and child physical health. Specifically, we find that a 10% increase in total household expenditure will result in a weight gain of 213–541 g in a “typical” child, with the findings being consistent across different age groups.

2. Econometric framework

As a reference case, we start with a model in which household expenditure is treated as exogenous. The impact on child health is therefore estimated as follows:

$$Y_{it} = \beta_0 + \beta_1 E_{it} + \beta_2 C_{it} + \beta_3 P_{it} + \beta_4 H_{it} + \varepsilon_{it}, \quad (1)$$

where Y_{it} is a vector of health indicators of child i at time t , specifically (1) BMI, (2) BMI-Z, and (3) HAZ. We use two alternative measures of household expenditure (E_{it}) of child i at time t : household total expenditure and household food expenditure per capita (in logs). C_{it} is a vector of child characteristics such as age and gender. Other control variables include parental characteristics (P_{it}) such as education and age; and household characteristics (H_{it}) such as household size and geographical location.²

As discussed above, a potential source of bias in equation (1) arises from the potential reverse causality between household expenditure (E_{it}) and child health (Y_{it}). For example, poor households are less likely to provide adequate consumption and healthcare services to their children but, in turn, children with poor health may require greater parental care, thus resulting in a reduction in parental labor supply and household consumption. Another potential source of bias results from omitted variables. For example, parental genetics and attitudes toward children may be highly correlated with both household income and child health [Currie (2009), Fichera and Savage (2015)]. To address such endogeneity issues, an IV approach is adopted. Specifically, we estimate:

$$Y_{it} = \gamma_0 + \gamma_1 E + \gamma_2 C_{it} + \gamma_3 P_{it} + \gamma_4 H_{it} + \varepsilon_{it} \quad (2)$$

$$E_{it} = \alpha_0 + \alpha_1 Z_{it} + \alpha_2 C_{it} + \alpha_3 P_{it} + \alpha_4 H_{it} + v_{it}, \quad (3)$$

²Most studies based on developed countries use an extensive set of controls such as child nutrition, ethnic background and parents' health status and lifestyle [Currie *et al.* (2007), Khanam *et al.* (2009)]. Such information is, however, not commonly available in data on developing countries.

where Z_{it} is the instrumental variable for household expenditure in the first stage of the regression. The simultaneous equations (2) and (3) are then estimated using the 2SLS approach.³

We have identified two potential instruments for household expenditure, the unemployment rate and rainfall deviation, which have been explored in the broader literature. Given that the selection of instruments is an area which is always open to debate, to explore the robustness of our findings, we use both as alternative instruments for household expenditure.⁴

Firstly, we follow Kuehnle (2014), who suggests using the local unemployment rate as an instrument for income. The rationale is that areas with a high unemployment rate are often associated with lower job opportunities, thereby affecting household income directly. This is also applicable in the context of developing countries and rural areas where agriculture is the main activity. For example, while fewer economic opportunities in rural areas may not directly impact on farm households, there is an indirect effect through reduced demand for agricultural products. However, using the unemployment rate as an instrument requires the assumption that children do not contribute to household income, which may not be the case for developing countries where children often participate in paid work or family businesses [Trinh (2020)]. In this context, areas with a higher unemployment rate are likely to have lower proportions of child labor, resulting in better health outcomes [Doyle *et al.* (2007), Sim *et al.* (2017)]. In order to deal with the possible association between unemployment and child labor, we exclude children who are engaged in any type of work (paid or unpaid).⁵ Another concern is the direct impact of unemployment on child health via parent's debilitating mental health. However, with an extended family setup in Vietnam, especially in rural areas, where children are often looked after by other family members, financial distress is arguably the most likely pathway through which unemployment impacts child health.

Our second instrument, which is rainfall deviation, relates to a more recent literature [Case *et al.* (2002), Apouey and Geoffard (2013), Kuehnle (2014), Fichera and Savage (2015)]. The core idea is that climatic shocks impact on agricultural production and, consequently, farmers' living standards [Mendelsohn *et al.* (1994), Deschênes and Greenstone (2007), Trinh (2018)]. Adverse weather conditions are likely to cause crop failure, thereby impacting on household income and expenditure. However, it is important to acknowledge that weather conditions can have a direct impact on child health outcomes. For example, it has been argued that adverse weather shocks, such as drought or flood, may directly contribute to the incidence or spread of diseases,

³We have also used a three-stage Least Squares method for estimation. The results are broadly consistent (see Table A1, Online Appendix).

⁴Doyle *et al.* (2007) use "grandparental smoking" as an instrument based on the assumption that a household having grandparents who smoke is associated with lower parental education/income, but does not necessarily correlate with other determinants of child health. Unfortunately, this assumption may be violated in the context of developing countries where extended family living is commonplace.

⁵Note that the rate of child labor in our sample is around 7%, which is relatively small. In addition, our findings are robust to including these children in the analysis (see Table A2, Online Appendix). One may argue that children in developing countries perform household chores (e.g. cooking or caring for other household members) which may indirectly contribute to household income. A histogram of time spent on household chores in our sample indicates that a fairly low number of hours were spent by a small percentage of children on such activities, allaying any concerns in this respect (see Figure A1, Online Appendix).

such as malaria or poor sanitation [Thai and Falaris (2014), Cornwell and Inder (2015), Lohmann and Lechtenfeld (2015)]. Weather shocks are also found to impact on the parental allocation of time or household migration, thereby affecting child health outcomes [Connolly (2008), Gröger and Zylberberg (2016)]. To address such concerns, instead of using weather shocks or short-term changes in rainfall, we use the long-term change in precipitation, as measured by the deviation of actual rainfall from historical levels. This helps mitigate any possible direct association between environmental factors and child health.⁶ The link between rainfall deviation and expenditure can operate in both directions. A higher deviation of rainfall may improve agricultural activities by increasing water supply, but it may also destroy crop production by providing conditions for insects to develop. As such, which mechanism dominates is not important in our analysis, as long as it has a positive or negative correlation with household expenditure.⁷

3. Data

This paper uses panel data which come from the Young Lives Project, administered by the Department of International Development at the University of Oxford. This is a 15-year longitudinal study of childhood poverty covering the lives of children in four developing countries: Ethiopia, India, Peru, and Vietnam. Using four surveys, the project tracks more than 12,000 children in the four countries from 2002 to 2014, with a roughly equal number of boys and girls. The overall objective of the project is to promote a broad-based and multi-dimensional understanding of child development, poverty, and welfare in these countries, and in turn, to inform the development of policies that will reduce poverty.

In Vietnam, the survey follows 3,000 children in five provinces: Phu Yen, Ben Tre, Lao Cai, Hung Yen, and the city of Da Nang. There are 2,000 children born in 2001–2002 (the younger cohort), and 1,000 born in 1994–1995 (the older cohort). By using a sentinel sampling approach, the Young Lives data mainly focus on poor households in rural areas. In each province, four communes were selected for interview.⁸ Of the four selected, two communes were poor, one was average, and one was above average. The city of Da Nang, which is the only urban area chosen for the survey, is less developed than other large cities such as Hanoi and Ho Chi Minh City. We use an unbalanced panel over the period 2006–2014 (e.g., three survey rounds),⁹ where the total number of observations is 5,515, comprising 2,375 children. The percentage of children present in all three surveys is 50%.¹⁰

Our focus on Vietnam relates to the fact that, in addition to child health being a significant issue in Vietnam, compared to the other three countries in the Young Lives Project, Vietnam is a unique case study with detailed data on child health

⁶Rainfall deviation in the main model ranges between -18 mm and $+37$ mm. We also estimate the model by restricting our sample with rainfall deviation within ± 15 mm. Our results are consistent.

⁷While a large percentage of households in our sample earn a living through farming and their expenditure is directly affected by weather conditions, non-farm households can be argued to be indirectly affected, for example, through higher food prices.

⁸For more details, see: <https://www.younglives.org.uk/content/sampling-and-attrition>.

⁹We do not include the first survey in our dataset since information on the child health measures is only available from the second round of Young Lives.

¹⁰Although this may raise concern for attrition bias, Outes-Leon and Dercon (2008) show that the bias is generally negligible for Vietnam.

available in all rounds. The survey also includes household information such as household expenditure and food consumption; the holding of land, durable good ownership, and productive assets; families' financial situation; and a range of demographic characteristics.

Although the focus in the child health and wealth and child health and income gradient literatures has largely been on self-assessed health measures and morbidity, one widely used and more objective measure of child physical health used in other areas of economics is BMI, which is derived from the current height and weight of children in each round. However, a shortcoming of using BMI is its sensitivity to factors such as age, sex, and region [Beegle *et al.* (2009)]. This study therefore employs two other standardized measures of child anthropometry, which are constructed using the WHO guidelines: BMI-Z and HAZ [WHO (2010)].¹¹ The BMI-Z, also called BMI standard deviation scores, is a measure of relative weight adjusted for child age and sex, while the HAZ measures the child's standardized height adjusted for age and sex. Figure 1 plots the frequency distribution of children's BMI. The average BMI is 15.8; approximately 20% of children have a BMI lower than 15 and are thus considered underweight according to the WHO guidelines [WHO (2010)]. Conversely, only a very small percentage of children are overweight or obese (BMI of 25 or more). Given such a distribution, an increasing BMI can be considered as a measure of better health.¹² The Young Lives Project also provides information on child health reported by the biological mother. However, given the subjective nature of such information, we do not use this measure of health in our main analysis as it can potentially bias our findings [Currie (2009), Khanam *et al.* (2009)]. We have, however, explored the robustness of our findings to using this measure, as discussed further below.

The two key independent variables we use as measures of living standards in our analysis are total expenditure and food expenditure per capita, measured in thousand VND. Both expenditure variables are deflated for inflation using the 2006 constant price. In terms of the explanatory variables, we include child characteristics (age and gender), parental characteristics (the father's and mother's age and years of education), and household characteristics (household size and an indicator of whether the child lives in a rural area). The set of explanatory variables ties in with that commonly used in studies conducted in developing countries [Thai and Falaris (2014), Fichera and Savage (2015), Mulmi *et al.* (2016)].

Finally, the two instruments, the unemployment rate and rainfall deviation, are obtained from separate sources. Province-level unemployment rates, used to measure the proportion of unemployed people in the labor force in each period, are obtained from the annual Vietnam Statistical Handbook.¹³ The rainfall data are derived from

¹¹The Weight-for-age Z-score is also collected by Young Lives. This study does not examine this indicator as it is only available in Rounds 2 and 3.

¹²In contrast to developed countries, where child obesity is of increasing concern, the concern in developing countries relates to children being underweight. In our sample, the percentage of those children with a BMI in the WHO's unhealthy range of 25 or more is only 0.67%, whereas 2% of our sample lie above the unofficial Asian cut-off of 23 [WHO Expert Consultation (2004)]. Finally, the 85th percentile for BMI, defined by the Centers for Disease Control and Prevention as being overweight/obese [CDC (2018)], in our sample is 18.3 with 15% of our sample lying above this. Our findings are robust to restricting our sample to: (a) those with a BMI below 25; (b) those with a BMI below 23; and (c) those below the 85th percentile for BMI. The results are presented in Table A3 (Online Appendix).

¹³Available at <https://www.gso.gov.vn>.

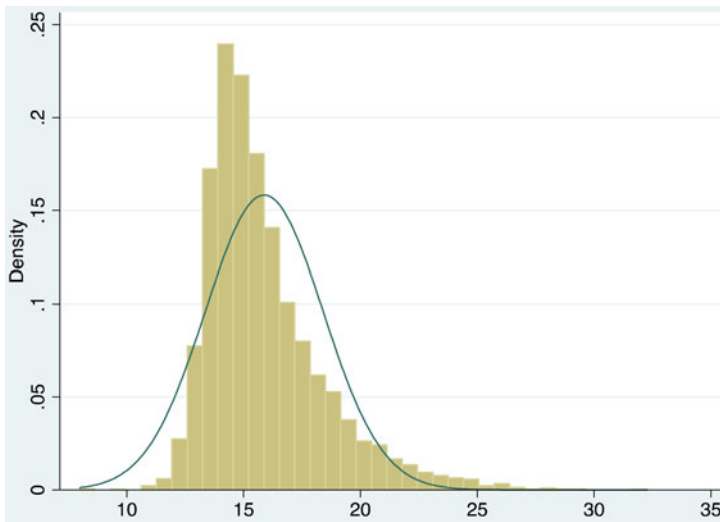


Figure 1. Histogram of BMI for Vietnamese children.

Source: Authors' calculation using Young Lives data.

the monthly precipitation of Gridded Monthly Time Series (Version 4.01) dataset (GMTS), developed by the Centre for Climatic Research, University of Delaware. This dataset provides global historical estimates of rainfall for a grid of 0.5 degree by 0.5 degree of latitude and longitude, where the grid nodes are centered on 0.25 degree. Each grid, thus, covers an area of 50 km². We then follow Trinh (2018) and use the administrative map of Vietnam to determine the longitude and latitude for each province. These rainfall data are then matched with the household data in Young Lives using the four closest grid points in the GMTS dataset and the month of interview. In order to reflect the long-term impact of weather conditions, precipitation data are collected over a 65-year period (1950–2014) to obtain a historical average. We then define rainfall deviation as the difference between the actual rainfall (averaged over a 12-month period prior to interview date) and the historical average rainfall.

Table 1 provides summary statistics for all variables used in this study. The average BMI of children in the sample is 15.8. On average, households' consumption expenditure is 461,000 VND and their average food expenditure is 282,000 VND. The average number of years of education for fathers and mothers are approximately 8 and 7, respectively. Finally, more than 80% of households live in rural areas, and the average household size is 4.6.

As a precursor to the econometric analysis, in Figure 2, we examine the relationship between household expenditure and health, based on the observed data. Four health levels are constructed using the 25th, 50th, 75th, and 100th percentiles of BMI-Z and the sample is also split into two age groups: 4–9 and 10–16 years. The graph suggests a positive correlation between the two measures of expenditure and child health. The results are consistent across the two age groups.

Table 1. Summary statistics

Variable	Description	Observation	Mean	Std. Dev.	Min	Max
Health indicators						
BMI	Body mass index	5,515	15.883	2.523	7.990	32.289
BMI-Z	Body mass index Z-score	5,515	-0.671	1.203	-7.73	4.35
HAZ	Height-for-age Z-score	5,523	-1.220	1.070	-6.14	12.66
Underweight	Underweight is defined as BMI ≤ 15	5,515	0.221	0.415	0	1
Household expenditure						
Total expenditure	Total monthly expenditure per capita	5,536	461.267	378.404	40.855	11,827
Food expenditure	Total monthly food expenditure per capita	5,536	281.757	195.821	18.912	5,383
Demographic characteristics						
Child gender	=1 if female; =0 otherwise	5,547	0.495	0.500	0	1
Child age	Age in years	5,547	9.416	3.314	4.140	16.060
Mother age	Age in years	5,520	35.541	6.731	19	61
Mother education	Mother's level of education (in years)	5,299	7.182	3.594	0	15
Father age	Age in years	5,379	38.304	6.770	20	70
Father education	Father's level of education (in years)	5,097	7.946	3.531	0	15
Household size	Number of people in household	5,547	4.590	1.355	1	15
Rural areas	=1 if rural; =0 otherwise	5,547	0.811	0.392	0	1
Instrumental variables						
Rainfall deviation	Actual rainfall—Historical rainfall (in millimetre)	5,547	-0.645	12.010	-18.601	36.864
Unemployment	Annual unemployment rate by provinces (%)	5,547	4.614	1.012	2.25	6.42

(Continued)

Table 1. (Continued.)

Variable	Description	Observation	Mean	Std. Dev.	Min	Max
Economic shocks						
Death of livestock		5,504	0.092	0.289	0	1
Drought		5,504	0.052	0.222	0	1
Flood		5,504	0.094	0.292	0	1
Crop failure		5,504	0.133	0.340	0	1
Pets on storage		5,504	0.017	0.129	0	1
Pets on livestock		5,504	0.055	0.227	0	1
Any shock		5,504	0.289	0.453	0	1

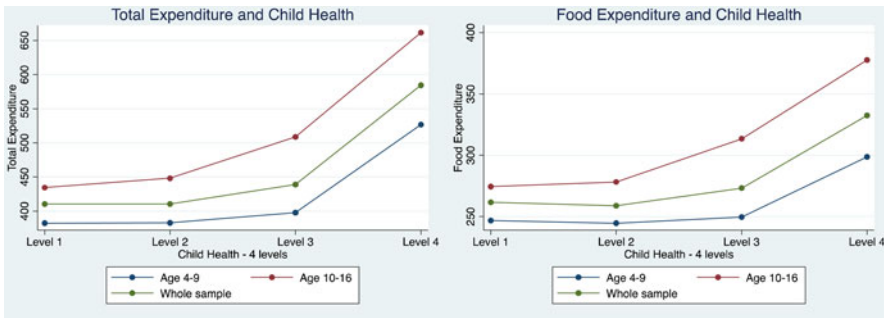


Figure 2. Household expenditure and child health.

Notes: Four levels of child health are constructed using BMI-Z: Level 1—BMI-Z \leq 25th percentile, Level 2—25th percentile<BMI-Z \leq 50th percentile, Level 3—50th percentile<BMI-Z \leq 75th percentile, and Level 4—BMI-Z>75th percentile.

Source: Authors' calculation using Young Lives data.

4. Results

4.1 Main findings

As a starting point, we estimate equation (1) using the Ordinary Least Squares (OLS) approach on a pooled sample, treating expenditure as exogenous and using province fixed effects to account for differences in geographic characteristics across provinces. The results are presented in Table 2. The first set of results in columns 1–3 relates to total expenditure used as a measure of living standards and columns 4–6 are estimated using food expenditure. Both sets of results indicate a strong correlation between household expenditure and child physical health.¹⁴ For instance, 1% higher total expenditure and food expenditure is associated with 0.0053 and 0.0038 higher BMI, respectively.

Next, we employ the IV approach to further examine the relationship between household expenditure and child health.¹⁵ This allows us to purge the correlation of household expenditure with the error term in equation (1) and to isolate the policy-driven effect of household expenditure on child health. From a policy perspective, these results inform health specialists about the likely impact of a food subsidy or cash transfer program on children's health.

We start by investigating the validity and strength of the two instruments, the unemployment rate and rainfall deviations. For an instrument to be valid, it must satisfy two conditions: firstly, it must have a statistically significant relationship with household expenditure; and, secondly, it needs to be uncorrelated with the residuals in equation (1). While the first condition is straightforward to test, the second

¹⁴We also estimate the model on the last round of survey data, using average expenditure across all three rounds of the survey as a measure of permanent expenditure and focus on long-term health, as measured by HAZ. The results are consistent although the effects of expenditure are smaller in magnitude. We are grateful to a referee for suggesting this robustness check.

¹⁵Given the longitudinal nature of the dataset, we also estimate a fixed-effects model. The effect of expenditure is statistically insignificant in all specifications. This is not surprising as we observe very small within-group variation in the expenditure measures, with year-to-year variability ranging between 200,000 VND (20\$) to 600,000 VND (30\$), relative to a variation of 40,000 VND to 11,827,000 VND across the sample.

Table 2. Household expenditure and child health: expenditure as exogenous

	(1)	(2)	(3)	(4)	(5)	(6)
	BMI	BMI-Z	HAZ	BMI	BMI-Z	HAZ
Total expenditure (log)	0.532*** (0.068)	0.312*** (0.036)	0.384*** (0.030)	–	–	–
Food expenditure (log)	–	–	–	0.382*** (0.068)	0.228*** (0.036)	0.365*** (0.030)
Girls	–0.175*** (0.061)	–0.102*** (0.033)	0.026 (0.027)	–0.182*** (0.061)	–0.106*** (0.033)	0.022 (0.027)
Mother age	–0.020* (0.010)	–0.012** (0.006)	–0.014*** (0.005)	–0.020* (0.011)	–0.012** (0.006)	–0.014*** (0.005)
Mother education	0.051*** (0.012)	0.027*** (0.006)	0.035*** (0.005)	0.060*** (0.012)	0.032*** (0.006)	0.039*** (0.005)
Father age	0.025** (0.010)	0.012** (0.005)	0.007 (0.005)	0.025** (0.010)	0.012** (0.005)	0.007 (0.005)
Father education	–0.018 (0.012)	–0.013** (0.007)	0.027*** (0.005)	–0.011 (0.012)	–0.009 (0.007)	0.030*** (0.005)
Household size	–0.005 (0.026)	0.003 (0.014)	–0.007 (0.011)	–0.018 (0.026)	–0.004 (0.014)	–0.008 (0.011)
Rural areas	–1.223*** (0.110)	–0.605*** (0.058)	–0.244*** (0.049)	–1.340*** (0.108)	–0.672*** (0.058)	–0.295*** (0.048)

Child age	0.026***	-0.005***	-0.001	0.027***	-0.005***	-0.000
	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Constant	11.421***	-1.042***	-3.246***	12.595***	-0.377	-2.936***
	(0.545)	(0.291)	(0.243)	(0.518)	(0.277)	(0.231)
Observations	4,954	4,954	4,960	4,954	4,954	4,960
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R ²	0.287	0.107	0.212	0.283	0.101	0.209

Notes: Estimated using OLS; robust standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3. Instrument performance

	(1) Total expenditure	(2) Food expenditure
Panel A: Unemployment rate as the instrument		
Unemployment rate ^a	-0.091*** (0.009)	-0.082*** (0.009)
Observations	4,953	4,953
Kleibergen–Paap <i>F</i> -stat (H_0 : weak IV)	105.395	84.309
Cragg–Donald Wald <i>F</i> -statistic	107.128	85.269
First stage <i>F</i> -statistic	141.53	138.65
Panel B: Rainfall deviation as the instrument		
Rainfall deviation ^a	0.005*** (0.001)	0.006*** (0.001)
Observations	4,557	4,557
Kleibergen–Paap <i>F</i> -stat (H_0 : weak IV)	25.741	34.201
Cragg–Donald Wald <i>F</i> -statistic	29.242	41.458
First stage <i>F</i> -statistic	94.26	103.59

Notes: Robust standard errors in parentheses.

^aPartial effects from first stage of the 2SLS. Other control variables include child gender and age, mother's age and education, father's age and education, household size, and an indicator for rural areas. The critical value of the *F*-test from Stock and Yogo (2002) is 16.38.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

condition (the exclusion restriction) cannot be tested, particularly if the model is just identified. However, as argued in the previous section, the two instruments are unlikely to have a direct effect on the child health outcomes. Table 3 shows a strong significant correlation between household expenditure and the two alternative instruments in the first-stage estimation (see the first row under panels A and B). As expected, a higher unemployment rate is associated with lower total and food expenditure, while a higher deviation of rainfall results in higher total and food expenditure.

We examine the strength of the instruments using the critical values tabulated by Stock and Yogo (2002). We test for weak instruments using the first stage *F*-statistic (the rule of thumb is that this statistic is greater than 10), the Kleibergen–Paap Wald *F*-statistic and the Cragg–Donald Wald *F*-statistic. Under the null hypothesis, we assume that the instrument is weak. The critical value of 16.38 [Stock and Yogo (2002)] implies a rejection of the null hypothesis for both the unemployment rate (Panel A) and rainfall deviation (Panel B) using all three statistics, hence endorsing the strength of the selected instruments.¹⁶

¹⁶We also conduct the Sargan test of overidentifying restrictions by estimating the model with both instruments simultaneously. In three out of six specifications (three different measures of child health and two different measures of expenditure), the *p*-value is large and the null hypothesis that the additional instruments are valid cannot be rejected.

We now move on to discuss our main results, which are shown in Table 4, with the model estimated using the unemployment rate (Panel A) and rainfall deviation (Panel B), and province fixed effects controlled for in all the regressions. The findings are generally consistent across the two empirical approaches, indicating a strong association between household expenditure and the child health outcomes, irrespective of the instruments used. This is explained by the fact that households with higher expenditure or higher living standards can consume better health and non-health inputs, as well as live in healthier environments. Higher income can also translate into an increase in the opportunity cost of time spent on health-promoting activities, especially by the mother [Miller and Urdinola (2010), Stoklosa *et al.* (2018)]. For example, important determinants of child health, such as, preparing nutritious food, bringing water from distant sources and travelling long distances to access health facilities, require a large amount of time [Miller and Urdinola (2010)]. Consumption expenditure can also be considered as a pathway through which income affects children's health as higher expenditure could result into better health care and nutrition. Our findings are consistent with this hypothesis.

From Table 4, using the unemployment rate as an instrument, it is apparent that a 1% increase in total expenditure (food expenditure) is associated with a 0.013 (0.015) increase in BMI. With rainfall deviation as an instrument, the corresponding increase in BMI is of the order of 0.033 (0.028). While these effects may appear small, if we translate them into a change in weight for a "typical" child in our sample (i.e., at the mean values of all the explanatory variables), a 10% increase in total expenditure, for example, will result in a weight gain of 213 (541) grams based on the two partial effects of 0.013 and 0.033 from Panels A and B, respectively.¹⁷ The results are generally consistent across the BMI-Z and HAZ measures providing additional support for the robustness of our findings. Specifically, we find that a 10% increase in, for example, food expenditure is associated with increases of 0.10 and 0.23 of a standard deviation in BMI and height, respectively. As noted earlier, relative to BMI representing the short-run health status of the child, height captures long-term, cumulative effects of poor nutrition, as it affects child development, particularly at younger ages. As such, our results indicate the existence of both long-run and short-run effects of expenditure on child health. We also estimate the models by clustering standard errors at province and commune levels and the results are generally consistent.¹⁸

Clearly, the marginal effects of both expenditure variables in the IV model are larger than the respective OLS effects in Table 2, where we do not take account of potential reverse causality and the presence of unobserved heterogeneity. The negative bias in the OLS estimates could result from unobserved parental work choices (such as a preference to stay at home to provide better care to their children), which would be positively related to child health but negatively correlated to income and household

¹⁷We use the formula $BMI = \text{weight (in kg)} / \text{height}^2 \text{ (in m)}$, and a sample mean height of 1.28 m to calculate the weight gain. A similar exercise for the two age groups, 4–9 and 10–16 year olds with sample mean heights of 1.13 m and 1.46 m, respectively, results in weight gains of 272 g and 580 g, respectively, for a 10% rise in total expenditure using the results from Panel A.

¹⁸Given that the informal sector is quite significant in Vietnam, we use two alternative instruments as measures of labor market disadvantage: (1) the share of the agricultural sector and (2) the share of non-farm individual business, both of which are arguably better measures of self-employment and employment in the informal sector. We find consistent results. The results are available on request.

Table 4. Household expenditure and child health: second stage of two-stage least squares estimation (2SLS)

	(1)	(2)	(3)	(4)	(5)	(6)
	BMI	BMI-Z	HAZ	BMI	BMI-Z	HAZ
Panel A: Unemployment rate as the instrument						
Total expenditure (log)	1.322*** (0.511)	0.897*** (0.250)	2.051*** (0.268)	–	–	–
Food expenditure (log)	–	–	–	1.477** (0.581)	1.002*** (0.288)	2.290*** (0.318)
Child age	0.025*** (0.001)	–0.006*** (0.001)	–0.004*** (0.001)	0.025*** (0.001)	–0.006*** (0.001)	–0.004*** (0.001)
Girls	–0.155** (0.063)	–0.087** (0.034)	0.068* (0.035)	–0.164*** (0.064)	–0.093*** (0.034)	0.053 (0.037)
Mother age	–0.016 (0.012)	–0.009 (0.006)	–0.006 (0.006)	–0.015 (0.012)	–0.008 (0.006)	–0.005 (0.007)
Mother education	0.020 (0.024)	0.004 (0.012)	–0.029** (0.012)	0.026 (0.022)	0.008 (0.011)	–0.019 (0.012)
Father age	0.023** (0.011)	0.011* (0.006)	0.004 (0.006)	0.024** (0.011)	0.011* (0.006)	0.005 (0.006)
Father education	–0.045** (0.021)	–0.032*** (0.011)	–0.028** (0.011)	–0.040** (0.020)	–0.029*** (0.010)	–0.021* (0.011)
Household size	0.065 (0.051)	0.055** (0.026)	0.140*** (0.028)	0.081 (0.058)	0.065** (0.029)	0.164*** (0.033)

Rural areas	−0.839***	−0.321**	0.568***	−0.932***	−0.383***	0.423***
	(0.269)	(0.135)	(0.144)	(0.242)	(0.123)	(0.136)
Constant	6.253*	−4.869***	−14.150***	5.994*	−5.045***	−14.542***
	(3.345)	(1.648)	(1.770)	(3.507)	(1.748)	(1.940)
Observations	4,953	4,953	4,959	4,953	4,953	4,959
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Panel B: Rainfall deviation as the instrument						
Total expenditure (log)	3.250***	2.271***	1.909***	−	−	−
	(1.053)	(0.598)	(0.499)			
Food expenditure (log)	−	−	−	2.753***	1.924***	1.590***
				(0.860)	(0.478)	(0.388)
Child age	0.021***	−0.009***	−0.003***	0.023***	−0.007***	−0.002**
	(0.003)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
Girls	−0.139*	−0.062	0.067*	−0.177**	−0.089**	0.044
	(0.077)	(0.046)	(0.038)	(0.071)	(0.041)	(0.034)
Mother age	−0.006	−0.002	−0.008	−0.008	−0.003	−0.009
	(0.014)	(0.008)	(0.007)	(0.013)	(0.007)	(0.006)
Mother education	−0.066	−0.054**	−0.028	−0.024	−0.025	−0.003
	(0.042)	(0.024)	(0.020)	(0.029)	(0.016)	(0.013)
Father age	0.016	0.007	0.005	0.018	0.009	0.006
	(0.013)	(0.008)	(0.006)	(0.013)	(0.007)	(0.006)
Father education	−0.105***	−0.076***	−0.019	−0.072***	−0.053***	0.000
	(0.036)	(0.020)	(0.017)	(0.026)	(0.014)	(0.012)

(Continued)

Table 4. (Continued.)

	(1)	(2)	(3)	(4)	(5)	(6)
	BMI	BMI-Z	HAZ	BMI	BMI-Z	HAZ
Household size	0.239** (0.098)	0.175*** (0.056)	0.122*** (0.046)	0.198** (0.082)	0.146*** (0.047)	0.095** (0.037)
Rural areas	-6.139 (6.904)	-13.744*** (3.933)	-13.199*** (3.286)	-1.410 (5.183)	-10.439*** (2.894)	-10.264*** (2.347)
Constant	0.021*** (0.003)	-0.009*** (0.001)	-0.003*** (0.001)	0.023*** (0.002)	-0.007*** (0.001)	-0.002** (0.001)
Observations	4,557	4,557	4,562	4,557	4,557	4,562
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Robust standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

consumption. Similarly, extended family set-ups could be negatively related to expenditure but could impact positively on child health. These results conform to prior studies that have found a larger IV estimate of income gradient relative to OLS [Doyle *et al.* (2007), Kuehnle (2014), Fichera and Savage (2015)]. For example, Kuehnle (2014) finds that the IV estimate of the effect of income on the probability of a child being in poor health is four times larger than the OLS estimate.

Although our main interest lies in the relationship between household expenditure and child health, the coefficients on the other control variables provide some interesting results. For example, girls are more likely to have negative health outcomes compared to boys. Also, children living in urban areas with better access to healthcare services are more likely to have better physical health than those living in rural areas.¹⁹ Interestingly, we find mixed evidence of the role of parental education on child health. The results mostly indicate a positive and significant relationship between mothers' education and child health, which could be explained by an accumulation of healthcare knowledge. However, in almost all estimations, we find a negative association between the father's education and child health. One likely reason could be the presence of multicollinearity between the mother's and father's education. We further explore this issue using alternative specifications. Firstly, we remove the mother's education from the models and find that the OLS estimate of the effect of the father's education becomes positive and significant. The IV estimate however remains negative but becomes statistically insignificant. Next, we estimate the models removing the father's education from the specification. We find that in all cases our main results remain essentially unchanged, lending confidence to our earlier results.²⁰

As a further test of the robustness of our results, we estimate the model with self-assessed health, which is a categorical variable defined as 1 for poor/very poor health, 2 for average health, and 3 for good health. We use the Conditional mixed-process (CMP) modeling approach, suggested by Roodman (2011), to estimate equation (2) (an Ordered Probit specification) and equation (3) as a system with correlated error terms. Our results, presented in Table 5, are consistent with the previous findings. Both total expenditure and food expenditure have statistically significant effects on child health. This lends further support to the instruments we have used in the study.

We further explore the robustness of our results by estimating the health–expenditure relationship across two different age groups. This is motivated from the income–health gradient literature, which shows heterogeneous results across age groups. Some studies, particularly in developed countries, have found the relationship between child health and household income to be stronger for older children [e.g., Currie and Stabile (2002), Burgess *et al.* (2004)]. In contrast, Cameron and Williams

¹⁹We also estimate the model with an indicator of low birth weight in order to control for the child's initial stock of health [see, e.g., Currie and Stabile (2002), Cameron and Williams (2009)]. We find a positive and significant effect of birth weight on child health but the main effect of expenditure becomes negative and statistically insignificant. It is quite likely that the effect of expenditure is attenuated by the initial health stock effect. Likewise, we control for household quality, access to sanitation, and access to safe drinking water (where all three are measured as indices), which we believe are important determinants of child health. Once again, their inclusion in the model makes the expenditure effect statistically insignificant. Presumably, these variables themselves are indicators of living standards such that it is difficult to disentangle their effects from the main effect of expenditure. The results are shown in Table A4 (Online Appendix).

²⁰The results are available on request.

Table 5. Household expenditure and child self-reported health

	Dependent variable: self-reported health			
	Unemployment as instrument		Rainfall as instrument	
Total expenditure (log)	0.728*** (0.248)	–	0.353*** (0.135)	–
Food expenditure (log)	–	0.606*** (0.222)	–	0.227* (0.125)
Observations	5,070	4,959	5,070	4,959

Notes: Robust standard errors in parentheses. Dependent variable is a categorical variable defined as 1 for poor/very poor health, 2 for average health, and 3 for good health. System of Ordered Probit and linear regression estimated using CMP. Other control variables include child gender and age, mother’s age and education, father’s age and education, household size, and an indicator for rural areas.
 *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

(2009) did not find that the impact of income varies with age in Indonesia. Since previous studies have not established any systematic construct of age groups, we split our sample into: children aged from 4 to 9 years, and children aged from 10 to 16 years. The criteria we use here is that children move from primary to secondary education at the age of 10 in Vietnam.²¹ The main results are presented in Table 6. Overall, we find a consistent effect of household expenditure on child health across the two age groups. For example, a 1% increase in total expenditure results in an increase in BMI of 0.021 (0.011) for the 4–9 (10–16) years old children (Panel A) when we instrument expenditure using unemployment, and of 0.041 (0.010) (Panel B) when we instrument expenditure using rainfall. However, given the small sample sizes, the results should be interpreted with caution.

Finally, in order to provide some further insights on the magnitude of the effects of household expenditure on child health, we estimate the effect of total expenditure and food expenditure on the probability that a child is underweight.²² Specifically, we estimate a Probit model with expenditure as an endogenous regressor, where our dependent variable is now defined as $U_{it} = 1[\delta_0 + \delta_1 I_{it} + \delta_2 C_{it} + \delta_3 P_{it} + \delta_4 H_{it} + w_{it}] > 0$ and U_{it} is a binary indicator for whether a child is underweight at time t . Table 7 presents the results. The marginal effects of total expenditure and food expenditure (shown in brackets) are both statistically significant at the 1% level of significance. The findings indicate that a 1% rise in total (food) expenditure is associated with a 0.367 (0.300) decrease in the probability that a child will be underweight (using the unemployment rate as an instrument).

4.2 Economic shocks and child health

In this section, we investigate the impact of adverse economic shocks on children’s health. Specifically, we examine whether there are any differential effects of these

²¹In this study, we also divide the sample into different categories of child age and obtain consistent results (see Table A6, Online Appendix).

²²Following the WHO (2010), we define underweight status as $BMI \leq 15$.

Table 6. Household expenditure and child health by age-groups

	BMI		BMI-Z		HAZ	
	Age 4–9	Age 10–16	Age 4–9	Age 10–16	Age 4–9	Age 10–16
Panel A: Unemployment rate as the instrument						
Total expenditure (log)	2.141*** (0.814)	1.106** (0.509)	0.341 (0.506)	1.598*** (0.268)	1.864*** (0.524)	1.518*** (0.234)
Observations	2,796	2,157	2,796	2,157	2,802	2,157
Panel B: Rainfall deviation as the instrument						
Total expenditure (log)	4.112*** (1.135)	1.018 (0.824)	1.506** (0.603)	1.542*** (0.436)	1.819*** (0.526)	2.274*** (0.476)
Observations	2,651	1,906	2,651	1,906	2,656	1,906

Notes: Robust standard errors in parentheses. Estimated using 2SLS. Results of first stage are not shown. Other control variables include child gender and age, mother's age and education, father's age and education, household size, and an indicator for rural areas.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 7. Household expenditure and underweight children: IV-Probit model

	Dependent variable: probability of being underweight			
	(1)	(2)	(3)	(4)
Total expenditure (log)	-0.932***	-1.347***	-	-
	[-0.367***]	[-0.535***]		
	(0.096)	(0.113)		
Food expenditure (log)	-	-	-0.763***	-1.181***
			[-0.300***]	[-0.469***]
			(0.082)	(0.107)
Observations	4,981	4,583	4,981	4,583

Notes: Robust standard errors in parentheses. Marginal effects are shown in brackets. Results of the first stage are not shown. Other control variables include child gender and age, mother’s age and education, father’s age and education, household size, and an indicator for rural areas. Columns (1) and (3) use unemployment rate as an instrument, columns (2) and (4) use rainfall deviation as an instrument.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

shocks by socioeconomic status such that the shocks have a larger impact on children with lower household expenditure. Several studies have examined the impact of economic shocks on a range of child outcomes such as education, nutrition, and health [Jacoby and Skoufias (1997), Jensen (2000), Duryea *et al.* (2007), Maccini and Yang (2009), Baird *et al.* (2011)] with some evidence of a social gradient in the impact of these shocks [Hoddinott and Kinsey (2001), Carter and Maluccio (2003), Newhouse (2005)]. It is argued that households facing liquidity constraints have limited means to smooth consumption such that income fluctuations weigh heavily on poor households [Townsend (1995)].

The Young Lives dataset provides information on a range of adverse shocks (financial and emotional) experienced by households in the 12 months prior to the survey. Focusing on those economic shocks on which we have sufficient observations, and using BMI as the dependent variable, we examine both contemporaneous and lagged effects of each of the shocks on child health (see Table 8, Panels A and B, respectively). Specifically, in columns 1–6, we study the impacts of: death of livestock, drought, flooding, crop failure, pests on storage, and pests on livestock, all of which are arguably exogenous and can potentially lead to liquidity constraints on households. It is apparent from the summary statistics in Table 1 that crop failure is the most common type of economic shock faced by households. Finally, in column 7, we explore the effects of the household experiencing any of the six types of economic shock.

To examine the social gradient in the response to the shocks, we interact household expenditure with the respective shock variables.²³ We consistently observe a negative coefficient on the interaction term indicating a decreasing effect of the shocks with increasing household expenditure (Panel A). In other words, the impact of the shocks is larger for children from low expenditure households relative to those from

²³Most of these shocks will directly affect farm households. We have also estimated the model on a sub-sample of farm households. The results are largely consistent (see Table A7, Online Appendix).

Table 8. Household expenditure and child health: impact of exogenous shocks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Death of livestock	Drought	Flood	Crop failure	Pests on storage	Pests on livestock	Any shock
Panel A: Shock at time t							
Total expenditure	0.574*** (0.069)	0.562*** (0.069)	0.557*** (0.069)	0.586*** (0.071)	0.544*** (0.068)	0.563*** (0.069)	0.672*** (0.077)
Shock	3.880*** (1.226)	4.090*** (1.519)	2.255* (1.307)	2.918*** (1.033)	4.598* (2.595)	3.324** (1.371)	3.485*** (0.787)
Total expenditure \times shock	-0.678*** (0.215)	-0.730*** (0.271)	-0.458** (0.223)	-0.527*** (0.179)	-0.797* (0.463)	-0.553** (0.239)	-0.626*** (0.135)
Observations	4,954	4,954	4,954	4,954	4,954	4,954	4,491
R^2	0.289	0.289	0.291	0.289	0.288	0.289	0.289
Panel B: Shock at time $t-1$							
Total expenditure	0.554*** (0.070)	0.697*** (0.097)	0.684*** (0.099)	0.550*** (0.071)	0.678*** (0.096)	0.651*** (0.097)	0.697*** (0.115)
Shock	1.974* (1.189)	3.939* (2.092)	0.870 (1.513)	1.053 (1.050)	4.166 (2.960)	-0.890 (1.807)	0.426 (1.062)
Total expenditure \times shock	-0.367* (0.206)	-0.658* (0.360)	-0.170 (0.250)	-0.208 (0.181)	-0.742 (0.511)	0.163 (0.303)	-0.085 (0.177)
Observations	4,945	2,969	2,969	4,945	2,969	2,969	2,661
R^2	0.288	0.328	0.327	0.288	0.327	0.327	0.320

Notes: Estimated using OLS. Robust standard errors in parentheses. Other control variables include child gender and age, mother's age and education, father's age and education, household size, and an indicator for rural areas.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

high expenditure households. The shock effects are particularly large and statistically significant for drought and pests on storage. The results in Panel B are largely consistent except that the coefficients of the interaction terms are mostly statistically insignificant, which suggests that the shocks only affect children's health in the short run.

5. Conclusion

This paper provides empirical evidence on the relationship between socioeconomic status and child physical health in Vietnam. In contrast to existing studies, which generally use income or a wealth index to measure socioeconomic status, we use household expenditure (measured using food expenditure and total expenditure) as an alternative measure. The concerns raised in the existing literature over the use of a composite wealth index as well as issues with measuring income within a developing country context endorse our focus on household expenditure. Using expenditure instead of income also allows us to explore the mechanisms via which income affects child health, in which household consumption plays an important role. Moreover, in contrast to the existing literature, which tends to focus on subjective health measures, we exploit a set of objective measures of child health, namely, BMI, standardized BMI (BMI-Z) and standardized height (HAZ). This allows us to examine the effect of expenditure in both the short run (using BMI) and the long run (using height). Finally, the potential endogeneity of household expenditure is addressed using an IV approach, with the local unemployment rate and rainfall deviation used as instruments. We provide a number of robustness checks that lend substantial empirical support toward our identifying assumptions as well as our findings.

Our results indicate a strong statistically significant relationship between household expenditure and child health. We find evidence that expenditure impacts on child health both in the short run, as captured by changes in BMI, and via the accumulative effects of poor nutrition on height, in the long run. Specifically, we find that a 10% increase in total expenditure (food expenditure) is associated with a 0.013 (0.015) increase in BMI. This translates into a weight gain of 213 (541) grams in a "typical" child in our sample. The results are also generally consistent across the various measures of health outcomes, notably BMI-Z and HAZ. For example, a 10% increase in food expenditure is associated with increases of 0.10 and 0.23 of a standard deviation in BMI and height, respectively. We also examine our results across two different age groups, children aged from 4 to 9 years, and children aged from 10 to 16 years. Overall, we find consistent effects of expenditure across both age groups. Finally, we examine the effect of a range of exogenous adverse economic shocks on children's health. We find that the effects of the shocks are greater for children from lower socioeconomic backgrounds.

Our findings highlight the importance of health policy interventions especially for children living in rural areas with low economic development and poor healthcare services. Existing policies in Vietnam, such as public health insurance programs, have focused on health care provision. Nonetheless, many households opt for private health providers in order to get treated quickly [Nguyen (2016)]. This results in an increase in health care expenditure (i.e., out-of-pocket expenditure) that may potentially lead poor households into a poverty trap. Our findings demonstrate that policies which directly impact on household resources, such as a food subsidy and/or

cash transfer programs, are likely to have a significant effect on children's health and well-being both in the short run and long run. In turn, in the longer term, enhanced child health outcomes can potentially lead to higher educational attainment, improved labor market outcomes, and better health later in life, which may serve to combat intergenerational transmission issues.

Conflict of interest

The authors declare that they have no conflict of interest.

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