ISSN 1756-7904

DEV ODG

Working Paper Series

Interactions between short-and long-term health of children: A case from rural Ethiopia

Bereket Kebede

UEA

2008

Working Paper 6

The School of Development Studies, University of East Anglia
Norwich, NR4 7TJ, United Kingdom

DEV Working Paper 06

Interactions between short-and long-term health of children: A case from rural Ethiopia[1]

Bereket Kebede

First published by the School of Development Studies in June 2008

This publication may be cited as:
Kebede, B, Interactions between short-and long-term health of children: A case from rural Ethiopia, Working Paper 06, DEV Working Paper Series, The School of Development Studies, University of East Anglia, UK.

About the Author

Bereket Kebede is a Lecturer in Economics at the School of Development Studies at the University of East Anglia, Norwich, UK.

Contact:
b.kebede@uea.ac.uk
The School of Development Studies
University of East Anglia
Norwich, NR4 7TJ
United Kingdom
Tel: +44(0)1603 592807
Fax: +44(0)1603451999

[1] This paper was presented at the 8th International Health Economics Annual Conference held in Copenhagen, Denmark in July 2007. The author is grateful to the discussant of the paper, Scott Grosse, and other participants of the conference for their useful comments and questions.

About The DEV Working Paper Series
The Working Paper Series profiles research and policy work conducted by the School of Development Studies and Overseas Development Group. Launched in 2007, it provides an opportunity for staff, associated researchers and fellows to disseminate original research and policy advice on a wide range of subjects. All papers are peer reviewed within the School. Recent past work, provided it meets the standards required and has contemporary significance is also welcome.

About the DEV/ODG Reports and Policy Papers
These are reports and papers that reproduce consultancy, applied research findings and policy work conducted by the School of Development Studies or Overseas Development Group. Launched in 2007, the reports provide an opportunity for staff, associated researchers and fellows to disseminate studies and findings on a wide range of subjects. Recent past work, provided it meets the standards required and has contemporary significance is also welcome.

About The School of Development Studies
The School of Development Studies (DEV) applies economic, social and natural sciences to the study of international development, with special emphasis on social and environmental change and poverty alleviation. DEV has a strong commitment to an interdisciplinary research and teaching approach to Development Studies and the study of poverty. This has been developed over a forty year period, bringing together researchers and students from different disciplines (economists, social scientists, natural resource scientists) into research areas and teaching teams.

The Overseas Development Group (ODG)
Founded in 1967, the ODG is a charitable company wholly owned by the University of East Anglia, which handles the consultancy, research, and training undertaken by the faculty members in DEV and approximately 200 external consultants. Since its foundation ODG has provided training for professionals from more than 70 countries and completed more over 1,000 consultancy and research assignments. ODG provides DEV staff with opportunities to participate in on-going development work - real-world experience which adds a unique and valuable element to the School's teaching programmes.

For further information on DEV and ODG, please contact:
School of Development Studies
University of East Anglia, Norwich NR4 7TJ, United Kingdom
Tel: +44 (0)1603 592807
Fax: +44 (0)1603 451999
Email: dev.general@uea.ac.uk
Webpage: http://www1.uea.ac.uk/cm/home/schools/ssf/dev

Abstract

In contrast to other studies, this paper examines the determinants of short-term child health by controlling for the long-term health status of children. Using data from rural Ethiopia and linear mixed models that control for individual heterogeneity, the empirical analysis indicate that the effect of per capita household expenditures on the weight-for-age z-scores of children in rural Ethiopia is influenced by the children's height-for-age z-scores implying that the efficiency with which short-term health inputs are transformed into health outcomes is significantly affected by long-term health status of children.

Introduction

There is growing literature on the health of children using anthropometric measures to capture physical health and nutritional status. Factors affecting long- and short-term health as reflected in anthropometric outcomes are analysed either by estimating health production functions or reduced forms. While height-for-age score is widely used for long-term nutritional and health status of children, weight-for-height or weight-for-age scores are used as measures of short-term health conditions. Most studies focus on the effect of socio-economic characteristics of households – including income – on child health.

Using data from a sample of poor Colombian children living in small municipalities Attanasio et al. (2004) analysed the influence of household consumption and public infrastructure on anthropometric outcomes and found that both are important determinants of child health. Tarozzi and Mahajan (2007) show that with overall economic growth short-term anthropometric outcomes significantly improved during the 1990s in India but the results for long-term health measures are mixed; the effects are also differentiated by gender. Similarly Borooah (2005) using land as proxy for income found a positive income effect on child health. Akresh and Verwimp (2006) examine the long term effects of economic shocks on child health in Rwanda; crop failures and conflicts related to civil war reduced the height-for-age z-scores of girls but didn't have significant effect on boys. Differences in the effect of income on anthropometric outcomes for urban and rural areas of Romania are analysed by Skoufias (1998). In rural areas while income influences height-for-age it has no effect on weight-for-height; in contrast, there is no significant impact on either in urban areas. Using exogenous changes in the allocation of property, Galiani and Schargrodsky (2004) show that children in households with secure property rights in squatter settlements in Argentina have higher weight-for-height scores. Case et al. (2002) find a positive impact of income on the health of children, the effect increasing with age. A study by David et al. (2004) using data from Nicaragua and Honduras finds that in addition to income, maternal stature, age difference with an older sibling and household size are significant determinants of child height. Alderman et al. (2005) show that better nutrition – as measured by anthropometric outcomes – is associated with higher income in Tanzania; in addition, nutritional programmes have substantial impact on child health. Using a dynamic health production function Fedorov and Sahn (2005) show that mother's education, father's employment status and per capita household expenditures have large effects on the health of Russian children. Comparison between escapees from North Korea with people from South Korea shows that the stature of the latter has increased significantly compared to the northerners; this can be explained by differences in economic growth and income between the two countries (Pak, 2004).

Most of the work cited above, as well as others find positive correlation between income or similar measures of economic status and short- or long-term child health. Typically, studies focusing on short-term child health examine how socio-economic factors affect health without controlling for the long-term health status of children. This implicitly assumes that the transformation of inputs into health outcomes in the short-run is independent of the long-term health status of children. This is equivalent to assuming that children with different long-term health status have the same capacity of transforming income into short-term health. In terms of nutrition, this implies that if children with different long-term health are fed the same amount of food it will affect their short-term health equally. As children with a better long-term health are expected to respond differently in the short-run from those with poor long-term health, this is likely incorrect.

Unlike other studies, this paper controls for the long-term health status of children when examining the determinants of short-term child health. Our results indicate that children's height-for-age z-scores influence the effect of per capita household expenditures on the weight-for-age z-scores of children in rural Ethiopia implying that the efficiency with which short-term health inputs are transformed into health outcomes is significantly affected by long-term health status of children.

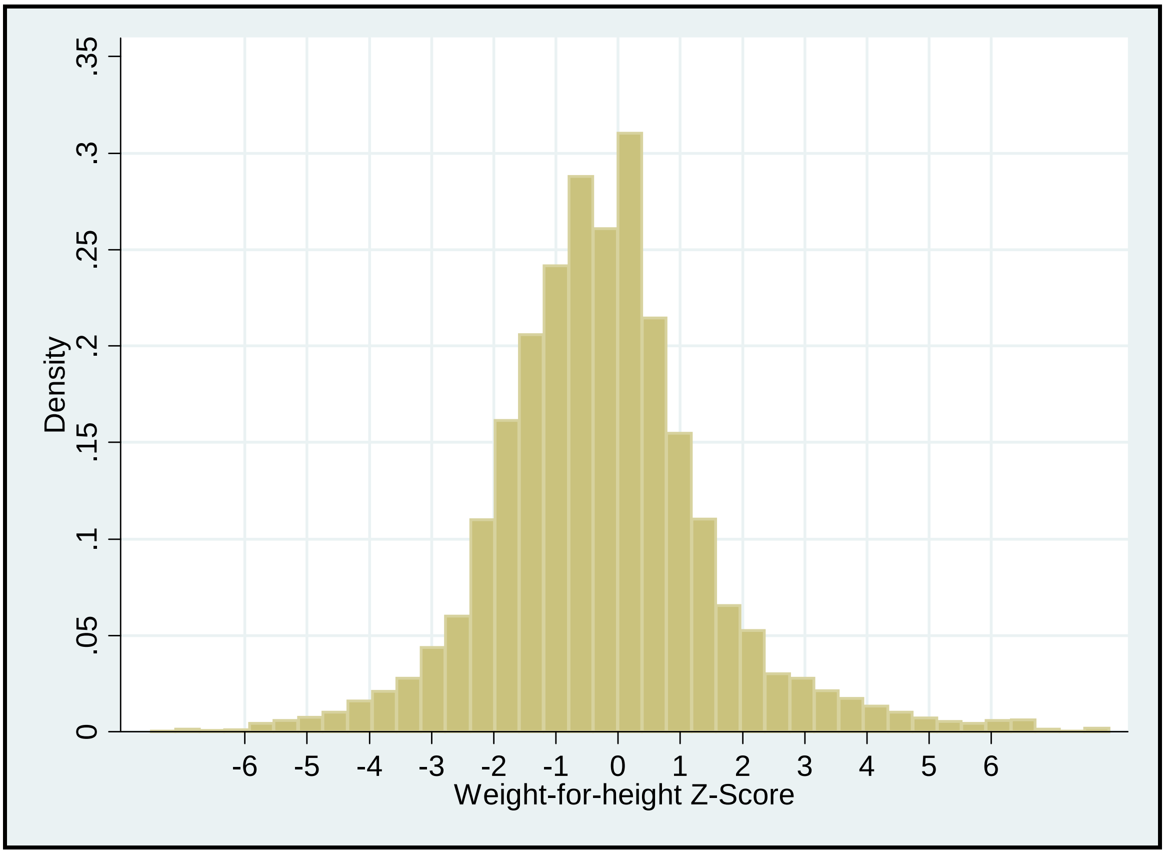
The rest of the paper is organised in the following way. The next section presents the data and descriptive statistics and Section 3 presents the conceptual framework. The last two sections will present the main results and conclusions.

Data and descriptive statistics

This paper uses data from the Ethiopia Rural Household Surveys (ERHS) conducted by the Economics Department of Addis Ababa University, the Centre for the Study of African Economies (CSAE) of Oxford University and the International Food Policy Research Institute (IFPRI). The surveys covered around 1500 households in fifteen different villages (peasant associations) dispersed over the main settled agricultural areas of Ethiopia; the surveys are longitudinal and attrition rates are relatively low. So far, the ERHS has been conducted for six rounds excluding the initial limited survey done by IFPRI in 1989; three rounds in 1994-5, one round each in 1997, 1999 and 2004. This paper uses the data from the four rounds between 1994 and 1997. Unbalanced panel data on anthropometric scores of around 3,800 children younger than 11 years with other individual, household and community level information are used. While the total number of observations is around 10,000, 33% of the children are observed in all the four rounds.

As in most developing countries, children in rural Ethiopia suffer from malnutrition and long-term health problems. **Figure 1** shows the histogram for weight-for-height z-scores – which reflects short-term nutritional and health status – of the sampled children for all rounds. Half of the children have negative scores implying high levels of malnutrition and poor short-term health status; this proportion increases to 77% for weight-for-age z-scores, a related measure of short term nutritional and health status.

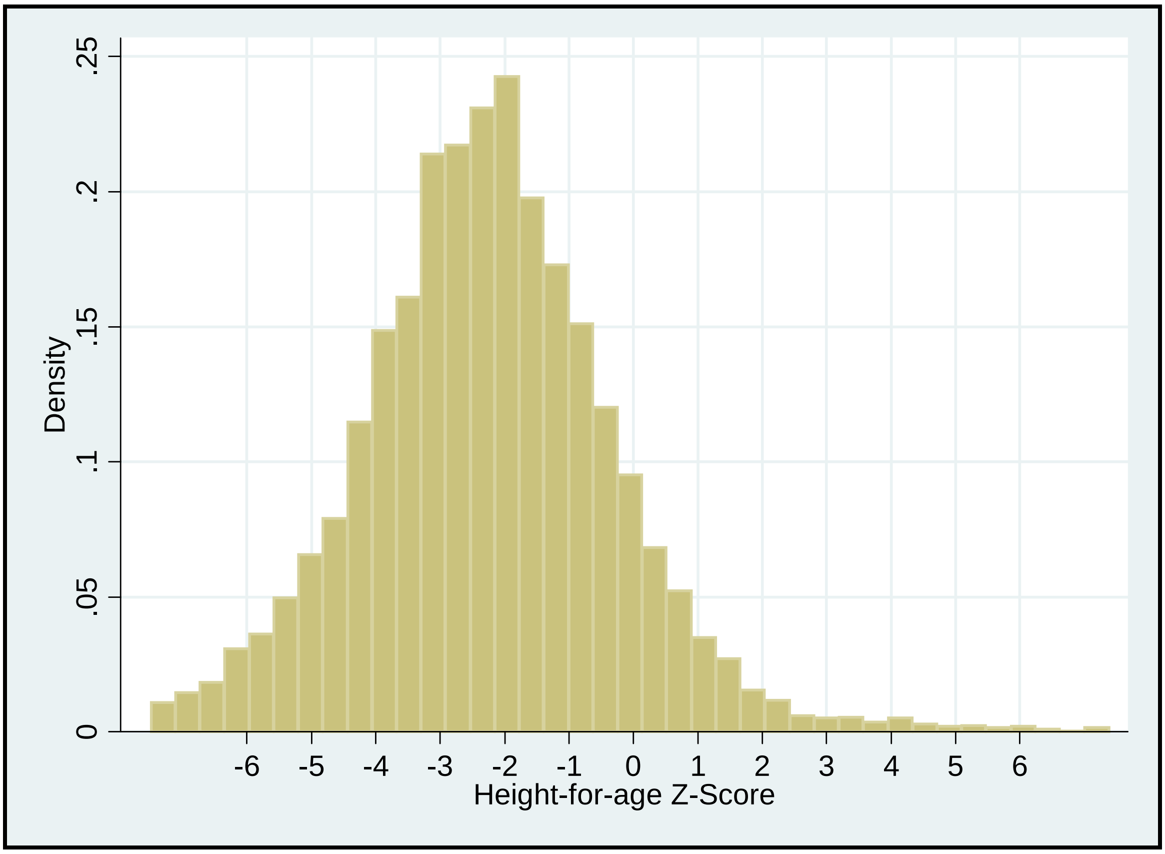
Figure 1: Weight-for-height z-score of children (1994-97)



The long-term nutritional and health status of the children is also very poor. **Figure 2** presents the height-for-age z-scores of the sampled children for all the rounds; 77%

of the children have negative z-scores indicating the poor long-term nutritional and health status of the children.

Figure 2: Height-for-age z-score of children (1994-97)



We obtain similar aggregate patterns for weight-for-height and height-for-age of children when the data are disaggregated to the village level; the histograms for weight-for-height and height-for-age z-scores of children disaggregated to village levels are given in Appendices 1 and 2 at the end. Even though the distributions are different for the sampled villages, both the weight-for-height and height-for-age z-scores for all villages clearly indicate that the typical child in rural Ethiopia is severely deprived in both short- and long-term nutritional and health conditions even in relatively richer regions. This can further be illustrated by looking at the proportion of children that are wasted and stunted; children with less than -2 weight-for-height and height-for-age z-scores are respectively classified as wasted and stunted. **Table 1** presents the proportion of children wasted, stunted and with weight-for-age z-scores less than -2 in the sampled villages.

Table 1: Percentage of wasted and stunted children in sampled villages

Village	Wasted (%)	<-2 weight-for-age	Stunted (%)
Haresaw	8.65	36.73	55.19
Geblen	13.61	44.92	56.16
Dinki	16.92	30.77	32.09
Debre Berhan	11.66	29.90	43.20
Yetmen	8.89	43.13	61.19
Shumsheha	14.04	36.02	51.32
Sirbana Godeti	12.66	27.07	37.55
Adele Keke	6.91	32.98	45.21
Korodegaga	6.58	25.37	39.04
Terufe Ketchema	5.81	27.60	45.52
Imdibir	16.62	49.86	55.31
Aze Deboa	8.91	41.82	58.91
Adado	10.51	44.08	60.02
Gara_Godo	11.28	43.71	54.52
Domma	12.13	33.02	46.83

For each village between 32% and 61% of the sampled children were stunted. The relatively low figures for the percentage of wasted children are somewhat misleading. Since weight-for-height captures how much children weigh given their height, it underestimates short-run nutritional deprivation if the children are stunted, as our sampled children are. To give a different perspective on short-run nutritional and health status, the percentage of children with weight-for-age z-scores less than -2 is given in Column2 of Table 1; between 25% and 50% of the children in each sampled village have scores less than -2 indicating the severe short-run health conditions of children.

As the descriptive results indicate, children living in rural areas of Ethiopia have poor short- and long-term nutritional and health status. As indicated in the introduction, much research has been done on determinants of short- and long-term child health. The focus of this paper is to examine how factors influencing the short-term health of children are influenced by their long-term health status. For example, current income affects the short-term health of children but its effect is expected to be different for children with different long-term health. A higher level of income will likely improve short-term child health but by how much is likely to be influenced by the child's long-term health. The next section sets out the conceptual framework and estimation strategy to pursue this.

Conceptual framework and estimation

Let h be a measure of the short-term health of children. In studies focusing on the short-term health of children, the correlation between this measure and its determinants (e.g., income, access to health facilities, etc.) are examined; let X represent these determinants. Hence, in a reduced form the relationship examined in these studies can be represented as

$$h = f(X) \quad \ldots (1)$$

The hypothesis pursued in this paper argues that the transformation of X into short-term health is likely to be affected by the long-term health status of children. Let H stand for the long-term health status of children (for example, height-for-age). If the link between the determinants and short-term health is affected by the long-term health status, the above functional form will be modified into

$$h = f(X; H) \quad \ldots (2)$$

To be more specific, we hypothesise that children with better long-term health status will be more 'efficient' in transforming the X resources into short-term health h. Formally, if $H_1 > H_2$, i.e., the long-term health status of the first child is better than that of the second, then we expect

$$\left.\frac{\partial h}{\partial X}\right|_{H_1} > \left.\frac{\partial h}{\partial X}\right|_{H_2} \quad \ldots (3)$$

Given this framework, let's now discuss the estimation strategy to test the hypothesis. We use weight-for-age z-scores of the sampled children are used as measures of short-term health, height-for-age z-scores reflect their long-term health status. We opted for weight-for-age rather than weight-for-height scores because of the following reasons. Note that height should enter on the right-hand side of the regression to control for long-term health status of children. If the dependent variable includes height – as weight-for-height z-scores do – then the error term in the regression will be correlated to the included height variable biasing the estimated coefficient (endogeneity bias). In addition to this estimation problem, weight-for-height is by definition negatively related to height since it is a measure of weight given the height of children.

To test the hypothesis the following type of regression is estimated:

$$w = f(c, H, c{*}H, O, \mu) \quad \ldots (4)$$

where w is weight-for-age z-scores of sampled children, c is real per capita consumption expenditure, H is height-for-age z-scores used as a measure of long-term health status, $c{*}H$ is an interactive term between per capita consumption expenditure and height-for-age, O stands for all other variables included in the regression affecting weight-for-age and μ is the error term. Per capita consumption expenditure rather than income is included because income figures are not available and, as in most developing countries, expenditure figures are much more reliable than incomes (see Deaton, 1997).

The estimation of regression (4) can result in biased estimates of the coefficients of c, H and c*H because of two reasons: endogeneity and unobserved heterogeneity. Regarding the first, per capita consumption expenditure is likely to be endogenous because it is likely to be correlated with omitted variables – which appear as part of the residual; this introduces a bias to the coefficient estimates. To overcome this problem we can use the Instrumental Variable technique and use predicted values of per capita consumption expenditure, where per capita land cultivated by households is used as an instrument. In Ethiopia, since land is owned by the state and is allocated by peasant associations to farm households it serves as a good instrument for per capita expenditures. The amount of land allocated to households affects household expenditures (income) but the reverse is unlikely to be true. In addition, since land is mainly administratively allocated it is less likely to be correlated to other unobservable factors correlated to expenditure (income).

In addition to endogeneity, we also expect substantial unobserved heterogeneity in the way individual children are affected by per capita consumption expenditure and other determinants. This heterogeneity is captured by estimating individual-level random intercepts and coefficients on per capita consumption expenditure. Formally, if *i* and *t* index each child and time (survey round) respectively the estimated regression appears as

$$w_{it} = \beta_0 + \beta_{0i} + \beta_1 c_{it} + \beta_{1i} c_{it} + \beta_2 H_{it} + \beta_3 (c_{it} * H_{it}) + \beta_4 O_{it} + \mu \qquad \ldots (5)$$

First note that the constant term is constituted of two elements; β_0 is an intercept common to all children and β_{0i} is specific to each child. In other words, in addition to the common/average intercept for all children, β_0, each child has specific regression intercept, β_{0i}; this is a random intercept. There are also two coefficients on per capita consumption expenditure, β_1 and β_{1i}. β_1 is a fixed coefficient common to all children. But note β_{1i} has a subscript *i* indicating it's specific for each child; in other words, the slope is different for each child (random coefficient). The marginal effect of per capita expenditure is composed of an average effect, β_1, common to all children and a child-specific effect capturing heterogeneity, β_{1i}; hence, the overall effect for each child is $\beta_1 + \beta_{1i}$. These random intercepts and coefficients capture the individual-level heterogeneity among the children. These regressions controlling for both fixed and random effects are estimated using linear mixed model (Verbeke and Molenberghs, 2000). The next section presents and discusses the main estimation results.

Results and discussion

As indicated in the previous section, the weight-for-age z-scores of sampled children is regressed on predicted per capita consumption expenditures, height-for-age z-scores, interaction between the two and other controls. The additional controls are age and sex of the child, whether the household head or wife completed primary education, household size, body-mass-index[2] (BMI) of household heads, food price indices and dummies controlling for survey rounds and villages. The BMI of household heads is included to control for the genetic and other links between the weight of children and their parents'. Food prices affect food consumption and hence we expect them to influence the nutritional status of children. The food price are weighted average prices of the most important food items, the total expenditure of households on each item in each surveyed village being used as weights. Food prices vary between survey sites and over time.

Table 2 presents the results from linear mixed regressions; the final two rows of the table present standard deviations of child-level random intercepts and coefficients estimated. First let's discuss the results reported in column (1). As expected the BMI of the household head is positively and significantly correlated with the weight-for-age z-scores of children. This reflects both the genetic link between parents and children and the fact that they share a similar condition of living within the household. Also as expected food prices have a negative and significant effect on weight-for-age z-scores of children. While household size and primary education of the wife are not significant, the educational level of household heads is positively and significantly correlated to weight-for-age[3]. The weight-for-age z-scores of male children are significantly lower than that of girls. This is likely to be the result of the age of the sampled children. Our sample includes children younger than 12 years and during this time girls are expected to grow faster than boys; boys usually catch up in later years. The negative and significant coefficient on the dummy variable for male children most likely reflects this differential growth (rather than discrimination against boys). The child's age is also negatively related with her weight-for-age scores. This implies that children get more deprived when they grow older compared to their earlier years; pre- or post-natal conditions probably are relatively better than later years. As expected the height-for-age z-scores of children are positively and significantly (at 1% level) correlated with their weight-for-age z-scores. But contrary to expectation, per capita consumption expenditure – as instrumented by per capita land holding – is not significant correlated to weight-for-age scores.

---

[2] BMI is the ratio of weight in kilograms to height in metres squared. It is a good measure of short-term nutritional status of adults.

[3] This is not because of multicolinearity between primary education of household head and wife as the variance inflating factors for the two are very small.

Table 2: Linear mixed regression of weight-for-age z-scores on per capita consumption expenditure and other determinants

	(1)	(2)
Predicted per capita expenditure	0.0410	0.0617**
	(0.056)	(0.026)
Height-for-age Z-Score (HAZ)	0.4740***	0.3810***
	(0.047)	(0.015)
HAZ*predicted per capita expenditure	-0.0079	
	(0.011)	
Predicted per capita expenditure		
*25-50 percentile HAZ		0.0289***
		(0.011)
*50-75 percentile HAZ		0.0562***
		(0.014)
*75-100 percentile HAZ		0.0981***
		(0.020)
Male child	-0.0658**	-0.0690**
	(0.031)	(0.030)
Age of child	-0.1670***	-0.1680***
	(0.016)	(0.015)
Household head primary school	0.1100**	0.1040**
	(0.055)	(0.053)
Wife primary school	0.0722	0.0722
	(0.11)	(0.11)
Household size	0.0646	0.0672*
	(0.043)	(0.041)
BMI of household head	1.5490***	1.5060***
	(0.13)	(0.13)
Food price index	-0.1590**	-0.1160
	(0.073)	(0.071)
Round and site dummies included but not reported		
Constant	-4.9830***	-5.2610***
	(0.46)	(0.41)
Observations	7577	7577
Number of children	3153	3153
Wald chi2(30)	4157.51	4582.58
Prob > chi2	0.0000	0.0000
Log restricted-likelihood	-11511.39	-11495.61
LR test, chi2(3)	143.80	158.06
Prob > chi2	0.0000	0.0000
SD of random intercept	1.1608	0.2569
SD of random coefficient	0.2897	0.1149

Note: All continuous variables are in natural logarithms; standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

The main interest of this paper is the coefficient on the interaction between height-for-age z-scores and predicted per capita consumption expenditures. If this coefficient is positive and significant it supports the null hypothesis; children with higher height-for-age transform consumption expenditures into higher weight-for-age scores compared to those with lower height-for-age. In other words, children with better long-term health status are better in transforming income into short-term health. But the coefficient on the interactive term is not significant (and is negative). This result doesn't support the null hypothesis.

One possible reason for no significant coefficient on the interactive term between per capita consumption expenditure and height-for-age z-scores is nonlinearity. For example, the effect of income on weight-for-age may be very low for those children with low height-for-age but nonlinearly increases for those with higher height-for-age. Children with very poor long-term health may also be very inefficient in transforming income into short-term health; on the other hand, those with very good long-term health may be very good in transforming income into short-term health. To explore if nonlinearity is the cause for non-significance of the interactive coefficient, first dummy variables representing children in four quartiles of height-for-age z-scores are created and then interacted with per capita consumption expenditure. The results of the regression using the interactive terms between the dummies for quartiles of height-for-age z-scores and per capita consumption expenditure are given in column (2) of **Table 2**; the lowest quartile – 0 to 25 percentile – is used as the reference group (dropped from the regression). Except the coefficient on household size – which marginally becomes significant at 10% level – and predicted per capita consumption expenditure the magnitude of the other coefficients is very similar to the previous regression.

One significant difference between the coefficients of the two regressions is in the interactive terms; all the interactive terms between per capita consumption expenditure and dummies for the quartiles of height-for-age z-scores are now highly significant (at 1% level). This confirms our suspicion that the non-significance in the previous regression is due to nonlinearity. In addition to the significance, the coefficients on the interactive terms increase for higher quartiles of height-for-age z-scores; from around 0.03 to 0.05 and then to 0.10. This clearly indicates that the effect of income (per capita consumption expenditure) on weight-for-age increases with height-for-age scores; children with better long-term health status are better in transforming income into short-term health.

The overall marginal effect of per capita consumption expenditure on a child's weight-for-age z-score is now the sum of the coefficient on per capita expenditure, the coefficient on the relevant interactive term (depending to which quartile the child belongs) and the random coefficient specific to the child. If we re-write equation (5) in the previous section to reflect the interactive terms using quartiles of height-for-age, it would look like the following:

$$w_{it} = \beta_0+\beta_{0i}+\beta_1 c_{it}+\beta_{1i} c_{it}+\beta_2 H_{it}+\beta_3^2(c_{it}*D_2)+\beta_3^3(c_{it}*D_3)+\beta_3^4(c_{it}*D_4)+\beta_4 O_{it}+\mu \quad \ldots (6)$$

Here D_2, D_3 and D_4 are the dummy variables representing the second, third and fourth quartiles of height-for-age z-scores (first quartile being the reference) with their respective coefficients, β_3^2, β_3^3 and β_3^4. In this framework, the overall marginal effect of per capita consumption expenditure on the weight-for-age z-score of a child belonging to the j^{th} height-for-age quartile becomes

$$(\partial w_{it}/\partial c_{it}) = \beta_1 + \beta_{1i} + \beta_3^j \qquad \text{for } j=1, 2, 3, 4 \text{ and } \beta_3^1 = 0 \quad \ldots (7)$$

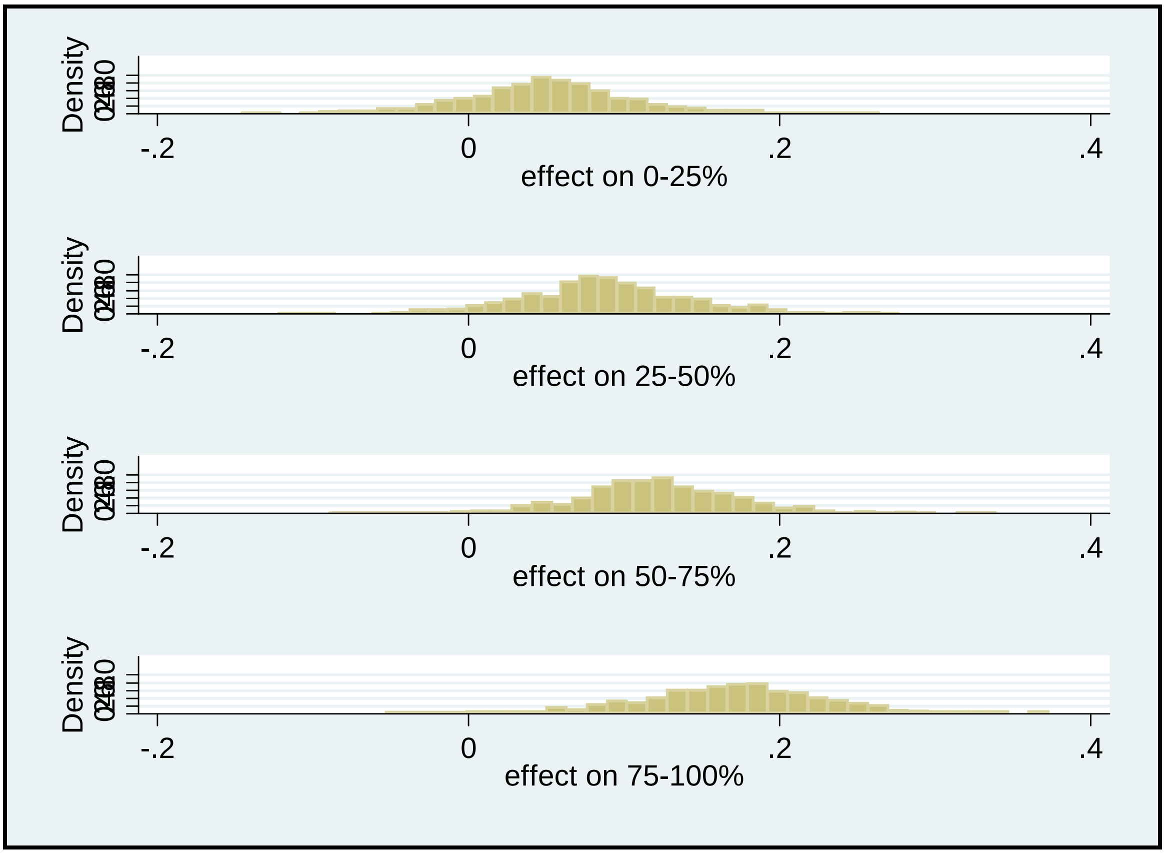
After the estimation of the regression reported in column 2 of **Table 2**, the above marginal effects are computed for each child in the sample. **Table 3** reports the mean, median and standard deviation of the overall marginal effect of per capita consumption expenditure on weight-for-age disaggregated by height-for-age quartiles. It is clear that both mean and median values of the overall marginal effects increase with quartiles of height-for-age. The fact that the standard deviations do not significantly increase for higher average values of the marginal effects is indicative that the rise is not due increases in the variances of the distributions.

Table 3: Marginal effects of per capita consumption expenditure on weight-for-age by quartiles of height-for-age

Quartiles	No. of children	Mean	Median	St. dev.
0-25%	2,043	0.0519	0.0516	0.0550
25-50%	2,081	0.0876	0.0857	0.0533
50-75%	2,038	0.1205	0.1190	0.0537
75-100%	2,043	0.1701	0.1705	0.0613

While **Table 3** presents summary statistics, the whole distribution of the marginal effects for each quartile can be shown using histograms for each height-for-age quartiles (see **Figure 3**). The histograms clearly indicate a shift to the right in the distributions of the marginal effects for children belonging to higher quartiles of height-for-age. This is a clear indication that the effect of per capita consumption expenditure (income) on the short-term health of children as captured by the weight-for-age z-scores increases for children with higher height-for-age z-scores. This supports our initial hypothesis that the long-term health status of children affects their capacity to transform resources into short-term health.

Figure 3: Histograms of the overall marginal effects of per capita consumption expenditure by height-for-age quartiles



The findings of this paper have significant implications on research and policy issues. An examination of the determinants of short-term health should take into account the long-term health status of individuals. Almost no existing studies on short-term health control for the long-term health. The findings also have policy implications. For example, the effect of short-term nutritional interventions may not be properly understood if policy makers and practitioners ignore the link with the long-term health status of individuals.

Even though the analysis of this paper focuses on anthropometric outcomes, the findings have wider implications on the link between short- and long-term health. Research and policy interventions focusing on the short-term conditions should take into account the long-term health status. For example, short-term response to treatment may be significantly affected by an apparently unrelated long-term health condition of patients.[4]

[4] I'm grateful to Sharada Weir for this idea that extends the implications of the findings of this paper into a wider perspective.

Conclusions

This paper started with the hypothesis that the effect of resources on short-term health of children is differentiated by their long-term health status. Using weight-for-age and height-for-age z-scores for short- and long-term health status of children in rural Ethiopia, it showed that indeed the marginal effect of household resources – particularly household per capita consumption expenditure – significantly increases with height-for-age z-scores. The paper employed linear mixed models with both fixed and random effects and used instrumental variable estimation to mitigate problems of endogeneity. The findings of the paper have both research and policy related implications. Most studies examining determinants of short-term health have so far ignored the possible linkage with long-term health. The findings of this paper highlight that this neglect may cover-up significant heterogeneity among individuals in the way they convert resources into short-term health. Future research on short-term health should take the effect of long-term health status into account. In addition, policy making and practical implementations in interventions affecting the short-term health of individuals would be better informed if the inter-linkage between short- and long-term health is taken into consideration.

Reference

Akresh, Richard and Verwimp, Philip. "Civil War, Crop Failure and the Health Status of Young Childlren," Bonn, Germany: Institute for the Study of Labor (IZA), 2006.

Alderman, Harold; Hoogeveen, Hans and Rossi, Mariacristina. "Reducing Child Malnutrition in Tanzania: Combined Effects of Income Growth and Program Interventions," Washington DC: World Bank, 2005.

Attanasio, Orazio; Gomez, Luis Carlos; Rojaz, Ana Gomez and Vera-Hernandez, Marcos. "Child Health in Rural Colombia: Determinants and Policy Interventions." *Economics and Human Biology*, 2004, *2*, pp. 411-38.

Borooah, Vani K. "The Height-for-Age of Indian Children." *Economics and Human Biology*, 2005, *3*, pp. 45-65.

Case, A.; Lubotsky, D. and Paxson, C. "Economic Status and Health in Childhood: The Origins of the Gradient." *American Economic Review*, 2002, *92*(5), pp. 1308-34.

David, Vincent; Moncada, Marco and Ordonez, Fidel. "Private and Public Determinants of Child Nutrition in Nicaragua & Western Honduras." *Economics and Human Biology*, 2004, *2*, pp. 457-88.

Deaton, A. *The Analysis of Household Survey: A Microeconometric Approach to Development*. Baltimore and London: John Hopkins University Press for the World Bank, 1997.

Fedorov, Leonid and Sahn, David E. "Socio-Economic Determinants of Children's Health in Russia: A Longitudinal Study." *Economic Development and Cultural Change*, 2005, *53*(2), pp. 479-500.

Galiani, Sebastian and Schargrodsky, Ernesto. "Effects of Land Titling on Child Health." *Economics and Human Biology*, 2004, *2*, pp. 353-72.

Pak, Sunyoung. "The Biological Standard of Living in the Two Koreas." *Economics and Human Biology*, 2004, *2*, pp. 511-21.

Skoufias, E. "Determinants of Child Health During the Economic Transition in Romania." *World Development*, 1998, *26*(11), pp. 2045-56.

Tarozzi, Alessandro and Mahajan, Aprajit. "Child Nutrition in India in the Nineties." *Economic Development and Cultural Change*, 2007, *55*(3), pp. 441-86.

Verbeke, G. and Molenberghs, G. *Linear Mixed Models for Longitudinal Data*. New York: Springer, 2000.