

5-1-2010

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### Recommended Citation

Masiye, Felix; Chama, Chitalu; Chitah, Bona; and Jonsson, Dick (2010) "Determinants of Child Nutritional Status in Zambia: An Analysis of a National Survey," *Zambia Social Science Journal*: Vol. 1: No. 1, Article 4.  
Available at: <http://scholarship.law.cornell.edu/zssj/vol1/iss1/4>

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# Determinants of Child Nutritional Status in Zambia: An Analysis of a National Survey

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*Malnutrition affects many children and is a leading cause of childhood mortality and non-fatal health loss. Zambia has one of the highest rates of malnutrition in the world. About half of the Zambian children are stunted while one in five is underweight. Prevalence of wasting is much lower. This article examines the determinants of nutritional status among children aged below five years in Zambia using data from a national cross-sectional survey conducted in 2006. Multivariate analysis is used to quantify the effects of several household and child-specific socioeconomic and demographic factors on nutritional status, as well as a geographic context (community level) fixed effect. Our analysis indicates that household expenditure is a leading determinant of nutritional status of a child. Further, the positive effect of parental education was observed. Children become more malnourished as they get older than 18 months. Poor nutrition falls disproportionately on rural children, after all other included covariates were controlled for. The significance of the geographic context suggests an underlying ecological pattern to malnutrition besides the individual and households factors. Understanding the determinants of poor nutritional attainment can provide insights in designing interventions for reducing the high levels of child malnutrition in Zambia.*

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## **1. Introduction**

There is heightened global policy attention to the problem of poor nutritional attainment among children in developing countries. The United Nations has included two nutrition-based indicators, defined as the prevalence of underweight children (under five years of age) and the proportion of population below minimum level of dietary energy consumption, to monitor progress towards its Millennium Development Goal (MDG) number one (eradication of extreme poverty and hunger). Thus, nutritional status is often used as a measure of social development. Furthermore, nutritional status is strongly connected to health outcomes (Braveman 1998; Muller and Krawinkel, 2005). The most recent estimates on deaths attributable to malnutrition indicate that about 20% of all deaths and 20% of health loss (measured in Disability-Adjusted Life Years (DALYs)) among children aged below five years living in low-income countries can be attributed to nutritional deficiency (Black et al., 2008). DALYs are used by the World Bank and the World Health Organisation (WHO) to represent a composite measure of mortality and non-fatal consequences of disease or ill-health. Furthermore, children afflicted by severe or chronic malnutrition also go

on to suffer diminished functional and intellectual capacity as adults (Muller and Krawinkel, 2005).

Malnutrition in children takes several different forms. Our focus is on what is commonly referred to as protein-energy malnutrition. Nutritional status in children is determined in surveys using measurements of a child's height, weight and age. Three indices of nutritional status are typically constructed from these measurements. These are, weight-for-age, height-for-age, and weight-for-height. These measurements are compared against an international reference population (the United States population) to determine whether or not a child is malnourished. An underweight child is one having a low weight when compared with the reference population of the same age and sex. A child is considered stunted if it has a low height compared with children of the same age and sex. Similarly, wasting implies that a child has a low weight for their height, compared to the reference population (WHO, 1986).

Studies have demonstrated that significant differences in nutritional attainment are observed among children of different population groups within countries. Often these differences are patterned along socio-economic strata. That is, the burden of malnutrition falls disproportionately on children from lower socioeconomic groups (Wagstaff et al., 2003; Gwatkin et al., 2003; Haddad et al, 2003; Zere and McIntyre, 2003; Anand and Ravallion, 1993; Van de Poel et al., 1998). However, a necessary condition for reducing health disparities is to ascertain the role of socioeconomic and demographic factors in shaping patterns of nutritional status among children in Zambia.

Zambia is located in a region in Sub-Saharan Africa where the prevalence of malnutrition is highest in the world (Black et al 2008). It is estimated that about half (54%) of all children aged below five years are stunted while one in five (19.7%) are underweight. The prevalence of the wasting form of malnutrition is 6%. We use the most recent representative national survey conducted in 2006 to investigate the determinants of child nutritional status in Zambia. The aim is to measure the quantitative significance of individual and household demographic, socio-economic and geographical factors in determining child nutritional status. We employ a multilevel statistical model that permits us to measure the effects of individual and household effects and geographical context factors separately. Information on determinants of child nutritional attainment could provide insights in designing interventions for dealing with child malnutrition in Zambia.

The article is organised as follows. In section 2, we provide a brief description of the country's socioeconomic context and the child nutrition profile. We discuss the study methods and estimation techniques in section 3. Section 4 presents and analyses the findings of the study. A discussion follows in section 5. Finally, we present the conclusions of the article in section 6.

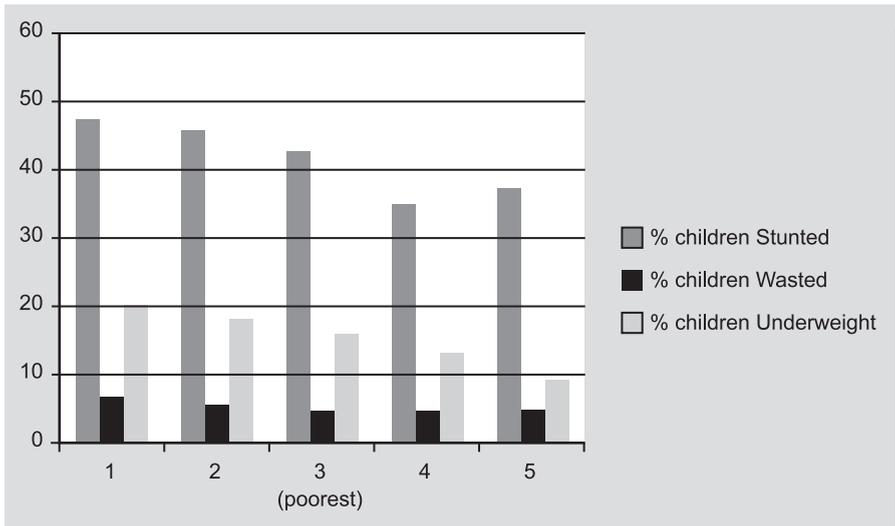
## **2. Country Context**

Zambia is a low-income country of twelve million people in Southern Africa. It has a per capita Gross Domestic Product (GDP) of about United States \$600 (WHO, 2009). The economy depends largely on mineral exports (mainly copper) and agricultural products. Subsistence agriculture and the informal sector employ a large

proportion of the labour force. The country depends on significant donor support to finance its national budget. The current global economic recession is having a devastating effect on the economy. There have already been many job losses in the mining sector. Public revenues are likely to be negatively affected, potentially constraining the capacity of the Government to support important public services.

In 1992, the new Zambian government introduced major economic reforms aimed at restructuring the economy. The Structural Adjustment Programme (SAP) was supported by the International Monetary Fund (IMF) and the World Bank. In the ten years or so that followed the implementation of the SAP, the country experienced reduced social spending to major sectors notably health, education, public water and sanitation. Access to health and other social services is a major problem especially among the poor and rural population. Consequently, general human conditions have continued to deteriorate. In 2006, it was estimated that 50% of the population were living below one United States dollar a day. This, however, is a substantial improvement from the much higher poverty levels recorded during the 1990s. Major human development indicators have worsened. Average life expectancy at birth is 43 years. Nearly one out of seven children born in the country dies before their fifth birthday. Maternal Mortality Ratio (MMR) is estimated at 449 per 100,000 live births (CSO, 2009). About 15% of adults aged 15-49 are HIV positive. Essentially, widespread malnutrition among children is an epitome of these dismal human conditions that obtain in the country. Figure 1 shows the prevalence of malnutrition by expenditure quintile in 2006.

Figure 1: Prevalence of malnutrition by expenditure quintile in 2006, Zambia



Source: CSO (2009), authors' own calculations

### **3. Data and Methods**

#### ***Data sources***

The data used in the study are based on a representative national survey conducted by the Central Statistical Office (CSO) with technical support from the World Bank. The survey is part of the World Bank's global data collection enterprise in developing countries called Living Standards Monitoring Surveys (LSMS). In Zambia these surveys are conducted by the CSO.

The 2006 Zambian Living Conditions Monitoring Survey (LCMS) covered about 20,000 households using a multi-stage sampling procedure. Sample weights are provided in the datasets. In our estimation, we applied those sample weights to the data in order to ensure the national representativeness of the results. Anthropometric measures of child nutritional status constitute only one module among several fields in these datasets. In addition, the LCMS also contains data on several other variables ranging from household socio-economic characteristics, demographic composition, and access to social services and amenities. We linked the child nutritional data file with other relevant files containing data on household conditions and parental characteristics.

#### ***The Model***

A structural causal web of the determinants of nutritional status has been presented which includes proximal causes (socio-economic, physical, environmental, political, and social), underlying causes (income poverty, food insecurity, employment, inadequate care, and household conditions) and immediate causes (inadequate dietary intake and disease) (Muller and Krawinkel, 2005). The specific causal paths between these factors and child nutritional status are, of course, complex. However, abstracting from this framework, determinants of child nutritional status can be modelled in terms of a reduced-form health production function.

In this approach we posit that poor nutrition reflects an imbalance in dietary intake and/or a consequence of chronic exposure to disease. Dietary intake, in turn, is determined by access to resources and the ability to use those resources to produce good nutrition. Similarly, access to good quality health care can prevent or mitigate the adverse effects of chronic infection on nutritional wellbeing (although chronic under-nourishment can also increase proneness to infection) (Muller and Krawinkel, 2005; Gwatkin et al., 2003). In this context, child nutrition is assumed to be a function of a set of socio-economic factors such as household income, parental education, household hygiene and individual characteristics, in a regression framework (Wagstaff et al., 2003). As such, in this model, we estimate a production function of distal determinants of nutritional status.

We decided to keep our dependent variable as a continuous variable (i.e. the z-score for HAZ, WAZ and WHZ) rather than a dichotomous variable (e.g. stunted or not). The model to be estimated is specified as follows:

$$y_{ij} = \alpha_j + X_{ij} \beta + u_j + \varepsilon_{ij}$$

Where  $y_{ij}$ , is the dependent variable of the  $i^{th}$  child living in  $j^{th}$  cluster while  $X_{ij}$  are the associated covariates;  $\beta$  are parameters to be estimated. The model specifies a separate intercept,  $\alpha_j$ , for each cluster. In other words, this model assumes that the effect (slope) of different covariates on the dependent variable score is the same across different geographical units defined as clusters, but the intercepts across clusters (i.e. the level of relationship of different clusters with the dependent variable) could vary. The term  $u_j \sim N(0, \sigma_u^2)$  represents the residual occurring at the  $j^{th}$  (cluster) level while  $\varepsilon_{ij} \sim N(0, \sigma_{\varepsilon}^2)$  represents the residual at level- $i$  and captures unaccounted for variations across children within a  $j^{th}$  unit.

### **Measures of nutritional status**

We used all the three anthropometric indicators mentioned earlier. In the LCMS, children aged 3-59 months in the sampled households are measured for age in months, height and weight. From these measurements, three anthropometric indicators are constructed on height-for-age, weight-for-age and weight-for-height in the form of z-scores. Each z-score depicts the deviation from the median height or weight of a child of the same age and sex in the reference population (the United States population). These scores called *HAZ*, *WAZ* and *WHZ* are already compiled in the LCMS, following international norms approved by the WHO (WHO, 1995).

For example, a child with a *HAZ* z-score of zero is considered to have the median height of a United States child of the same age and sex. A z-score less than zero indicates how much lower the child's height from the median height of the relevant population. Measurement of all three anthropometric indicators in surveys can be prone to error. As is recommended, we eliminate all observations with *HAZ* z-scores which were below -5 or above +3, less than -5 or greater than 5 for *WAZ*, and less than -4 or greater than 5 for *WHZ*. Such ranges are considered to be implausibly high or low respectively. About 4.8% of the observations were dropped.

### **Covariates of child nutritional status**

In this article, we have included seven household-level and child-level covariates. Household per capita expenditure (which is used as a proxy for income) is expected to affect a child's nutritional status through its effect on the quantity and quality of food and other resources available within the household. A higher level of household expenditure implies that a household has greater financial capacity to buy good quality food. However, the wasting form of malnutrition or weight-for-age indicators of nutrition have been found to be insensitive to household income in some studies (Zere and McIntyre, 2003; Van de Poel et al., 1998).

Parental education is another factor that has been considered to affect the nutritional status of children. The basic hypothesis is that, everything else being equal, better-educated parents (especially the mother) have greater capacity to utilise effective sources of nutrients, and thereby alleviate risks of malnutrition in their children. In the survey education was defined as the number of schooling

years completed. However, the empirical evidence is mixed (Behrman and Wolfe, 1987). We included the education level of the head of the household and the biological mother of the child.

We included the area of residence, defined as rural or urban. Although area of residence often tends to be a confounder of other socio-economic factors such as income, in this case we are interested in its independent effect, after controlling for all the other factors. The question is whether living in a rural area influences a child's proneness to malnutrition, after income and other factors are controlled for.

In addition, we tested if the quality of domestic water source and sanitation has any effect on a child's nutritional status as suggested in some studies (Merchant et al., 2003). Water was constructed as a dummy defined as 1 for safe drinking water and 0 otherwise. The following sources of water were classified as good: tap water within the house, tap water outside the house and a protected communal borehole. Bad water included all other categories such as unprotected borehole or well, bottled water, rain water, water bought from vendors and 'other source'. Sanitation was defined using the quality of the toilet facility as a dummy: Good sanitation consisted of a flush toilet (inside or outside the house) while all other types of toilets were classified as poor toilet.

Finally, we included two child-specific variables. These are the sex and age of child. Based on the literature on malnutrition studies, boys are generally more prone to malnutrition than girls, all else being equal (Wagstaff et al., 2003). It is also reported that young children aged at least one year are more prone to malnutrition than infants, possibly due to the lost benefits of breast-feeding or reduced intensity of maternal care.

### ***Econometric Estimation***

A significant challenge in applied multivariate analysis is to find an estimation strategy that fits the data well and also possesses desirable statistical properties. This process involves dealing with several econometric estimation issues. First, based on the literature on the socio-economic determinants of child nutritional status, we address the potential endogeneity of household expenditure. Endogeneity, in this case, could arise from the possibility that a chronically and severely undernourished child, who is likely to be in poor health, could potentially reduce household expenditure by reducing the parents' time available for earning an income. In this case, malnutrition becomes a predictor of household expenditure rather than the reverse. Thus, reverse causation creates a form of endogeneity. Further, endogeneity could result from error in the measurement of per capita household expenditure. Specifically, error in the measurement of a regressor tends to cause correlation between the explanatory variable and error term (Wooldridge, 2002).

Another source of endogeneity results from correlation between included regressors and omitted variables. This means that the effect of omitted variables is captured in the error terms. Thus, the regressors are correlated with the error term. The consequence of endogeneity for Ordinary Least Squares (OLS)

estimation is to bias the true effect of household expenditure on child health, usually downwards (i.e. towards zero). OLS estimates are inconsistent while the standard errors are inefficient, potentially leading to misleading inferences (Wooldridge, 2002). In the literature it is recommended that the researcher should first run a formal test (e.g. Wu-Hausman test or the GMM C test) to ascertain whether expenditure should be considered endogenous. The danger is that running Instrumental Variables (IV) estimation in the absence of endogeneity can actually produce worse results than OLS (Baum et al., 2003; Staiger, 1997).

We carried out our endogeneity test of household expenditure under the framework of the IV-GMM estimator. The IV-GMM provides a robust fit under general circumstances (in particular in the presence of heteroscedasticity of unknown form). In this sense, this routine is superior to the traditional Hausman test if the assumption of homoscedasticity is violated. It also permits the inclusion of sample weights. Our Wu-Hausman test statistic indicates that we cannot reject the null hypothesis of exogenous expenditure. This would imply that the expenditure variable could in fact be treated as exogenous. In a recent cross-country empirical study on the effects of socio-economic status on child malnutrition, Haddad et al. (2003) found that household wealth was endogenous in some cases but exogenous in others. This demonstrates that an empirical test is necessary.

The second estimation issue we confront is the choice between a fixed-effects estimator and a random-effects estimator. The *hausman* test is the appropriate test for this. We performed an enhanced *hausman* test, which is robust to heteroskedastic or clustered errors, to evaluate the suitability of either the fixed-effects or random-effects specification (Baum et al., 2003). The choice is important because in the presence of correlation, the random effects estimator is inconsistent (Wooldridge, 2002). The null hypothesis in this test is that there is no correlation between explanatory variables and the cluster-level error term. Our test statistic leads us to reject decisively the null hypothesis, indicating the superiority of the fixed effects estimator. A third estimation issue has to do with the likely non-constant error variances at the household level (level-one unit of observation) by requesting robust standard errors.

A fourth concern emanates from the possibility that errors between households within the same cluster may not be independent, although errors across clusters might be. Within-cluster correlation produces inconsistent standard errors, leading to a potential for invalid inference (Wooldridge, 2002). Ideally, we should adjust our fixed effects estimator to control for clustered variances. However, potential dangers exist when estimating the cluster-robust standard errors of the error variance in a situation where the panels are as unbalanced (non-uniform number of units in each cluster) as ours (Nichols and Schaffer, 2007). While the mean number of units (households) per cluster was 7.5, 25% of clusters had three units while 20% of clusters have at least 10 units.

Fifth, we are also interested in measuring the independent effects of household factors and geographic area effects on child nutritional status. Our unit

of geographic area is the sampling cluster. These are sub-district localities which typically comprise a collection of a few community neighbourhoods. In such studies good reasons exist for including geographic area fixed or random effects. Regions in Zambia exhibit varying levels of economic development. The country also shows different patterns with regard to epidemiology, food security, access to health care, and cultural practices towards child-care. The fixed effect (or random effect) parameter will represent unmeasured area-level factors that may be affecting child-nutritional status. Related to this issue, we include an interaction term between location of residence (i.e. rural or urban) and household expenditure. It could be hypothesised that malnutrition in urban children may be more sensitive to changes in cash incomes than in rural children. This can come about because in urban areas households are tied to the monetary economy while the agricultural subsistence economy can enable rural households meet some of their nutritional requirements.

A final issue we encountered arose from missing observations on the variable representing the child's biological mother's education attainment. Mother's education is considered a strong predictor of child nutritional wellbeing. Of the 10,400 children in the sample, 1,470 (nearly 14%) had missing data on the variable mothers' education. There could be many reasons for this. Some of these children are orphans and were being looked after by others. In countries such as Zambia with very high adult mortality levels largely induced by HIV/AIDS, it is not uncommon that many children of such young age are orphans. Further, some biological mothers could have been absent from the household on account of schooling, divorce, visiting and for some other reasons. But it could also simply be the case that enumerators could not obtain education data on some of the mothers. However, we do not investigate the reasons why the child's biological mother was missing.

In the event that data on this covariate were missing in a non-random manner, this creates a special case of sample-selection bias (Lindsey and Lindsey, 2001). A consequence of this problem is the loss of consistency (Wooldridge, 2002). Furthermore, we cannot use the sub sample of children whose mother's education was recorded. The first step is to test whether missing mothers' education is linked to the outcome variable (nutritional status of the child). Thereafter, we use interactions to check whether income and other covariates have a different effect if the biological mother is absent from the household (Lindsey and Lindsey, 2001). Coefficients for interaction terms for missing mother and rural-urban resident were not significant, implying that the effect of covariates were essentially the same between children without mothers and also between rural and urban children.

## **4. Results**

### ***Descriptive Statistics of Sample***

The descriptive statistics of the sample are presented in table 1. We show the prevalence of height-for-age, weight-for-age and weight-for-height malnutrition among

Zambian children aged five years or less, separately for rural and urban areas. Table 1 demonstrates that malnutrition among children is high in both urban and rural Zambia. Height-for-age malnutrition is highest followed by weight-for-age malnutrition.

Table 1 also shows the substantial rural-urban variation in malnutrition. The prevalences of stunting and underweight malnutrition are higher among rural children compared with urban counterparts. The prevalence of wasting is nearly the same in both rural and urban areas. But from a global perspective, all Zambian children suffer a great burden of stunting and underweight malnutrition. Rural children tend to have inferior nutritional status, compared with children who live in urban areas. It is also worth noting that even in the presence of widespread overall malnutrition the prevalence of wasting as a specific form of malnutrition is quite low. Further, table 1 also shows that rural poverty is very high while access to good sanitation and water is quite low.

Table 1: Descriptive statistics of sample, selected variables

Variable	Rural	Urban
Mean Age of sampled children, in months *	25.84	27.94
Age distribution (%)		
0-11 months	15.9	16.8
12-23 months	21.7	21.6
24+ months	62.4	61.6
Mean years of schooling of household head*	9.73	13.04
Mean <i>HAZ</i> z-score*	-1.83	-1.42
Mean <i>WAZ</i> z-score *	-0.91	-0.63
Mean <i>WHZ</i> z-scores*	0.33	0.35
% children Underweight ( <i>WAZ</i> <-2)	21.8	15.1
% children stunted ( <i>HAZ</i> <-2)	51.0	40.2
% children wasted ( <i>WHZ</i> <-2)	5.4	4.9
% of sample living in urban area	54.6	45.4
% of Male children in sample	48.9	50.0
% of households with safe drinking water	40.3	84.7
% of households with access to good sanitation	21.2	25.0
% of households living below the poverty line	83.0	40.8

\* at 95 % confidence level

### **Determinants of child nutritional status**

The main regression results are presented in table 2. We find that missing mother's education does not influence child's nutrition in the case of *HAZ* and *WAZ*, but is shown to have a positive effect for *WHZ* (significance at the 5% level). For *HAZ* and *WAZ*, this implies that the outcome variable does not depend on whether the child's biological mother's education is missing or not, which partially rules out significant sample selection bias.

## Determinants of Child Nutritional Status in Zambia: An Analysis of a National Survey

Table 2: Determinants of child nutrition regression results

	HAZ		WAZ		WHZ	
	Coef.	Robust SE	Coef.	Robust SE	Coef.	Robust SE
Log per capita expenditure	0.092***	0.030	0.067***	0.022	0.016	0.026
Residence (rural=1,urban=0)	-0.211*	0.115	-0.203**	0.080	-0.114	0.090
Sex (male=1,female=0)	-0.171***	0.043	-0.181***	0.033	-0.167***	0.038
Age in months (child)	-0.055***	0.006	-0.052***	0.005	-0.048***	0.006
Age_square(child)	0.001***	0.000	0.001***	0.000	0.001***	0.000
Edu household head	0.019**	0.008	0.016***	0.006	0.005	0.007
Safe water =1, bad water=0	0.019	0.062	0.075	0.048	0.057	0.061
Good sanitation=1, bad sanitation=0	-0.014	0.111	0.060	0.082	0.128	0.089
Constant (mean cluster effect)	-1.977***	0.330	-0.824***	0.245	0.913***	0.291
	Adj R-squared= 0.30		Adj R-squared= 0.46		Adj R-squared= 0.32	
	F( 8, 9663) = 20.24		F( 8, 9663) = 20.24		F( 8, 9663) = 14.20	
	n= 10,388		n= 10,388		n= 10,388	

Note: \*\*\* indicates significance at 99% ; \*\* is significance at 95% ; and \* is significance at 10% level.

Household per capita expenditure is shown to have a strong effect in the case of models for *HAZ* and *WAZ*. The coefficients suggest that a one percent increase in household per capita expenditure increases the z-score of a child's height-for-age index by about 9% (or 7% in the case of *WAZ*). Notably, the coefficient on expenditure was not significant for the weight-for-height nutrition indicator, *WHZ*. This result suggests that height-for-age nutritional indicator does not necessarily depend on household expenditure. We do not have a good understanding of why *WHZ* seems to portray a rather counter-intuitive phenomenon. Furthermore, we attempted to include the square of income to see if income influences could be non-linear, but all the coefficients did not prove to be significant (results not shown here).

The negative and strongly significant coefficient on age for all the three indicators suggests that younger children tend to have better nutritional status than older children. It is also demonstrated that the effect of age is not constant at all ages. The positive coefficient of the square of age suggests that the effect of age is concave, although this effect is rather small but significant. This is possibly linked to the effect of breast-feeding or more intense maternal care among younger children (most children stop breast-feeding around 15-18 months of age).

The education level of the head of the household was found to be a positive and significant determinant of *HAZ* and *WAZ* score, after all other covariates are controlled. Again, the size of the coefficient stays the same across all the different models estimated. This variable is not significant when we use *WHZ*. However,

when mother's education is included it is found to be insignificant. It appears that even the effect of the education of the household head is attenuated by the inclusion of mother's education.

Access to safe drinking water and sanitation are both shown to be insignificant predictors, for all of the three anthropometric indicators. Although some studies have reported a significant effect of sanitation and safe water (Wagstaff et al., 2003; Merchant et al., 2003), other studies have found no significant effect of safe water or sanitary toilet (Van de Poel, 2007).

In addition, being a resident of a rural area was a significant predictor of nutritional status in the case of *HAZ* and *WAZ*. The significant difference in prevalence of malnutrition between rural and urban areas is mediated through other socio-economic variables, particularly household expenditure. Our results also show that the hypothesis of no cluster fixed-effects is rejected (the fixed effect parameter is significant). The cluster effect is negative for *HAZ* and *WAZ* but negative for *WHZ*. The size of the cluster fixed effect for *HAZ* is nearly double its size for *WAZ*. This finding points to the existence of significant unmeasured cluster neighbourhood effects that impact on children's nutritional status.

## 5. Discussion

We have used a representative national survey to measure the effect of a range of factors that influence the nutritional status of Zambian children. The key findings are as follows: a strong wealth gradient is revealed, with children from poorer households having inferior nutritional status. This result indicates that children from poor households with less income to spend do exhibit a greater proneness to malnutrition, particularly stunting and underweight. However, just as has been reported elsewhere, household income was not a significant predictor of a child's weight-for-height nutritional status.

Sex and age are shown to be strong predictors of child nutritional status. The effect of age is probably mediated by breastfeeding or more intense parental attention in younger children. The effect of sex in favour of girls is probably more biological. The education level of the head of the household was found to be an important positive predictor of better nutritional status, although its effect was tempered by the inclusion of the education of the biological mother of the child. When included alone, the mother's education was significant in the case of *HAZ* and *WAZ*. We believe that apart from giving better knowledge about nutrition, education also usually implies empowerment of women. In this way, education can give a woman more domestic power in allocating household resources towards adequate diet for children.

Our examination of geographical effects revealed useful findings. First, we showed that being in a rural area produces an adverse effect on nutritional attainment of children. Second, we also found significant unmeasured effects that operate at the geographic (i.e. community) level. This result points to the significance of environmental context in influencing the nutritional status of children, after all individual and household factors were adjusted for. Finally, we

found no evidence that socioeconomic variables have a differential effect on a child's nutritional status between rural and urban areas.

One of the important issues of debate in the literature on determinants of nutrition is whether general socio-economic improvements alone are sufficient to bring about positive changes and reduce inequalities in nutritional status. Other approaches advocate more direct nutritional interventions targeted at vulnerable segments of the population. There is support for both approaches in this analysis: lack of income to spend impedes access to nutrition while children in households living in particular geographical and expenditure regions will need to be targeted for short-term nutritional programmes if they are to escape malnutrition. In the short term, targeted nutritional programmes are important, while general economic empowerment seems to be appropriate for dealing with deeper causes of nutritional deficiency among population groups.

### **Study limitations**

A number of issues could be addressed in this article. First, we cannot draw any causal inferences because of the cross-sectional nature of this article. Second, the economic approach used in this study is an attempt at modelling what are clearly complex phenomena. The literature on causes of malnutrition is less clear. For example, the nutrition literature points out that while stunting is a long-term phenomenon, wasting and under-weight are considered to be consequences of short-term nutritional deficiency (Müller and Krawinkel, 2005; WHO, 1995). Although current income is usually a good proxy for recent past income, it is still an open question how *HAZ* versus *WAZ* and *WHZ* change with income. Nonetheless, our task in this study was modest in trying to measure the influence of the major known covariates.

Finally, the dataset we used did not include some variables which could be potentially linked to child nutrition such as child's health status and parents' height. In addition, although this article found evidence that geographical area (cluster fixed effect) was a significant predictor of child nutritional status further research is required to investigate the role of specific geographic level variables such as epidemiology, access to health care, and proneness to food insecurity.

## **6. Conclusion**

Malnutrition is widespread among children in Zambia. It is a leading contributor to the high burden of disease. As our analysis has demonstrated, children from poorer households bear a disproportionate share of the burden of malnutrition. Hence it is not only useful to understand the factors that influence the nutritional status of children but also how those factors can be used to explain observed inequality in nutritional status.

The article identified and measured the effect of a range of socioeconomic and environmental factors that influence nutritional wellbeing of children. A socioeconomic gradient is confirmed in the case of height-for-age and weight-for-age nutritional status. We found no such gradient for weight-for-height nutritional status. Our results

also point to a significant role of geographical context effects. This implies that in addition to the well known characteristics of children and the households in which they live, we find that the environment in which children live does influence their nutritional attainment. This finding lends support to nutritional interventions that are targeted at disadvantaged groups and areas as a strategy to improve child nutrition. However, the observed differences in nutritional status among rural and urban children are moderated after individual and household factors are taken into account.

*Note:*

*We would like to express our gratitude to colleagues at the Department of Economics, University of Zambia, and to Dr. Mike Levin of Harvard University, for helpful comments on an earlier draft of this manuscript. We also thank Frank Kakungu and Munkoni Kambaila of the Central Statistical Office for help with data linkage and other queries in the LCMS datasets. This study received funding from the Swedish International Development Corporation Agency (Sida) through the Health Economics Research and Training Programme at the University of Zambia. The usual disclaimers apply.*

## References

- Anand, S. and M. Ravallion. 1993. "Human development in poor countries: on the role of private income and public services." *Journal of Economic Perspectives* 7, no. 1: 133-50.
- Baum, C.F.; M. E. Schaffer; and S. Stillman. 2003. "Instrumental variables and GMM: estimation and testing." *Stata Journal* 3: 1-31.
- Behrman, J. and B. Wolfe. 1987. "How does mother's schooling affect family health, nutrition, medical care usage, and household sanitation." *Journal of Econometrics*, no. 36: 185-204.
- Black, R.E.; L. H. Allen; Z. A. Bhutta; L. E. Caulfield; M. de Onis; M. Ezzati; C. Mathers; and J. Rovera. 2008. "Maternal and child undernutrition: global and regional exposures and health consequences." *Lancet*, no. 371: 243-60.
- Blinder, A.S. 1973. "Wage discrimination: reduced form and structural estimates." *The Journal of Human Resources* 8: 436-455.
- Braveman, P. 1998. "Monitoring equity in health. A policy oriented approach in low and middle income countries." *WHO/CHS/HSS98.1 Equity Initiative*, Paper no. 3, Geneva: World Health Organisation.
- Gwatkin, D.R.; S. Rustein; K. Johnson; R. Pande; and A. Wagstaff. 2003. *Socio-economic differences in health, nutrition, and population*. Vol. I and II, Washington, DC: The World Bank.
- Haddad, L.; H. Alderman; S. Appleton; L. Song; and Y. Yahannes. 2003. "Reducing child malnutrition: How far does incomes growth take us?" *The World Bank Economic Review* 17, no. 1: 107-131.
- Lindsey, J.K. and P. J. Lindsey. 2001. "Detecting covariates with non-random

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- missing values in a survey of primary education in Madagascar." *Journal of the Royal Statistical Association*, no. 164, Part 2: 327-338.
- Merchant, A.T.; C. Jones; A. Kiure; A. Kupka; G. Fitzmaurice; M.G. Herrera; and W. W. Fawzi. 003. "Water and sanitation associated with improved child growth." *European Journal of Clinical Nutrition*, no. 57:1562-1568.
- Müller, O. and M. Krawinkel. 2005. "Malnutrition and health in developing countries." *Canadian Medical Association Journal* 173, no. 3:279-286.
- Nichols, A, and M. Schaffer. 2007. "Clustered Errors in Stata." *Stata Users Group*: <http://ideas.repec.org/e/pni54.html> (accessed December 11, 2008).
- Staiger, D. and J. H. Stock. 1997. "Instrumental variables regression with weak instruments." *Econometrica* 65, no.3: 557-586.
- Van de Poel, E.; A.R. Hosseinpoor; C. Jehu-Appiah; J. Vega; and N. Speybroeck. 2007. "Malnutrition and the disproportionate burden on the poor: the case of Ghana." *International Journal of Equity in Health* 6: 21.
- Wagstaff, A.; E. van Doorslaer; and N. Watanabe. 2003. "On decomposing the causes of health sector inequalities with an application to malnutrition in Vietnam." *Journal of Econometrics*, no. 112: 207-223.
- Wooldridge, J.M. 2002. *Econometric analysis of cross-sectional and panel data*. Cambridge, Massachusetts: MIT Press.
- World Health Organisation Working Group. 1986. "Use and Interpretation of anthropometric indicators of nutritional status." *Bulletin of the World Health Organisation*, Vol. 64, no. 6: 929-941.
- World Health Organisation. 2009. WHO Statistical Information System. <http://www.who.int/whosis/en/> (accessed January 25, 2009).
- World Bank. 2009. *World Development Indicators*. Washington, D.C. :World Bank. <http://web.worldbank.org/wbsite/external/countries/africaext/zambiaextn/> (accessed January 25, 2009).
- World Health Organisation .1995. "Physical Status: The Use and Interpretation of Anthropometry." In *WHO Technical Report Series* No. 854, Geneva: World Health Organisation.
- Zere, E. and D. McIntyre. 2003. "Inequalities in child health in South Africa." *International Journal of Equity in Health* 2, no.7: 1-10.