Böheim:

Why are West African children underweight?

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Why are West African children underweight?*

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Abstract

The incidence of underweight amongst children under five in Western Africa has been increasing over the last decade (UNICEF, 2002). In Asia, where about two thirds of the world's underweight children live, the rate of underweight declined from about 36 per cent to some 29 per cent between 1990 and 2000. In sub-Saharan Africa, the absolute number of underweight children has increased and is now about 36 per cent. Using new data from Demographic and Health Surveys, I estimate the probability of underweight for a sample of West African children, controlling for selective survival.

Keywords: Underweight, child mortality
JEL classification: I12

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1 Introduction

The incidence of underweight amongst children under five in Western Africa has been increasing over the last decade (UNICEF, 2002). In Asia, where about two thirds of the world's underweight children live, the rate of underweight declined from about 36 per cent to some 29 per cent between 1990 and 2000. In sub-Saharan Africa, the absolute number of underweight children has increased and is now about 36 per cent. Underweight is of great concern as it increases the risk of illness and the risk of mortality (Pelletier et al., 1993). Children, i.e. a country's future labour force, who are underweight have impaired immune systems and poor physical and mental development.

The established framework to examine underweight is UNICEF's conceptual framework which distinguishes between three different levels of determinants (Engle et al., 1997; UNICEF, 1990). The immediate determinants of a child's growth and development, food intake and health, are influenced by factors which operate at the household, regional, or national level. All these studies stress the complex issues surrounding the modelling of malnutrition (Wolpin, 1997).

Macro-economic studies, for example Smith and Haddad (2000), analyse the prevalence of underweight children on national levels. Typical explanatory variables are literacy rates, female enrolment rates, per-capita incomes, health provisions, and similar indicators of relative wealth and the provision of health care.

Micro-econometric analyses of underweight use cross-sectional data from the World Fertility Surveys and the Demographic and Health Surveys (DHS), for example Pitt (1997). These data are comparable across countries and are suited to the analysis of underweight on a household level.

In this analysis I investigate the relative importance of determinants of children's underweight. Using new micro-level data from the Development and Health Surveys, matched with country-specific information from macroeconomic time-series, I estimate the probability of underweight for three West African countries, Burkina Faso, Ghana, and Togo.

The econometric model acknowledges the fact that sick children may not survive until the date of interview, the sample of children drawn at an interview may understate the actual prevalence of underweight in a population. The estimations confirm the presence of selective survival, but controlling for selective survival does not seriously change the estimated associations between the explanatory variables and the measure of underweight.

The most important determinants of a child's underweight are related to the country's wealth. Greater GDP per capita is associated with a reduced risk of underweight. Similarly, the female literacy rate shows a strong negative association with the risk of underweight.

On the household level, the richer the household the lower the risk of being underweight. However, despite this unsurprising result, a mother's fertility preferences appear to be important for the care a child receives: children whose mothers state that they did not want to have the child are more likely to be underweight.

Finally, twins and children whose weight was below average at birth are also at higher risk of underweight.

2 Analytical Issues

The analysis of underweight can be formulated in a variant of Becker's (1965) model of the household. The household is assumed to maximise utility from home production, P, labour market participation (which equals consumption of market goods), C, and leisure, L. A representation of a utility function is then as follows:

$$U = U(C, P, L).$$

The health status H_i of child i is assumed to be the outcome of the mother's decision about inputs such as whether to breastfeed, duration of brestfeeding, supplemental food, etc. Further determinants are exogeneous health factors, X_i, such as age, sex, the parents' education and health, and unobserved personal characteristics, u_i:

$$H_i = H_i(Y_i, X_i, u_i).$$

Estimation of whether the child is underweight or not are likely to suffer from classic sample selection biases. First, only children who survived till the day of interview are measured. The sample is likely to be biased towards healthier children as feeble children are more likely to have died. Second, if a mother cares about the health of her child, then any variable that influences the health of that child will also influence her fertility decisions, i.e. whether the child will be conceived or not.

The minority of empirical studies—even though they may recognise the need—deal with the problem of endogeneity. Endogeneity is a problem as factors that influence a *child's* health may be important at at least three different times in its *mother's* life (Pitt, 1997): (a) the decision to have a child; (b) conditional on having a child, on child survival; and (c) conditional on birth and survival, health as measured at the time of the survey.

Studies that control for endogeneity, for example Glick and Sahn (1998) or Pitt (1997), confirm the presence of selectivity, but the results are little changed when selection is accounted for. The most difficult practical problem with regard to these issues is parameter identification.[1] Since the fertility, and conditional on fertility survival and underweight may be considered endogenous choices, there is no usual exclusion restriction available.

In this analysis I do not control for endogenous fertility, but condition the probability of underweight on the probability of survival till the interview date. The model is a Heckman-type probit model. I use whether or not the mother used professional ante-natal care and whether or not the baby was delivered in a hospital as exclusion restrictions in the model. This choice of variable implies that professional ante-natal care influences the chances of survival, but not the weight of the child at the time of interview. Estimates of the chances of survival and the chances of being underweight (not reported here) indicate that the variables have a strong positive association with survival, but not with the probability of being underweight, conditional on the set of explanatory variables.

3 Data

Data are from Demographic and Health Surveys (DHS) for three West African countries. These surveys provide detailed information for a representative sample of women of reproductive age. Included in the survey are anthropometric measures of the women and their children that were born in the previous three (five) years.

- *Burkina Faso*: 1998–9, 6,445 women 15–49, anthropometry of children aged 0–59 months

[1] Pitt and Rosenzweig (n.d.) rely on the functional form of their model to identify the selectivity. Pitt (1995) uses the assumption that first-births are exogenous to model child mortality conditional on fertility selection.

- *Ghana*: 1998–9, 4,843 women 15–49, anthropometry of children aged 0–59 months
- *Togo*: 1998, 8,964 women 15–49 years, anthropometry of children 0–35 months

From these observations, I select all children who were born in the 36 months before the interview, including information on children who have died before the interview.

The DHS questionnaire covers a wide range of the household's socio-economic status, health, and reproductive behaviour. For each child I have also attached data from the World Development Indicators (2001) on background variables in the year of birth (GDP per capita, consumer price index, female literacy rate, development aid, and the population growth rate).

The variable of interest is a measure of health outcome, "underweight". This measure is derived from a child's weight, in relation to its age. A child is underweight if its weight-for-age is more than two standard deviations below the median of reference population.[2] Underweight is a measure of acute undernutrition.[3]

Underweight can manifest itself quickly in a child and reflects current living conditions, for example, whether the child is sick or not. In the first two years of a child, growth is strongest and a lack of food will influence their height as adults, although there is some evidence that the supplement of nutrients may induce a catching-up process.

Table 1 lists the proportion of underweight children in the three countries, for different age groups. It can be seen that the proportion of underweight children is with 37% highest in Burkina Faso. The overall proportion of underweight children is about 25% in Ghana and Togo. The proportion of children who are underweight is smallest when they are below 6 months of age. After that age, usually the time when mothers stop exclusively breastfeeding their children, the incidence of underweight increases sharply. As can be seen from Figure 1, the distributions of underweight by the child's age are fairly similar in the three countries. The number of children who are underweight increases after the sixth month until it peaks at about 12 months, and declines thereafter, with another peak at 24 months.

As stated above, it is likely that feeble children will not survive until the date of interview. Table 2 lists the proportion of dead children, by the age at the

[2]See Klasen (2000) for a critical assessment of the reference population.

[3]Chronic undernutrition is measured by height-for-age: regressions still to run.

time of interview. Of children up to 6 months of age, about 4% have died by the date of interview. Older children, and especially children in Burkina Faso, have higher rates of mortality. Those who were born 12 to 24 months before the interview, i.e. those who have the highest rates of underweight, have also high rates of mortality.

As noted above, preliminary estimations (not reported here, but available on request) have shown that whether or not the child was delivered in a hospital shows a strong positive association with survival, but not with the probability of being underweight. This is consistent with the fact that underweight is a short-term measure of undernutrition and that the children were born relatively long ago. The mean (median) age at the time of interview was 17 (16) months.

Table 3 lists health indicators for the three countries, for the years 1995, 1997, and 1999. There is little change over this period, fertility rates, mortality rates and life expectancy at birth are stable. Burkina Faso has the worst performance of the three countries: infant and under-5 mortality rates are about double the rate of Ghana. The indicators for underweight are only available for some years, they indicate that in 1999 about a quarter of children under five was underweight in Ghana and Togo. The only statistic available for Burkina Faso is for 1993 and indicates that about a third of children under five were underweight.

Immediate causes

The first group of explanatory variables are indicators which describe the child's health at the time of the interview. I include indicator variables for whether or not the child had fever, diarrhea, or a cough in the two weeks before the interview. To proxy for sanitary conditions, I include variables that indicate whether or not the household has a safe source of drinking water (either piped water or from a covered well), and if the household has a covered toilet facility.

The weight is influenced by the intake of food, unfortunately there are no detailed data. To proxy the calory intake I use an indicator variable that states whether or not the child is currently breastfed, and whether or not the child had solid food in the 24 hours before the interview. Additionally, I include a variable that states the duration of breastfeeding as a fraction of current age. Age enters the set of explanatory variables in a cubic polynomial.

Since the weight or height at birth is only recorded for a minority of children, mother's subjective impression of size at birth is used as a indicator for weight differences. To proxy for differences at birth I make use of the mother's subjective interpretation of the child's size at birth. I include indicator variables for whether or not the mother, at the time of the interview, thinks that the child was a small (big) child at birth. Also included is an indicator for the child's sex.

The amount of available food for a given child will also be determined by the degree of competition for food in the household. To distinguish first-born children, who presumably receive more attention than children who are born later, from their brothers and sisters, their ranking in the birth order is used as an explanatory variable. Since it is possible that mothers learn to care better for their children through practice the birth order is also included as a quadratic term.

Underlying Causes

Underlying causes are related to the security of food and the access to health care. Since mothers are the primary source of care, variables that proxy the mother's potential with respect to the provision of food and care are used. These proxy variables are the mother's age, her education, her ethnicity and her religion.

Whether or not a mother provides care to her child may be determined by her attitude towards pregnancy and by her fertility experience. I therefore include whether or not she wanted the child, whether or not she would like to have another child, if she thinks that pregnancy causes unhappiness, and the number of boys and girls who have died. A correlation between a child's underweight and that its mother's statement that she did not want the child does not necessarily imply that the mother does not care for her child, but it could also mean that she anticipated difficulties, e.g. the provision of food, and given the circumstances would have preferred not to have the child.

A mother's fertility choices will not be independent of her partner's preferences. Her partner's preferences are included indirectly. They enter the estimation equation through whether or not the mother thinks that her partner approves of fertility planning methods, and whether or not she thinks that her partner would like to have more children. Also included is the age of her first delivery, whether she is married or not, if she is (was) married, the age of first marriage, and if she had been in a partnership before.

The access to care and food will be determined by the household's income and wealth. In most households the mother's partner will be the main earner of income. Since income is not available in the data, I include the partner's work status, his education and occupational sector, and whether or not he works on his own land as explanatory variables. Wealth is proxied, in addition to the variables that describe the sanitary conditions, by whether or not the household has electricity, a radio, a fridge, or a bike.

The provision of food will in turn depend on the composition of the household. When the mother is in a partnership, I include a variable that indicates whether or not the partner lives at home. Care for the child is often undertaken in the extended family, variables that indicate the presence of another wife, whether or not the head of household is female, and the size of the household are included.

Basic Causes

Reliable data for these countries are difficult to find. Although the World Development Indicators list consistent 559 time series, only a few are available for the time period and all three countries. These data are annual figures for the calender year, there are no regional or quarterly disaggregate data available. For each child, I have attached the Consumer Price Index, the GDP/capita, the female literacy rate, the net development aid (in % of the country's GDP), and the population growth rate of the year it was born.[4]

4 Results

Table 4 tabulates the estimated marginal effects, evaluated at the means of the explanatory variables, for the selectivity corrected probit models. The first model uses only the variables included in the set of immediate causes, the second model only the underlying, and the third model the basic causes. The last column presents the estimation of a model where all three causes are combined in one estimation. The coefficients of the selection equation are given in the Appendix, Table 5, and are not discussed here.

I have also estimated models without correcting for selective survival (results not shown here). Neither for the single cause models nor for the model that uses the combined set of variables, the selection—although statistically significant—seems to matter. The marginal effects are by and large of the same magnitude and allow the same interpretation of associations between underweight and the causes.

Model 1, which uses only the variables classed as immediate causes, indicates that age is an important determinant of whether or not a child is underweight. Age enters the equation as a cubic polynomial and the probability

[4] Alternatively, I have used indicator variables for the country and year of birth. The substantive results do not change: Burkina Faso has the worst performance, and the probability of underweight is lower for later cohorts in all three countries.

of underweight increases with age, but at a decreasing rate. Children who are breastfed at the time of interview, and who have been breastfed for a longer fraction of their life, have a higher probability of being underweight, controlling for age and the consumption of solid foods in the last 24 hours. In other words, mothers who do not feed their children additional food have children who are more likely to be underweight.

Sanitary conditions are important, too. The access to clean water and the presence of a covered toiled are associated with a lower chance of being underweight. Children who were sick in the two weeks before the interview are also more likely to be underweight.

Babies who were larger at birth have a reduced risk of being underweight, and smaller babies are more likely to be smaller at a later point in time. The number of birth does not appear to be of importance in relation to the probability of underweight, nor do girls have a different chance of being underweight. Being a twin increases your chance of being underweight—the competition for resources takes its toll by increasing the chances of being underweight from a predicted probability of underweight of 21 per cent to about 33 per cent.

The differences between the countries are negligible, despite the huge differences in the underlying health statistics as shown in Table 3.

The second model, which uses only indicators of underlying causes, (column 2), confirms that the number of brothers and sisters is related to the probability of underweight, although the association is small.

The negative association between a mother's education and the chances of her child being underweight is surprising, the omitted variable is Secondary or Higher Education (about 60 per cent of children have mothers in that category). If women with more education have fewer children than this association could reflect differential fertility. This issue will be analyses in future work.

A mother's fertility preferences show relationship with the probability of her child being underweight. Children whose mothers say that they wanted the child later than at the time of birth, or not at all, are more likely to be underweight than children whose mother indicate that they wanted the child. This association does not necessarily mean that a mother who did not want her child does not care for it, it could also reflect economic difficulties which were anticipated or present at time of the (unwanted) pregnancy.

Using only basic causes to determine the probability of underweight, column 3, we see that GDP per capita and women's literacy rates have the single most important associations with the probability of a child being underweight. The amount of development aid also seems to reduce the chances of underweight. A fast growing population seems to produce children who are underweight—a notion that was already raised by Malthus who stressed that the fixity of land (the diminishing returns of the agricultural sector) implies a falling per capita consumption and a subsequent increased mortality.

When all three sets of explanatory variables are combined into one set of explanatory variables, column 4, most statistically significant associations shown in the single cause estimations remain significant.

5 Conclusion

The motivation for this analysis was the fact that the proportion of underweight children in sub-Saharan Africa has been increasing over the last decade, in contrast to other regions of the world. I have used new cross-sectional data from three West African countries, Burkina Faso, Ghana, and Togo, to estimate the probability of being underweight for a sample of children who were born in the 36 months before the interview. Since sick or feeble children will be more likely to die before the interview, I have controlled for selective survival.

The most important associations between explanatory variables and the probability of underweight that appear in the analysis are related to the household's demographic situation and the country's state of development.

Children who were born in the country with the greatest GDP per capita have the least risk of being underweight. Further, the higher the female literacy rate the lower is the risk of underweight. These two factors appear to be of more importance than the child's health, despite the fact that underweight is a short-term measure of malnutrition. The female literacy rate is probably effective through a mothers educational and fertility choices.

That fertility choices matter are borne out by the data: children of mothers who state that they did not want to have the child are more likely to be underweight. It cannot be concluded that these mothers simply do not care for their children: it may well be that they anticipated the problems in supplying their children with sufficient food.

Children who live in households where there is a secure source of water and where the toilet is covered have a reduced risk, probably via the reduced probability of infections, to be underweight.

Here, like in most other micro-econometric studies, there is an obvious need for better quality data. It is clear that a woman's choices are interrelated: her investment in human capital will determine her opportunity costs when deciding fertility. The interaction between fertility and a child's health, which I have not looked at in this analysis, is left for future research.

6 Tables and Figures

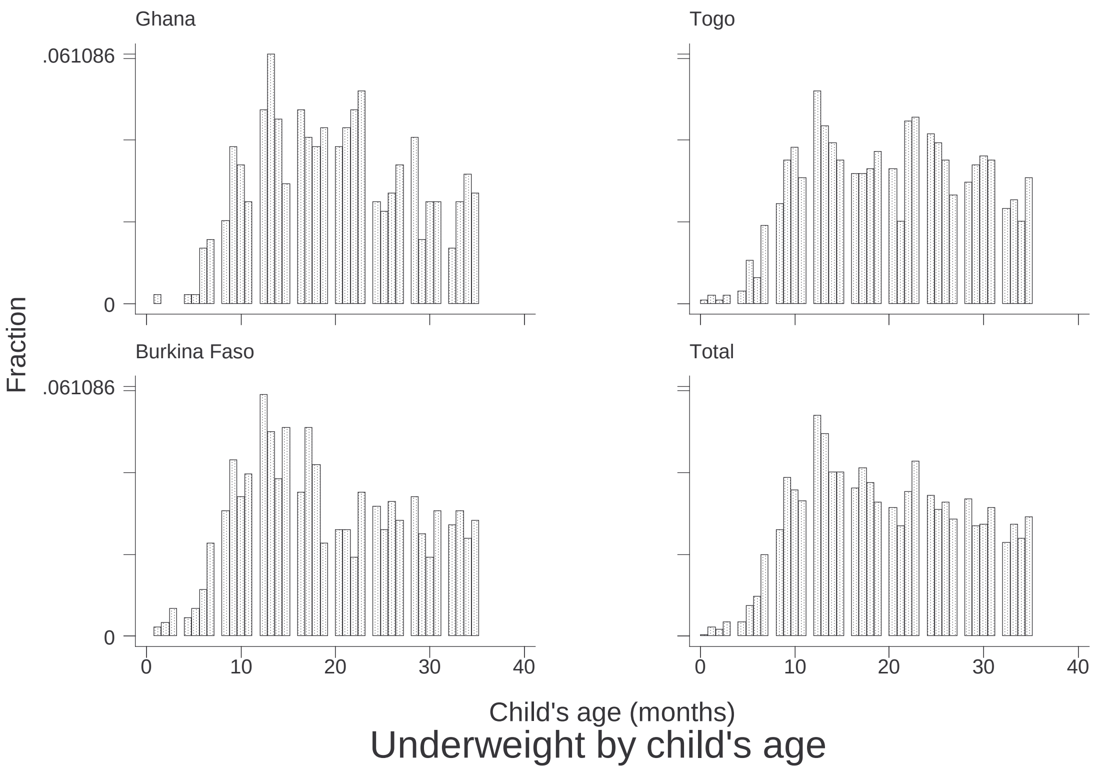

Figure 1: Distribution of underweight

Table 1: Proportion of underweight children, by age group and country (in %).

	Age (in months)				
	0–5	6–11	12–23	24–35	Total (N)
Burkina Faso	4.10	34.75	52.20	45.69	36.69 (2,454)
Ghana	0.53	18.66	38.43	26.22	25.17 (1,653)
Togo	3.27	20.66	37.15	29.94	25.32 (3,443)

Note: Underweight:= if the Z-score of weight ((weight - reference median)/ reference standard deviation) < -2. Children born in the 35 months before the interview date. Date are weighted to be representative of a country's population.

Table 2: Proportion of dead children, by age group at interview and country (in %).

	Age at interview (in months)					Age at death
	0–5	6–11	12–23	24–35	Total (N)	Mean (Median)
Burkina Faso	4.57	9.17	12.45	14.65	11.14 (3,474)	5.9 (3)
Ghana	3.46	4.96	7.43	7.73	6.47 (1,968)	5.7 (3)
Togo	4.10	6.04	8.92	7.80	7.17 (4,168)	4.2 (1)

Note: Children born in the 36 months before the interview date. Age at the time of interview in months includes imputed data. Data are weighted to be representative of a country's population.

Table 3: Health indicators, by country and year.

Year		Burkina Faso	Ghana	Togo
1995	Fertility rate, total (births per woman)	6.8	4.6	5.4
	Mortality rate, infant (per 1,000 live births)	107.8	57.0	79.7
	Mortality rate, under-5 (per 1,000 live births)	n/a	108.0	146.3
	Life expectancy at birth, female (years)	46.6	61.0	50.6
	Life expectancy at birth, male (years)	44.1	57.5	47.9
	Underweight (% of children under 5)	32.7[a]	27.3[b]	19.0[c]
1997	Fertility rate, total (births per woman)	6.8	4.5	5.2
	Mortality rate, infant (per 1,000 live births)	105.0	55.0	79.0
	Mortality rate, under-5 (per 1,000 live births)	219.0	104.0	146.0
	Life expectancy at birth, female (years)	46.9	61.8	50.1
	Life expectancy at birth, male (years)	44.1	58.3	47.6
	Underweight (% of children under 5)	n/a	n/a	n/a
1999	Fertility rate, total (births per woman)	6.6	4.3	5.1
	Mortality rate, infant (per 1,000 live births)	104.6	57.1	76.5
	Mortality rate, under-5 (per 1,000 live births)	210.0	109.0	143.0
	Life expectancy at birth, female (years)	45.7	59.3	50.3
	Life expectancy at birth, male (years)	44.1	56.6	48.0
	Underweight (% of children under 5)	n/a	24.9	25.1[d]

Note: Data from the World Development Indicators (2001). n/a indicates that the variable is not available for this country in that year. [a] Data for 1993. [b] Data for 1994. [c] Data for 1996. [d] Data for 1998.

Table 4: Probit models of being underweight, with correction for selective survival.

Variable	Immediate		Underlying		Basic		Combined		
	Marginal Effect	(S.E.)	ME	(S.E.)	ME	(S.E.)	ME	(S.E.)	$\bar{x}$
Immediate Causes									
Age	0.120	(0.007)					0.124		16.532
$Age^2/100$	-0.540	(0.041)					-0.557		3.762
$Age^3/1000$	0.773	(0.071)					0.793		0.981
Female	-0.007	(0.009)					0.004		0.500
Currently breastfed	0.070	(0.013)					0.049		0.752
Duration breastfed/Age	0.110	(0.039)					0.084		0.892
Solid food in last 24 hours	-0.041	(0.019)					-0.056		0.881
Clean water in household	-0.062	(0.010)					-0.013		0.300
Covered toiled in household	-0.031	(0.013)					-0.013		0.170
Size of child at birth: large	-0.064	(0.020)					-0.068		0.119
Size of child at birth: small	0.088	(0.036)					0.083		0.031
Child had in last 24 hours									
Fever	0.032	(0.011)					0.038		0.346
Diarrhea	0.040	(0.011)					0.030		0.248
Cough	0.013	(0.010)					0.016		0.322
Birth order	-0.002	(0.007)					0.002		3.929
Birth $order^2/100$	0.052	(0.064)					0.024		0.216
Twin	0.125	(0.037)					0.151		0.038
Underlying Causes									

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Variable	Immediate		Underlying		Basic		Combined		
	ME	(S.E.)	ME	(S.E.)	ME	(S.E.)	ME	(S.E.)	$\bar{x}$
Brothers at home			-0.010	(0.006)			0.004		1.416
Sisters at home			-0.017	(0.006)			-0.009		1.355
Number of brothers who died			-0.008	(0.008)			0.001		0.387
Number of sisters who died			0.001	(0.009)			-0.001		0.336
Mother's characteristics									
Age			0.003	(0.001)			-0.003		28.949
Mother's education									
None			-0.020	(0.028)			-0.005		0.096
Primary			-0.031	(0.015)			-0.020		0.198
Intermediate			-0.064	(0.021)			-0.041		0.109
Mother's religion									
None			-0.005	(0.022)			0.001		0.075
Christian			-0.047	(0.017)			-0.044		0.204
Islam			-0.001	(0.016)			-0.005		0.291
Traditional			0.015	(0.017)			0.023		0.232
Age at first birth			-0.004	(0.002)			0.000		19.309
Mother wanted last child									
Later			0.029	(0.012)			0.019		0.269
Did not want child			0.064	(0.025)			0.060		0.060
Mother's Body Mass Index[a]			-0.007	(0.002)			-0.006		22.077
Mother is married			-0.050	(0.034)			-0.011		0.967
Mother had previous unions			-0.012	(0.014)			0.004		0.179

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Variable	Immediate		Underlying		Basic		Combined		
	ME	(S.E.)	ME	(S.E.)	ME	(S.E.)	ME	(S.E.)	$\bar{x}$
Mother's age at first marriage			0.000	(0.002)			0.001		17.949
Mother wants more children			0.017	(0.014)			-0.016		0.684
Mother: Pregnancy causes unhappiness			-0.049	(0.012)			-0.009		0.618
Mother is currently working			0.024	(0.012)			-0.001		0.773
Mother: thinks that partner approves of fertility planning			0.016	(0.010)			0.006		0.438
Mother: thinks that partner wants more children than herself			-0.006	(0.013)			-0.009		0.207
Mother's partner									
Lives in the household			0.008	(0.019)			0.004		0.813
Has another wife			-0.005	(0.012)			0.005		0.393
Education									
None			0.037	(0.027)			0.030		0.552
Primary			0.056	(0.030)			0.042		0.158
Intermediate			0.004	(0.028)			0.009		0.225
Secondary			0.007	(0.051)			0.050		0.022
Unemployed			-0.077	(0.075)			-0.090		0.004
Occupation									
Professional			-0.017	(0.029)			-0.029		0.051
Clerk			0.036	(0.055)			0.007		0.013
Sales personnel			-0.009	(0.022)			-0.002		0.070
Service personnel			0.006	(0.029)			0.019		0.040

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Variable	Immediate		Underlying		Basic		Combined		
	ME	(S.E.)	ME	(S.E.)	ME	(S.E.)	ME	(S.E.)	$\bar{x}$
Skilled manual worker			-0.013	(0.017)			-0.006		0.143
Works on own land			-0.015	(0.012)			-0.016		0.360
Electricity			-0.001	(0.022)			0.000		0.128
Radio			-0.021	(0.011)			-0.031		0.566
Fridge			-0.091	(0.028)			-0.076		0.043
Bike			0.017	(0.013)			0.022		0.599
Size			0.001	(0.001)			0.001		8.332
Head is female			0.029	(0.024)			0.023		0.123
Basic Causes									
Urban			-0.064	(0.016)			-0.049		0.202
Burkina Faso	0.015	(0.021)	-0.009	(0.039)					
Togo	-0.034	(0.020)	-0.056	(0.028)					
Consumer Price Index					0.000	(0.000)	0.000		124.195
GDP/capita					-1.634	(0.452)	-0.531		1.348
Female Literacy rate					-1.245	(0.387)	-0.515		0.672
Development Aid					-0.037	(0.012)	-0.015		11.841
Population growth					0.485	(0.130)	-0.062		2.618
Predicted fraction underweight	0.212		0.260		0.270		0.207		
Rho^b	0.780	(0.067)	0.999	(0.003)	0.951	(0.073)	0.649	(0.150)	
Log-likelihood	-6142.96		-6567.18		-6727.83		-6026.40		

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Variable	Immediate		Underlying		Basic		Combined		
	ME	(S.E.)	ME	(S.E.)	ME	(S.E.)	ME	(S.E.)	$\bar{x}$

N=7,968 children of whom 90.15% (7,183) were alive at the interview.
1,478 (28.28%) of surviving children are underweight.
Marginal effects for dummy variables are for a change from 0 to 1.
[a] The body mass index (BMI) is defined as weight/height^2. The BMI is not adjusted for pregnant women.
[b] Estimated correlation between the two equations.

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A Appendix

Table 5: Probit estimations of being alive at time of interview.

Variable	Immediate		Underlying		Basic		Combined		
	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)	$\bar{x}$
Immediate causes									
Female	0.101	(0.015)	0.081	(0.040)	0.090	(0.040)	0.098	(0.014)	0.500
Professional prenatal care	0.237	(0.023)	0.225	(0.051)	0.233	(0.052)	0.238	(0.022)	0.788
Birth at hospital	0.084	(0.019)	0.072	(0.047)	0.097	(0.047)	0.077	(0.018)	0.430
Size of child at birth: large	0.048	(0.032)	0.027	(0.106)	0.026	(0.108)	0.050	(0.031)	0.119
Size of child at birth: small	0.000	(0.050)	-0.179	(0.144)	-0.189	(0.147)	0.002	(0.049)	0.031
Birth order	0.173	(0.017)	0.185	(0.040)	0.195	(0.041)	0.171	(0.016)	3.929
Birth order^2/100	-1.396	(0.122)	-1.424	(0.259)	-1.476	(0.275)	-1.402	(0.120)	0.216
Twin	-0.869	(0.053)	-1.027	(0.092)	-1.012	(0.092)	-0.873	(0.053)	0.038
Underlying causes									
Mother's age at interview	-0.003	(0.004)	-0.007	(0.008)	-0.010	(0.008)	-0.003	(0.003)	28.949
Mother's education									
None	-0.005	(0.046)	-0.048	(0.117)	-0.052	(0.117)	-0.005	(0.041)	0.096
Primary	0.073	(0.025)	0.053	(0.063)	0.080	(0.062)	0.055	(0.023)	0.198
Intermediate	0.110	(0.034)	0.064	(0.088)	0.121	(0.085)	0.076	(0.031)	0.109
Mother's religion									
None	-0.082	(0.037)	-0.092	(0.091)	-0.093	(0.089)	-0.081	(0.033)	0.075
Christian	-0.031	(0.029)	-0.071	(0.074)	-0.037	(0.073)	-0.065	(0.027)	0.204
Islam	-0.029	(0.026)	-0.035	(0.063)	-0.029	(0.062)	-0.030	(0.023)	0.291
Traditional	-0.110	(0.028)	-0.094	(0.070)	-0.117	(0.069)	-0.091	(0.025)	0.232

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Variable	Immediate		Underlying		Basic		Combined		
	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)	$\bar{x}$
Ethnic background				included					
Mother's age at first birth	0.008	(0.005)	0.009	(0.011)	0.013	(0.011)	0.006	(0.004)	19.309
Mother's age at first marriage	0.006	(0.004)	0.007	(0.009)	0.007	(0.009)	0.007	(0.003)	17.949
Basic Causes									
Consumer Price Index	0.002	(0.001)	0.003	(0.001)	0.003	(0.002)	0.002	(0.001)	124.195
GDP/capita	-1.153	(0.715)	-0.275	(1.910)	-1.670	(1.944)	-1.041	(0.647)	1.348
Female Literacy rate	-0.629	(0.644)	-0.282	(1.700)	-1.334	(1.723)	-0.578	(0.591)	0.672
Development Aid	-0.055	(0.019)	-0.025	(0.053)	-0.060	(0.054)	-0.054	(0.017)	11.841
Population growth	0.227	(0.201)	-0.283	(0.561)	0.152	(0.573)	0.132	(0.178)	2.618
Constant	2.214	(1.172)	1.830	(3.032)	3.570	(3.068)	2.335	(1.085)	

N=5,734 children of whom 91.16% (5,227) were alive at the interview.
1,478 (28.28%) of surviving children are underweight.
[b] The body mass index (BMI) is defined as weight/height^2.
The BMI is not adjusted for pregnant women.