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IMPACT OF ORPHANHOOD ON UNDERWEIGHT PREVALENCE IN SUB-SAHARAN AFRICA

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Abstract

Background: In Africa, approximately 25 million people live with HIV/AIDS and 12 million children are orphaned. While evidence indicates that orphans risk losing opportunities for adequate education, health care and future employment, orphanhood's immediate impacts on child nutritional status remain poorly understood.

Objective: This paper assesses the nutritional impact of orphanhood with a particular emphasis on taking account of various factors potentially confounding or masking these impacts.

Methods: Child anthropometry and orphan status was examined in 23 MICS and DHS surveys from throughout sub-Saharan Africa, which were subsequently merged into larger, region-specific datasets (East, West, and Southern Africa). To compare orphans and non orphans, linear regression and probit models were developed, taking account of orphan status and type, presence of surviving parent in the household, household structure, child age and gender, urban/ rural status and current wealth status.

Results: Few differences emerged between orphans and non orphans in controlled and uncontrolled comparisons, regardless of orphan type, presence of surviving parent or household structure. Age differentials did confound nutritional comparisons, though in the counterintuitive direction with orphans (8 months older on average) becoming less malnourished when age differences were taken into account. Wealth did appear to be associated with orphanhood status, though it did not significantly confound nutritional comparisons.

Conclusions: Orphans were not more malnourished than non orphans even when potential confounding variables were examined. As household wealth status is likely to change after becoming HIV-affected, ruling out wealth as a potential confounder would require more detailed, prospective studies.

Key words: HIV/AIDS, Sub-Saharan Africa, Child Anthropometry, Orphanhood, Fostering

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INTRODUCTION

The HIV/AIDS epidemic has been depicted as a succession of three waves [1]. The first wave is initial HIV infection, which is followed a few years later by the second wave, AIDS illness and death. The third wave is comprised of the indirect consequences of the disease, such as the children who have been orphaned or made vulnerable by AIDS. As this third wave emerges and begins to significantly impact communities, the needs of affected children are becoming a major concern. Over 12 million children are currently orphaned due to AIDS and these children risk losing opportunities for adequate education, health care, and proper nutrition [2]. While empirical evidence examining the negative effects of orphanhood is growing, there remains much uncertainty as to how it impacts child nutrition.

Up to now, only a handful of studies have been published that examine the effect of orphanhood on child nutritional status. Most have found few differences between orphans and non orphans. In Malawi, a study comparing children in institutions to orphaned and non-orphaned children living in villages found that among children under the age of five, there was no difference in nutritional status between village orphan children and village non-orphan children; but that children in institutions were worse-off than village children [3]. In another study in Malawi, it was found that children of HIV positive mothers had the highest mortality rates for all ages; but differences in anthropometric measurements between children with HIV positive and HIV negative mothers were small and not statistically significant. This finding persisted comparing orphans and non orphans [4].

In Tanzania, orphans were more likely than non orphans to be stunted, but not wasted [5]. In Uganda, a study of young orphans, found that while there was a higher prevalence of self-reported morbidity in orphan populations, there were no associations between orphan status and any form of malnutrition [6]. In Kenya, on the other hand, orphans were more likely than non orphans to be wasted but not stunted [7]. Finally, in an analysis of pooled Demographic and Health Survey (DHS) data from a number of countries, direct comparisons of underweight prevalence between orphans and non-orphans under the age of five revealed few differences [8].

The current study intends to re-examine the nutritional impact of orphanhood, conducting a pooled, regional analysis of the most recent DHS and MICS II data in East, West and Southern Africa. This study attempts to clarify the nutritional impact of orphanhood by taking account of orphan type, presence of surviving parents in the household, household structure, age differences (between orphans and non orphans) and (current) wealth status of the household. Addressing the issue of wealth is particularly important in the light of a recent study which showed that (in at least eight African countries) HIV was disproportionately affecting wealthier households [9]. Since higher income is associated with better in utero and early childhood growth, AIDS orphans may start with better anthropometry, masking the negative affects of a parent's death when examined on a population basis. Accounting for current wealth status, while not ideal (given that

Mishra et al findings are that wealth is positively associated with adults being HIV+ —not children being orphaned), is the only way to address this in cross-sectional data.

METHODS

Data and variables used

Regional datasets for East, West, and Southern Africa were compiled from the most recent DHS and from MICS II surveys. Specific datasets used included; Benin (DHS-2001), Ethiopia (DHS-2005), Ghana (DHS- 2003), Kenya (DHS-2003), Mali (DHS-2001), Malawi (DHS-2000), Namibia (DHS-2000), Nigeria (DHS-2003), Rwanda (DHS-2000), Uganda (DHS-2004), Zambia (DHS- 2001/02), Zimbabwe (DHS-1999), Angola (MICS-2000), Burundi (MICS-2000), Equatorial Guinea (MICS-2000), Gambia (MICS-2000), Guinea Bissau (MICS-2000), Lesotho (MICS-2000), Niger (MICS-2000), Senegal (MICS-2000), Sierra Leone (MICS-2000), Sudan (MICS-2000), Swaziland (MICS-2000), and Zambia (MICS-2000).

After construction of regional datasets, orphan categories were created. Various levels of aggregation and disaggregation were used throughout the analysis. Initial orphan categories examined were; i) orphan and ii) non orphan. Then, orphans were grouped into 4 categories; i) non orphan, ii) maternal orphan, iii) paternal orphan and iv) double orphan. These categories were then further defined by whether the (surviving) parent was in the household. Finally, household structure was taken into account by only examining children in single parent households (or children living in foster households without either parent) both orphaned and not. By so doing, this analysis was attempting to approach as nearly as possible the impact of orphanhood versus the impact of simply not living with a parent. Orphans status was initially determined using the questions asked of household head “Is [child’s name] natural mother/father alive?” included in both DHS and MICS II datasets. Presence of mother or father in household was determined in DHS data using the question “Does [child’s name] natural mother/father live in this household”.

Nutritional status was defined using weight for age z-scores (WAZ), underweight prevalence (yes/no) and WAZ score residuals (discussed later). WAZ scores were chosen as the primary anthropometric outcome for two reasons: i) it captures both linear growth retardation, and thinness either due to growth failure, or to actual loss of tissue (i.e. wasting), making it most likely to pick up differences between groups; ii) Weight for height (WHZ) and height for age z-scores (HAZ) are hampered by specific disadvantages. Stunting, for instance, usually begins in the first two years of life and can persist for several years. The extent of subsequent reversal depends on the circumstances both of the initial stunting (e.g. how far bone maturation is also retarded) and of catch-up growth. In cross sectional data, amount of time orphaned is not recorded, thus depending on how long the child has been orphaned, stunting may measure the nutritional impact of events prior to the parent’s death (i.e. parental illness). WHZ, on the other hand, has a practical drawback—prevalence is likely too small in Southern and West Africa for a powerful analysis, especially considering that orphan populations remain quite small (in a relative sense) themselves.

Bivariate analysis

Mean WAZ estimates were calculated by country for each orphan and non orphan category. However, with orphans older (by 8 months on average) than non orphans, it was first necessary to determine whether proper comparisons could be drawn without taking age into account. To do so, age adjusted and unadjusted mean WAZ scores were calculated. Adjusted scores were calculated using General Linear Models (GLM) and Analysis of Covariance (ANCOVA), where age was classified as a covariate and orphan variables were classified as fixed effect variables. Unadjusted means were calculated using simple mean comparisons. Findings indicated, as will be discussed in the Results and Discussion sections, that age adjustment was necessary to avoid spurious conclusions. Subsequent comparisons were all age adjusted.

After nutritional comparisons within country, the nutritional status of orphan and non orphan categories were compared within regions (East, West, and Southern Africa). For proper comparisons, regional weights had to be devised and a standardized outcome indicator developed. Regional weights were necessary to ensure that each respondent had a similar probability of selection. To calculate these weights, the following formula was used:

W= total child population in country/ number of children sampled in country survey
W'= W*(N/Sum of W)
W"= W'*(Internal weight for each dataset)

Where N= total number of countries per region, W= regional weight, W'= standardized regional weight, and W" = (standardized regional weight* weight internal to the dataset).

A standardized outcome variable was necessary because each country had a different underlying level of malnutrition or mean WAZ score. The objective was to eliminate this variation by setting the mean for each country to the same value (zero for convenience). To do so, WAZ scores were regressed by age of child to determine predicted WAZ values for a child *n* months of age. Models were run separately for each country and each were structured as follows:

$$Y\ (WAZ) = \beta_0 + \beta_1\ (age) + \beta_2\ (age^2) + \beta_3\ (age^3) + \mu$$

Then, the difference in actual WAZ and this predicted value was computed for each child (observed WAZ- predicted WAZ). This difference (subsequently referred to as the 'WAZ residual') was then saved to the dataset. To illustrate this process, a population of Kenyan children 24 months of age might have a mean WAZ (predicted by regression models) of -1.0. For an individual case of the same age with a WAZ of -1.2, the WAZ residual would be the "observed" WAZ (-1.2) minus the "predicted" mean WAZ for children of that age in Kenya (1.0), or -0.2.

Multivariate techniques

Ordinary least squares (OLS) regression and probit models were developed, using continuous 'WAZ residuals' as the outcome in the regression and the dichotomous underweight (yes/no) variable as the outcome for the probits. The method of using residuals (obtained from previous regressions) as dependents variables in further regressions has been tested previously and found valid in the analysis of child growth data [10]. Probit models were chosen as a complement to the linear regression models, as this method allowed for the calculation of predicted underweight prevalence, a more intuitive output. Specifically, probit models work by predicting changes in an outcome variable, given hypothetical changes in other relevant, control variables (in this case, orphan status, wealth, gender of child, and place of residence).

Multivariate linear regression and probit models were developed for each of the orphan and non orphan comparisons discussed previously, taking account of wealth status, age and gender of child and place of residence. It should be noted that child age was not included as a control variable in the linear regressions models. Since age was accounted for in the derivation of the

WAZ residual outcome variable, including age in the final model would have been redundant. Wealth status was defined by quintiles which were provided in each DHS and MICS II dataset. Models were developed in the following iterations:

<u>Orphan and non orphan:</u>

Y (WAZ residual)/ P (Underweight-yes/no) = b_0 + b_1(orphan) + b_2(child age) + b_3(child gender) + b_4(urban/ rural) + b_6(poorer quintile) + b_7(middle quintile) + b_8(richer quintile) + b_9(richest quintile) + μ

<u>Maternal, paternal, double, and non orphan:</u>

Y (WAZ residual)/ P (Underweight-yes/no) = b_0 + b_1(maternal orphan) + b_2(paternal orphan)+ b_3(double orphan)+b_4(child age) + b_5(child gender) + b_6(urban/ rural) + b_7(poorer quintile) + b_{10}(middle quintile) + b_{11}(richer quintile) + b_{12}(richest quintile) + μ

<u>Maternal, paternal, double, and non orphans by presence of parents in the household:</u>

Y (WAZ residual)/ P (Underweight-yes/no) = b_0 + b_1(maternal orphan/ father in) + b_2(maternal orphan/ father out)+ b_3(paternal orphan/ mother in) + b_4(paternal orphan/ mother out) + b_5(non orphan/ father out)+ b_6(non orphan/ mother out) + b_7(non orphan/ both out) + b_8(double orphan) + b_9(child age) + b_{10}(child gender) + b_{11}(urban/rural) + b_{12}(poorest quintile) + b_{13}(middle quintile) + b_{14}(richer quintile) + b_{15}(richest quintile) + μ

Both bivariate and multivariate analysis was conducted in STATA 9.0. In the multivariate analysis, the “robust cluster” function was utilized to ensure that sample design was accounted for and standard errors were estimated properly.

RESULTS

Regionally, East Africa had a slightly higher percentage of orphaned children (15%) than countries in either Southern or West Africa (13 and 7%, respectively). Examined per region, the highest orphan percentages were seen in heavily conflict affected countries (i.e. Rwanda and Sierra Leone) or highly HIV-affected countries (i.e. Zambia). Generally, percent of orphans did not correlate well with observed HIV prevalence (see Table 1). This was true in all three regions and is consistent with findings from previous studies that have shown a similar lack of correlation, when stage of the epidemic was not taken into account [11].

Initially country values were examined separately. Results are shown in Table 2. Mean age-adjusted WAZ scores indicated few differences in the nutrition status of orphans and non orphans, regardless of country. In cases where there were statistically significant differences, the majority were in the unexpected direction, with orphans appearing less malnourished than non orphans. This was true in Kenya, Nigeria, Mali, and Sierra Leone. Orphans appeared more malnourished only in Zambia. Counterintuitive results persisted when orphans were defined by which parent died.

As shown in Table 3, regional mean comparisons (using WAZ ‘residuals’) showed similar results. Orphans in West Africa were 0.32 z-scores better off than non orphans (p-value<0.000). This was pattern held regardless of which parent died, as maternal, paternal and double orphans were all significantly better off (by 0.65, 0.20, and 0.69 WAZ scores, respectively). In East

Africa, orphans again appeared less malnourished that non orphans, though in this case, findings were insignificant. This remained mostly true even when examined by type of orphan. The only exception was for double orphans, who were determined to be significantly better off than non orphans by 0.29 z-scores. In Southern Africa, differences between orphans and non orphans were insignificant, though it should be noted that the tendency was for orphans to be worse off than non orphans.

Results from adjusted linear regression and probit models showed the same general pattern, despite one or two notable differences (see Table 4). In line with the simple mean comparisons, orphans, in East and West Africa, remained less malnourished, having a predicted underweight prevalence 3 and 11 percentage points lower than non orphans, respectively (p-values= 0.034 and <0.000). Likewise, orphans in Southern Africa remained slightly more malnourished, by approximately 3 percentage points (p-value=0.053). Deviating from previous findings, however, observed differences in Southern and East Africa were significant. When the same analysis was conducted by types of orphans however, observed statistically significant differences only persisted in West Africa (again in the counterintuitive direction).

Tables 3 and 4 show nutritional comparisons taking account of presence of (surviving) parents. In Southern and East Africa, orphans again showed no differences from non orphans, regardless of whether potential confounders were included in the model. In West Africa, on the other hand, orphans again appeared significantly better off. Specifically, maternal orphans living with their father, paternal orphans living with their mother and double orphans were all significantly better off (by 1.25, 0.26 and 0.69 z-scores in the adjusted model respectively). The magnitude of the differences and the overall pattern were similar regardless of whether potential confounders were included in the model.

Table 5 shows differences between orphans and non orphans controlling for the structure of the household (i.e. comparing only single parent households). Again, however a similar pattern to previous comparisons emerged. Orphans in West Africa appeared better off than non orphans while in Southern Africa, the tendency was for them to be worse off. Little difference was seen in East Africa. Father's presence seemed more beneficial than the mother's among orphans in West Africa and among non orphans in Southern Africa (by 12 and 7 percentage points of predicted prevalence respectively). Conversely, mother's presence was more beneficial among non orphans in West Africa and among orphans in Southern Africa (by approximately 7 and 4 percentage points respectively). Which parent was present appeared to have little effect in East Africa.

Effects of age and wealth

Orphans were older (on average) than nonrphans by approximately 8 months. Initial WAZ mean comparisons within country (not taking account of age) showed few differences between orphans and non orphans, though, in the instances where there were differences, the general tendency was for orphans to be more malnourished that non orphans.[1] Removing the effect of age (using GLM and ANCOVAs), however, resulted in any existing differences disappearing and in some cases orphans appearing even slightly less malnourished than non orphans (see Table 6).

[1] Without taking age differences into account, orphans were more malnourished than non orphans in Namibia, Lesotho, and Rwanda.

Current wealth status did not appear to confound nutritional comparisons; however there did appear to be an association between orphan status and wealth. In Southern Africa, households with orphans appeared to be disproportionately in the poorest quintile, while in East and West Africa a larger percent appeared in the wealthiest or at least wealthier quintiles. Findings were largely significant, as shown in Table 7.

DISCUSSION

Scale of the problem

The tragedy of the HIV/AIDS epidemic is often embodied by the children left orphaned and vulnerable. Data from this study indicated that around 12%[2] of children under 17 in the countries surveyed were orphaned, with East and Southern Africa particularly hard hit. Orphan percentage was not strongly associated with estimated HIV prevalence. This is likely due to the natural progression of the HIV epidemic, where the epidemic curve shows that AIDS cases (and thus death from AIDS and resulting orphanhood) will not peak until 5-8 years after HIV infection has peaked [11,1]. In Uganda, for instance, while ante-natal HIV seroprevalence data peaked in the early 1990's and has since declined, the percentage of orphans remains high at 13.4% [12,13]. In Swaziland, on the other hand, the HIV epidemic began 5-10 years later. Here, prevalence is now estimated at 33% and still reported to be increasing, yet the percentage of orphans remains slightly lower than that seen in Uganda at 11.6% [14]. Obviously, the number of orphans is also dependent non HIV related factors, such as war. This is illustrated by the percentage reported in heavily war affected countries like Burundi and Rwanda, where between 19 and 28% (pooling Rwanda DHS 2000 and MICS II 2000 data) of children are orphaned.

With previous studies showing conflicting results, the main objective of this study was to determine: Are orphans consistently more malnourished, when examined cross-sectionally, than non orphans? The answer appears to be that orphans are not, even when taking account of age differentials and wealth. This appeared to be the case in all three regions (East, West and Southern Africa), regardless of which parent died (or both parents died) or whether the surviving parent was in the household. In cases where there were clear differences (i.e. West Africa: Mali, Nigeria, and Sierra Leone), the difference was in a counterintuitive direction with orphans significantly less malnourished than non orphans.

With few nutritional differences emerging (and counterintuitive findings persisting), the question arose as to whether differences were being masked by the variability among both orphan and non orphan households. To test this, similarly structured orphan and non orphan households were compared against one another (i.e. maternal orphans living with their fathers were compared to non orphans living without their mother but with their father). By drawing these comparisons, the hypothesis was that differences between household circumstances would be reduced and that the nutritional impact of orphanhood would be more visible. When examined, however, differences again were insignificant or counterintuitive (in the case of West Africa). Interestingly, in some cases, parent's absence was actually found to have a larger nutritional impact than parents' death. This was true in Southern Africa where a father's absence in this region appeared to have a larger, negative nutritional impact on non orphans than did the death of either parent on orphans.

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[2] This percentage is not weighted.

Effects of age and wealth differentials

The next question was: Are nutritional differences between orphans and non orphans masked by age differentials or differences in wealth status of households with and without orphans? Given that the probability of a parent dying increases with age, orphaned children are typically older on average than non orphans (as they were in this study). As the risks of malnutrition are not uniform throughout childhood, different age distributions between comparison groups are problematic. Very young children are generally protected from malnutrition to a certain extent (because of breastfeeding, etc) but as they grow older nutritional status deteriorates significantly largely initiated by increases in nutritional requirements and greater exposure to the surrounding environment. By two, nutritional status stabilizes and children can experience slight improvements (i.e. catch up growth), though rarely making up for the large deterioration seen when young. Thus, when examined as a group, orphans, being older and lacking representation in the younger, better-off cohorts, are likely to exhibit higher levels of malnutrition than non orphans. Data from this study certainly supported this hypothesis. Without taking age into account, orphans in several countries (i.e. Lesotho, Rwanda, and Malawi) appeared to be more malnourished than non orphans, though these differences largely disappeared when age was taken into account (see Table 6).

Wealth status has recently been found positively associated with HIV affectedness in a multi-country study of DHS data [9]. This association held even when various potential behavioral risk factors, urban/rural status, age, and education were taken into account. The implication of these findings, that the majority of HIV+ people (according to DHS surveys) were from wealthier rather than poorer households, is quite important in the context of the present study. If HIV does indeed affect wealthier households disproportionately, then many orphans, by virtue of being born into wealthier households, are likely to have nutritional advantages prior to orphanhood (better in utero growth, birthweight, etc) that would likely confound future nutritional comparisons. Orphanhood may have negative nutritional consequences but the extent of these consequences is likely mitigated by the nutritional advantages gained in utero and early in life. A study in Tanzania neatly illustrates exactly how SES (prior to orphanhood) could potentially confound nutritional comparisons. In this study, households were classified as “non poor” and “poor” and the nutritional impact of an adult death on “non poor” and “poor” children was assessed. “Non poor” children affected by an adult death did experience significant nutritional deterioration, but they did not deteriorate to such an extent that they were worse off than poorer children living with their parents [5]. Thus, despite orphanhood’s significant nutritional impact, affected children did not deteriorate enough to distinguish themselves from poor non orphans. Given this, the results of the present study are less surprising. If the majority of AIDS orphans come from wealthier households as Mishra et al. suggests and orphanhood causes the nutritional status of wealthier children to deteriorate only to levels seen among poor non orphans, as Ainsworth and Semali suggest, then finding differences between orphans and non orphans when examined cross-sectionally, is likely difficult.

The present study did try to address some of this potential confounding by accounting for present wealth status of orphan and non orphan households. Examined by region, there did appear to be some association between orphanhood and wealth status. In Southern Africa, orphan households appeared slightly more likely to be in the poorer and poorest quintiles, while in East and (especially) West Africa, orphan households appeared slightly more likely to be in the moderate to wealthiest quintiles. Associations with wealth, however, did not significantly confound nutritional comparisons. When included in the multivariate analysis, wealth did not change either the direction of association (in other words, orphans appeared better off with or without wealth included in the model) nor did it substantially change the magnitude of nutritional differences.

Since household wealth status is likely to change in the period after an adult death (due to lost productivity, payment of medical care/ burials, etc), this was not surprising. To fully account for the associations between wealth and HIV in future nutritional assessments of orphans, knowledge of wealth status pre and post orphanhood would be required.

Aside from potential endogeneity associated with wealth, several other weaknesses of this study merit mention. First, cause of parental death was not recorded nor taken into account. Given that HIV affects every facet of life, AIDS-related orphanhood is likely to have a different nutritional impact than orphanhood due to other causes. If so, the inclusion of non AIDS-related orphans in this analysis likely clouded the real nutritional impact of being orphaned due to AIDS. Secondly, it is possible, given the increasing reliance on non traditional fostering patterns, that a significant number of the most vulnerable orphans were unintentionally excluded from these DHS and MICS II household surveys. Then, only the better off orphans (and the least likely to show differences) were included in these comparisons. This appears unlikely, though, as the percent of orphans excluded by household surveys has been studied previously and not found to be a significant [15].

Conclusions

The goal of this study was to assess nutritional differences between orphans and non orphans. After drawing comparisons between various orphan and non orphan categories, no differences emerged, regardless of which parent died, whether the surviving parent was in the household, etc. Age was determined to be confounding nutritional comparisons. Orphans, being older, were more likely to spuriously be considered worse off than non orphans if age differences were not taken into account. This is illustrated quite nicely by within country comparisons. Current wealth status of the household did not appear to be masking results, though wealth status cannot be ruled out as a potential confounder as the wealth of the household prior to orphanhood was not known.

Tables:

Table 1. Observed percentage of orphans in the sample population in relation to estimated HIV/AIDS prevalence

Region	Estimated HIV/ AIDS prevalence*	Percent orphaned	Type of Survey
Southern Africa			
Malawi (2000)	14.1	11.8	DHS
Namibia (2000)	19.6	10.5	DHS
Zambia (2001)	17.0	14.8	DHS
Angola (2000)	3.7	10.8	MICS II
Lesotho (2000)	23.2	15.7	MICS II
Swaziland (2000)	33.4	11.6	MICS II
Zambia (2000)	17.0	15.1	MICS II
Total	**18.3^{+}**	**12.9^{+}**	
West Africa			
Benin (2001)	1.8	6.4	DHS
Ghana (2003)	2.3	6.7	DHS
Mali (2001)	1.7	5.5	DHS
Nigeria (2003)	3.9	6.9	DHS
Equatorial Guinea (2000)	3.2	8.7	MICS II
Gambia (2000)	1.2	5.6	MICS II
Guinea Bissau (2000)	3.8	7.5	MICS II
Niger (2000)	1.1	4.8	MICS II
Sierra Leone (2000)	1.6	12.9	MICS II
Senegal (2000)	0.9	6.1	MICS II
Total	**3.0^{+}**	**7.3^{+}**	
East Africa			
Ethiopia (2000)	4.4	12.3	DHS
Kenya (2003)	6.1	11.0	DHS
Rwanda (2000)	3.1	27.2	DHS
Uganda (2000/01)	6.7	13.4	DHS
Burundi (2000)	3.3	19.2	MICS II
Rwanda (2000)	3.1	11.6	MICS II
Sudan (2000)	2.3**	10.3	MICS II
Total	**4.1^{+}**	**15.0^{+}**	

Note: $^{+}$ denotes unweighted mean prevalence per region; *Source: HIV prevalence: 2006 UNAIDS report; **denotes data from south and north Sudan combined

Table 2. Summary of mean age-adjusted WAZ of orphans and non orphans

	Orphan (N)	Non orphan (N)	P-value
Southern Africa			
Malawi	-1.15 (397)	-1.08 (8332)	--
Namibia	-1.25 (168)	-1.13 (3966)	--
Zambia	-1.26 (291)	-1.31 (5383)	--
Angola	-1.42 (271)	-1.38 (5091)	--
Lesotho	-0.91 (290)	-0.78 (3128)	--
Zambia	-1.40 (188)	-1.24 (3974)	0.071
Swaziland	-0.52 (194)	-0.44 (2976)	--
East Africa			
Ethiopia	-1.43 (149)	-1.55 (4442)	--
Kenya	-0.80 (245)	-0.94 (4950)	0.097
Rwanda [DHS]	-1.21 (600)	-1.16 (5364)	--
Uganda	-1.13 (193)	-1.16 (5301)	--
Rwanda [MICS]	-1.28 (233)	-1.24 (2102)	--
Burundi	-1.96 (217)	-1.84 (2386)	--
Sudan (South)	-1.40 (117)	-1.38 (940)	--
Sudan (North)	-1.67 (346)	-1.66 (19413)	--
West Africa			
Benin	-1.09 (64)	-1.15 (4005)	--
Ghana	-1.10 (69)	-1.10 (3009)	--
Mali	-1.20 (187)	-1.39 (9823)	0.050
Nigeria	-0.70 (78)	-1.23 (4856)	0.001
Equatorial Guinea	-0.63 (137)	-0.74 (2161)	--
Guinea Bissau	-1.16 (157)	-1.14 (5363)	--
Niger	-1.49 (49)	-1.61 (3353)	--
Gambia	-0.88 (43)	-0.94 (2209)	--
Senegal	-1.05 (209)	-1.09 (9112)	--
Sierra Leone	-0.86 (152)	-1.18 (2205)	0.009

Note: N's are weighted; P-values are only shown if <0.1

Table 3. Mean WAZ residuals for orphans and non orphans in Southern, East and West Africa

	Number of children (N's)	Mean WAZ residuals	P-values
Southern Africa			
Non Orphan	36672	0.003	--
Orphan	1908	-0.048	0.075
Maternal Orphan	284	-0.035	--
Paternal Orphan	1493	-0.054	--
Double Orphan	131	0.007	--
Maternal orphan/ father not in HH	149	-0.026	--
Maternal orphan/ father in HH	135	-0.045	--
Paternal orphan/ mother not in HH	172	-0.011	--
Paternal orphan/ mother in HH	1321	-0.060	0.061
East Africa			
Non Orphan	29149	-0.002	--
Orphan	1444	0.036	--
Maternal Orphan	216	0.143	--
Paternal Orphan	1153	-0.00004	--
Double Orphan	74	0.294	0.036
Maternal orphan/ father not in HH	87	0.087	--
Maternal orphan/ father in HH	129	0.180	0.090
Paternal orphan/ mother not in HH	76	0.255	0.066
Paternal orphan/ mother in HH	1077	-0.018	--
West Africa			
Non Orphan	29166	-0.002	--
Orphan	563	0.321	<0.000
Maternal Orphan	118	0.647	<0.000
Paternal Orphan	412	0.199	0.001
Double Orphan	33	[0.686]	0.002
Maternal orphan/ father not in HH	54	-0.050	--
Maternal orphan/ father in HH	64	1.234	<0.000
Paternal orphan/ mother not in HH	60	-0.132	--
Paternal orphan/ mother in HH	353	0.255	<0.000

Note: N's are weighted; P-values are only listed if <0.1

Table 4. WAZ residuals and predicted underweight prevalence for orphans and non orphans in Southern, East and West Africa, adjusted for age and gender of child, urban/ rural status, and current wealth status of household

	Number of children (N's)	Mean WAZ residuals	P-value	Predicted prevalence (probit model)	P-value
Southern Africa					
Non Orphan	33337	0.005	--	25.9	--
Orphan	1675	-0.056	--	28.6	0.053
Maternal Orphan	257	-0.090	--	31.4	--
Paternal Orphan	1303	-0.050	--	27.7	--
Double Orphan	115	-0.052	--	33.0	--
Maternal orphan/ father not in HH	136	-0.055	--	31.5	--
Maternal orphan/ father in HH	121	-0.129	--	32.2	--
Paternal orphan/ mother not in HH	144	-0.039	--	31.4	--
Paternal orphan/ mother in HH	1159	-0.052	--	27.6	--
East Africa					
Non Orphan	24607	0.012	--	30.6	--
Orphan	1265	0.059	--	27.7	0.034
Maternal Orphan	203	0.148	--	27.5	--
Paternal Orphan	996	0.027	--	28.1	-
Double Orphan	66	0.293	--	21.1	--
Maternal orphan/ father not in HH	74	0.115	--	28.6	--

Maternal orphan/ father in HH	129	0.170	--	30.1	--
Paternal orphan/ mother not in HH	64	0.287	--	24.2	--
Paternal orphan/ mother in HH	932	-0.009	--	29.8	--
West Africa					
Non Orphan	24681	-0.004	--	28.9	--
Orphan	422	0.312	0.001	19.0	<0.000
Maternal Orphan	97	0.636	0.020	12.6	<0.000
Paternal Orphan	303	0.195	0.035	21.5	0.033
Double Orphan	22	[0.617]	0.004	[10.4]	0.003
Maternal orphan/ father not in HH	46	-0.096	--	19.3	0.097
Maternal orphan/ father in HH	51	1.29	<0.000	9.5	<0.000
Paternal orphan/ mother not in HH	47	-0.096	--	28.0	--
Paternal orphan/ mother in HH	256	0.268	0.010	21.5	0.054

Note: N's are weighted; P-values are only listed if <0.1

Table 5. Predicted underweight prevalence for orphans and non orphans living with only one parent in Southern, East and West Africa

	Orphan	Non Orphan	Total
Southern Africa			
Father out and mother in	27.3 (1159)	27.3 (6229)	27.3 (7388)
Mother out and father in	31.6 (121)	20.5 (234)	24.3 (355)
Both parents out	32.9 (115)	23.8 (1322)	24.5 (1437)
Total	28.1 (1395)	26.5 (7785)	
East Africa			
Father out and mother in	28.6 (932)	26.8 (3768)	27.0 (4700)
Mother out and father in	27.7 (129)	26.6 (160)	27.2 (289)
Both parents out	21.1 (66)	27.4 (614)	26.8 (680)
Total	28.1 (1127)	26.9 (4542)	
West Africa			
Father out and mother in	20.7 (256)	24.9 (3158)	24.6 (3414)
Mother out and father in	8.7 (51)	31.5 (295)	28.1 (346)
Both parents out	[10.4 (22)]	28.6 (885)	28.2 (907)
Total	18.2 (329)	26.1 (4338)	

Note: N's are weighted; Probit models are adjusted for child age, urban and rural status, gender of child, and current wealth status of household

Table 6. Effect of age adjustment on nutritional comparisons of orphans and non orphans

Mean unadjusted WAZ of orphans and non orphans

East Africa	Orphans	Non orphans	P-value
Ethiopia	-1.52 (153)	-1.54 (4469)	0.894
Kenya	-0.91 (256)	-0.95 (4982)	0.633
Rwanda [DHS]	**-1.31 (645)**	**-1.12 (5739)**	**<0.000**
Uganda	-1.23 (215)	-1.13 (5893)	0.239
Rwanda [MICS]	**-1.40 (248)**	**-1.22 (2238)**	**0.045**
Burundi	**-2.02 (217)**	**-1.83 (2386)**	**0.022**
Sudan (South)	-1.43 (117)	-1.37 (940)	0.699
Sudan (North)	-1.75 (330)	-1.64 (18590)	0.170

Mean age-adjusted WAZ of orphans and non orphans

East Africa	Orphans	Non orphans	P-value
Ethiopia	-1.43 (149)	-1.55 (4442)	0.245
Kenya	-0.80 (245)	-0.94 (4950)	0.097
Rwanda [DHS]	**-1.21 (600)**	**-1.16 (5364)**	**0.351**
Uganda	-1.13 (193)	-1.16 (5301)	0.765
Rwanda [MICS]	**-1.28 (233)**	**-1.24 (2102)**	**0.674**
Burundi	**-1.96 (217)**	**-1.84 (2386)**	**0.126**
Sudan (South)	-1.40 (117)	-1.38 (940)	0.885
Sudan (North)	-1.67 (346)	-1.66 (19413)	0.849

Table 7. Wealth status of household fostering orphans (DHS data only)

	Poorest quintile	Poorer quintile	Middle quintile	Richer quintile	Richest quintile
Southern Africa					
Non orphans	21.2 (3512)	20.3 (3352)	20.7 (3428)	19.3 (3195)	18.5 (3058)
Orphans	25.8 (1318)	18.1 (926)	17.6 (899)	18.8 (963)	19.7 (1010)
East Africa					
Non orphans	22.1 (5386)	17.6 (4292)	17.2 (4201)	17.3 (4217)	25.8 (6295)
Orphans	21.1 (1179)	18.3 (1019)	16.5 (919)	15.8 (880)	28.4 (1583)
West Africa					
Non orphans	20.7 (2608)	20.5 (2579)	19.7 (2479)	19.2 (2418)	19.8 (2496)
Orphans	19.2 (304)	18.3 (290)	23.1 (367)	22.3 (354)	17.0 (270)

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