HOUSEHOLD STRUCTURE AND CHILD HEALTH IN BOTSWANA

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ABSTRACT

Children in low and middle income countries (LMICs) are generally brought up in larger, more diverse households than in higher income countries. Such households are little studied in LMICs, with Botswana providing an interesting case study. New household types are emerging in Botswana in the form of extensive non-marital childbearing and parental cooperation with other household members. This experience has resulted in children being raised in very different household structures.

This study examines the association between household structure and child health in Botswana from a child's perspective. A child's view of the household uses relationships of household members to the reference child to define the household structure. Previous work defined household structure from recasting relationships of household members to the household head.

Two measures of child health assessed are stunting and diarrhoea. Data analysed comes from nationally representative survey: the 2007 Botswana

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Family Health Survey (BFHS). Logistic regression models serve to control for confounding variables associated with child health.

The findings from the multilevel analysis indicate that household structure is crucial to supporting child health for long term illness. Socio-economic status of the household and child's age are both related to stunting and diarrhoeal prevalence. Policy implications of these results are important for improving child health in LMICs. In addition this study demonstrates the importance of defining household structure with regard to safeguarding child health from a child's point of view.

INTRODUCTION

Early child health is important for health in later life. Hence improving child health experiences in developing countries continues to be an important public health goal. Families and households are important social units to attaining this goal. Families and households provide benefits of parental financial and time resources (Thomson and McLanahan, 2012, Thomson et al., 1994, Waldfogel et al., 2010). Families and households also provide a physical place that support childrearing, procreation, consumption and economic production (Simpson, 2012, Van Imhoff et al., 1995, Van de Walle, 2006, Laslett, 1972).

Due to the significance of families and households on human well-being, an increasing number of studies have explored the link between family structure and child well-being, although these have commonly been

undertaken in higher income settings. The studies generally agree that family structure is associated with child well-being, with children raised by single parents having poorer health across a number of outcomes compared to those raised within marriage e.g. (Brown, 2004, Thomson and McLanahan, 2012).

Most of the studies done on the family and child well-being provide a good starting point to understanding the role of the family environment on child well-being, but not enough has been done on household structure and child health outcomes in low income and middle income countries (LMICs). Research indicates that families in LMICs are larger, more complex in terms of membership and functioning; there are multiple family and non-family members. For example an analysis of longitudinal data from South Africa on the importance of grandmothers on child prenatal development notes a complication in the circumstances in which partnerships are important.

Similarly in her study, Sear (2008) notes the potential connection of other family members to child deaths. Sear (2008) states that residing with maternal aunts (affinal kin) only has a protective effect on child survival in marriages where men have more resources, and hence less competition with the aunts and mothers for resources. Both of these studies on households in LMICs don't give details for the kind of support provided, but are useful for starting the debates on household structure and child health in LMICs.

Another justification for an interest in household structure and child health in LMICs lies with the continued high rates of infectious diseases among under-fives in these environments. In general morbidity and mortality rates among infants and children in low and middle income countries have not improved at the desired rate, especially when compared to developed countries. Estimates of pneumonia and diarrhoea among children under five years are highest for sub-Saharan Africa and South Asia, accounting for 95 percent of all deaths that occur each year in the developing world (UNICEF, 2012). Stunting in 2011 was highest in sub-Saharan Africa (40%) and South Asia (39%) (UNICEF, 2012).

Both diarrhoea and stunting have been shown to be associated with poor home environments, though with variations within and between countries (UNICEF, 2012). Thus, in search of answers for improving child morbidity, one concern is that children in low and middle income countries are mostly brought up in larger, more diverse households than in the United Kingdom and the United States. As a result, understanding characteristics of these households remains critical to demonstrating household influence on child health outcomes.

This study constitutes the first step in using more expanded categories of family that take into account household relationships in defining household structure from a child's perspective. Defining the household structure this way links the relationship of the household member to the reference child.

The main research questions addressed are:

1. What types of household structures are observed in 2007?
2. What is the relationship between household structure and child health in 2007?
3. How does the household structure interact with household context to influence child health?
4. How does the household structure interact with maternal factors to influence child health?

DATA AND METHODS

The data examined comes from the 2007 Botswana Family Health Survey. The survey contains information on maternal and child health outcomes as well as data on demographic, socio-economic status, family living conditions and immunization coverage. The sampling design for the survey involved two stages. The first stage of sampling involved a selection of enumeration areas (EA) proportional to the number of households in the EA. The second stage of sampling involved a systematic selection of occupied households from the selected EAs (Republic of Botswana, 2009). Within sampled households, all eligible women (12-49 years) were interviewed, and detailed information collected about their children aged under 5 years.

Dependent variables

Two outcomes are of interest. With regards to health issues over the long term, an indicator is the prevalence of stunting. Children with Z scores less than <-2 standard deviation (SD) below the median on height for age in

comparison to the World Health Organization international reference standard are considered stunted (WHO, 2013, Berger et al., 2007). Stunting is generally agreed to capture the net effects over time of the households, independent of individual characteristics on the child. As noted by Horton (1986), stunting can be explained by measures which reflect past and long-run socio-economic influences.

A clear short term illness is diarrhoea. The indicator used is whether the child, under five years, had diarrhoea with blood in the two weeks preceding the survey and those with diarrhoea in the preceding 24 hours. All the two outcomes are binary; coded for 1 for presence of the illness and 0 for absence of the illness. Logistic multilevel modeling is used in the analysis.

Main explanatory variable of interest

The main independent variable is household structure. In the dataset the relationship of the index child to the head of household was recorded. The head of household was therefore a mother, father, grandparent, aunt, uncle, other relative or household member not related to the index child. In the dataset the relationship of all other members of the household was defined as the household head. However, as the unit of analysis is the child, all these relationships were recast as to the relationship to the child. This is an important and innovative aspect of this study, as it is hypothesised that the relationship of the child to the rest of the members to the household is related to health, rather than the overall household structure ignoring where the individual child sits within that structure.

Control variables

The control variables include household context variables and maternal factors. The household context variables are wealth quintile, residence, and region. Maternal factors include mother's age at the time of the survey, level of education, marital status, and type of woman interviewed. Lastly, both sex and age of the child are included.

Data analysis

The procedures for model selection, assessment, and predictions are discussed for the two child outcomes. Analysis is done in *STATA* and *MLwiN*. A mixed effect model was used (e.g. with both fixed, random and slope effects included). Interactions and contextual variables were also studied. Only the explanatory variables with coefficients which were significantly associated with the outcome in the bivariate analysis done before the multilevel analysis are retained.

RESULTS

Basic characteristics of children and their households

The data has 2822 children from 1949 households which are nested within 298 enumeration areas. Slightly over half of the children (50.1%) are male. The mean age is 28.7 months (SD=16.8).

Child morbidity and household structure

Overall the prevalence of stunting is 29.2 per cent, while 18.0 per cent of children were reported as having suffered from diarrhoea in the two weeks prior to the survey. Table 1 show significant differences in stunting prevalence between children raised in households where the father is the head compared to where the father is not the household head (23.8% versus 30.7%; $p<0.05$). The results on stunting also indicate that children in uncle headed households have poorer health outcome than in households not headed by an uncle (43.1% versus 28.8%; $p<0.05$). The results on diarrhoea prevalence differ significantly among children in households headed by mothers (15.1% versus 18.7%; $p<0.1$), and those headed by an aunt (10.6% versus 18.3%; $p<0.05$). The prevalence of diarrhoea is also more pronounced among children in households headed by other relatives of the child than those not headed by a relative to the child (27.1% versus 17.5%; $p<0.05$).

Table 1: Per cent distribution of outcomes by specific household head, BFHS 2007

Characteristic	Stunted (below -2 SD height/age)		Diarrhoea in the last 24 hours and 2 weeks preceding the survey	
	%	X^2	%	X^2
Mother is head				
Yes	27.8	0.506	15.2	**0.079**
No	29.6		18.7	
Father is head				
Yes	23.8	**0.009**	19.0	0.496
No	30.7		17.7	
Grandparent is head				
Yes	30.3	0.384	18.6	0.464
No	28.4		17.4	
Uncle is head				
Yes	43.1	**0.033**	13.0	0.366
No	28.8		18.1	
Aunt is head				
Yes	35.2	0.266	10.6	**0.034**
No	29.0		18.3	
Ambiguous head				
Yes	60.7	0.132	30.0	0.316
No	29.2		17.9	
Other relative is head				
Yes	31.7	0.627	27.0	**0.011**
No	29.1		17.5	
Head not related to child				
Yes	42.5	0.114	18.7	0.893
No	29.0		17.9	
Total	**29.2**		**18.0**	

Table 2: Per cent distribution of outcomes by household context, maternal factors and child characteristics, BFHS 2007

Characteristic	Stunted (below -2 SD height/age)		Diarrhoea in the last 24 hours and 2 weeks preceding the survey	
	%	X^2	%	X^2
Socio-econ.status				
Poorest	32.9	**0.000**	22.2	**0.000**
Second	33.9		18.2	
Middle	29.2		18.1	
Fourth	23.3		16.9	
Richest	17.6		8.9	
Region				
North	23.5	**0.008**	21.3	**0.048**
South	25.0		16.3	
West	33.2		21.6	
East & North East	29.2		14.3	
Central	32.8		17.4	
Residence				
Rural	31.9	**0.014**	19.1	0.153
Urban	26.6		16.8	
Mother education				
Up to primary level	34.0	**0.008**	19.4	**0.020**
Secondary	27.0		19.0	
Higher	22.4		11.5	
Mother's age				
<20	31.3	0.757	26.9	**0.005**
20-34	29.3		17.8	
35-49	28.0		16.9	
Mother's marital status				
Married	22.1	**0.036**	12.7	**0.008**
Ever married	34.4		12.0	
Non-married	31.4		20.5	
Single	29.9		19.7	
Woman interviewed				
Caretaker	29.7	0.827	16.8	0.382
Mother	29.1		18.4	
Child's age group				
0-5	25.8	**0.000**	16.7	**0.000**
6-11	28.2		28.1	
12-23	46.4		29.1	
24-35	35.7		17.7	
36-47	23.3		9.0	
48-60	15.7		8.3	
Child's sex				
Female	26.9	**0.029**	19.0	0.188
Male	31.6		16.9	
Total	**29.2**		**18.0**	

Table 2 shows that the socio-economic status of the household, region, mother's education, mother's marital status and child age are associated with both stunting and diarrhoea. In addition for stunting, residence, and sex of the child are important for child health. Unlike stunting, diarrhoeal prevalence is also associated with mother's age at the time of the birth of the child. For example the results on both the outcomes indicate that children in poorer households (1^{st}–4^{th} quintiles) have higher disease prevalence than those in rich households (5^{th} quintile).

Explanatory models

Explanatory analysis explores whether the variables at the child level: household structure, household context, and maternal factors have different effects within and between different households (level 2 variables) and enumeration areas (level 3 variable) on the prevalence of stunting, and diarrhoea among children under five years old.

Estimate of parameters for unconditional models

The first step of the analysis examines the null models for the standard logistic regression (survey weights are applied to this model), and null multilevel models for stunting and diarrhoea at level 2 and 3. Table 3 shows that the estimate for the standard logistic model for the proportion of children who are stunted, and have diarrhoea are [exp (-0.884)] =0.41, and [exp(-1.520)] =0.22 respectively. In comparison the odds ratios for the multilevel models at level 2 are 0.34 for stunting, and 0.17 for diarrhoeal infection. For multilevel models at level 2 and level 3 the odd ratios are 0.34,

and 0.17 respectively for the two health conditions. Testing for the null hypothesis that $\sigma^2_{uo}=0$, the test statistic is (11.84, p=0.0003) for stunting, and (11.92, p=0.0003) for diarrhoea. There is strong evidence that the between household variance is not zero and hence conclude that there is variation between households and the use of the multilevel model is appropriate.

Table 3: Coefficient and standard error of intercept logit models and intercept multilevel models for proportion of children who are stunted, and who have diaarhoea,BFHS 2007

Model effect	Standard logit models		Multilevel models(null at level 2)		Multilevel models(null at level 2 & 3)	
	Stunting	DIAR	Stunting	DIAR	Stunting	DIAR
Fixed effect						
Intercept	-0.884	-1.520	-1.072	-1.772	-1.072	-1.777
std.error	0.021	0.012	0.091	0.103	0.095	0.106
Random effect						
Variance of Intercept (level2)			1.066	0.850	0.909	0.689
std.error			0.431	0.322	0.417	0.314
Random effect						
Variance of Intercept (level3)					0.160	0.161
std.error					0.100	0.094
-2logL	-1209.7	-1253.0	-1238.3	-1269.8	-1236.5	-1267.8
AIC	2421.4	2508.1	2480.6	2543.5	2479.1	2541.6
N	2056	2717	2054	2715	2056	2715

Random intercept, contextual and interactions

The second step adds all the level 1 predictors to the unconditional model, and allows the intercept to vary across households (Table 4). The models are labelled for model 1 (with only the household structure variables) and model 2 controls for household structure, household context and maternal factors.

Adding explanatory variables to the random intercept model changes the estimates of the between household variance for both stunting and diarrhoea illnesses. For example, for stunting the value of between household variance changes from 1.066 in the null model to 1.549 (model 2) in the random intercept model with all the predictors. The changes suggest that the distribution of the explanatory variables is difference across households.

Table 4 indicates that the coefficient for the contextual effect of wealth is significant at 5 per cent level for both stunting and diarrhoea. Possible interactions were investigated. The effect of household wealth on the probability of child illness is allowed to vary by whether a household is headed by father and father's headship by mother's education.

Table 4: Random intercept models for stunting and diaarhoea,BFHS 2007

	Stunting						Diarrhoea					
	Model1			Model2			Model1			Model2		
	Coef.	SE.	P value	Coef.	SE.	P value	Coef.	SE.	P value	Coef.	SE.	P value
Fixed part												
Household structure												
mother is household head	-0.590	0.214	**0.006**	-0.650	0.264	**0.014**	-0.233	0.206	0.257	-0.016	0.251	0.949
father is household head	-0.786	0.216	**0.000**	-0.309	0.597	0.604	-0.018	0.199	0.928	-0.628	0.593	0.289
grandparent is household head	-0.438	0.185	**0.018**	-0.748	0.244	**0.002**	-0.006	0.178	0.971	0.140	0.229	0.541
Wealth status (ref=Poorest household)												
Second				0.135	0.215	0.531				-0.061	0.197	0.758
Middle				-0.004	0.248	0.986				-0.122	0.230	0.595
Fourth				-0.550	0.299	0.066				-0.173	0.263	0.511
Richest				-0.806	0.370	**0.029**				-1.127	0.384	**0.003**
Mother's education(ref=Primary)												
Secondary				-0.280	0.192	0.143				-0.165	0.175	0.345
Higher				-0.032	0.346	0.927				-0.565	0.349	0.106
Child age group (ref=0-5 months)												
6-11				-0.103	0.316	0.743				0.891	0.278	**0.001**
12-23				1.022	0.290	**0.000**				0.880	0.260	**0.001**
24-35				0.490	0.271	0.070				0.100	0.259	0.699
36-47				-0.401	0.291	0.168				-0.531	0.283	0.060
48-60				-0.953	0.322	**0.003**				-0.972	0.322	**0.003**
Interactions												
father head* wealth status				0.258	0.169	0.127				0.091	0.159	0.565
father head*mother's education				-0.710	0.353	**0.044**				0.329	0.332	0.322
Intercept	-0.603	0.166	0.000	-0.366	0.351	0.296	-1.721	0.178	0.000	-1.788	0.360	0.000
Random part												
HHId: Identity var(_cons)	1.165	0.459	0.000	1.549	0.690	0.000	0.852	0.325	0.000	1.097	0.511	0.002
Log likelihood			-1230.76			-862.27			-1268.62			-900.84
N			2054			1541			2715			2044

CONCLUSIONS

This study examined the association between household structure and child health in Botswana from a child's perspective. The findings from the multilevel analysis indicate that household structure is crucial to supporting child health for long term illness. Short term illness or diarrhoeal prevalence household is only associated with the socio-economic status of the household, and child's age. The analysis also underscores the importance of understanding household structure and child health from relationships of the household members to the reference child.

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