How important are community characteristics in influencing children's nutritional status? Evidence from Malawi population-based household and community surveys

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A B S T R A C T

Using the 2004 data from the Malawi Integrated Household Survey and the Malawi Community Survey, this study investigates the influence of community characteristics on stunting among children under five years of age in a rural context. Multilevel logistic regression modelling on 4284 children with stunting as the dependent variable shows that availability of daily markets and lineage defined in terms of patrilineal or matrilineal communities were significant community determinants of childhood stunting in Malawi. There were significant differences in socio-economic status between household heads from matrilineal and patrilineal communities. Implementation of strategies that empower communities and households economically such as supporting the establishment of community daily markets and promoting household income generating opportunities can effectively reduce the burden of childhood stunting in Malawi.

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1. Introduction

Child under-nutrition continues to be a major challenge in Malawi even though there have been several government initiatives in place to improve the situation (Malawi-Government, 2009). Current estimates indicate that 47% of Malawian children are stunted and 13% are underweight (Malawi National Statistical Office and ICF-Macro, 2011). Stunting measures chronic inadequacies in nutrition while underweight is a composite measure of short-term and long-term nutritional status. Poor child nutritional status is thought to be implicated in 34% of under-five mortality in Malawi (ORC Macro, 2006), currently estimated at 87 per 1000 live births (WHO, 2010) and in more than 50% of under-five deaths globally (Rice et al., 2000).

Under-nutrition among children is a result of inadequate nutrient intake and illness, and is associated with socio-economic, demographic, maternal, and behavioural factors (Millard, 1994a; UNICEF, 1998; Mosley and Chen, 1984). The shared environment within households and communities is also critically important in influencing child nutritional status (UNICEF, 1998; Millard, 1994b; Mosley and Chen, 1984; Griffiths et al., 2004; Madise et al., 1999). Communities often share common characteristics such as customs, beliefs and values, and may also have common access to resources such as income, transport, markets, schools and health centres. Previous studies have found associations between child nutritional status and the education level of the community (Corsi et al., 2011); economic inequality at the provincial level (Larrea and Kawachi, 2005) and access to clean water and environmental conditions (Pongou et al., 2006).

Studies undertaken in Malawi have found clustering of child under-weight within households and communities (Griffiths et al., 2004; Madise et al., 1999), but variations in the levels of stunting across communities have not been systematically examined. Factors associated with children's nutritional status in Malawi include child's age (Madise and Mpoma, 1997; Madise et al., 1999; Chirwa and Ngalawa, 2008), childhood illnesses (Madise and Mpoma, 1997; Madise et al., 1999; Kazembe and Katundu, 2010; Chirwa and Ngalawa, 2008), urban/rural residence, maternal education status, access to electricity (Madise and Mpoma, 1997) and employment status of female headed households (Chirwa and Ngalawa, 2008). Although stunting and underweight have common bio-behavioural determinants, socio-economic factors have an overarching influence on stunting (Janevic et al., 2010; Hong et al., 2006; Hong and Mishra, 2006; Chirwa and Ngalawa, 2008).

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A systematic understanding of community effects on stunting is critical in Malawi where a substantial proportion of children are undernourished.

One community factor which could influence a child's well-being in Malawi is lineage (whether a community is matrilineal or patrilineal) since this may have an effect on the level of investment in children and women's autonomy (Berge et al., 2013). The Chewa and Nyanjas in the central region and the Yao and the Lomwe of the southern region trace their descendants through the mother (matrilineal) whilst most of the tribes from the northern region trace their descendants through the father (patrilineal). Although there is a strong association between lineage and region of residence, there is some mixing. For example, the Senas in the southern region are the only patrilineal tribe in that region. Some Tongas in the northern region are matrilineal, some Nyanja groups who live on the border between the northern and central regions are patrilineal, and Ngonis in the southern and central region are matrilineal while those who settled in the northern region are patrilineal (Berge et al., 2013; Telalagić, 2012). A typical characteristic of the matrilineal family system is that even after marriage, the woman remains united with her own kin and she has control of her children from her marriage (Phiri, 2009). As a result, women from such communities tend to be more autonomous compared to women from patrilineal communities. Evidence from Ghana and Mozambique, show that higher autonomy for women in the matrilineal family systems is statistically associated with the likelihood of women heading households as well as high divorce rates, when compared to women from patrilineal communities (Takyi and Gyimah, 2007; Arnado, 2004) and higher rates of divorce have been found to significantly decrease the probability of child survival in a Malawian matrilineal community (Sear, 2008). Children in patrilineal societies belong to the father even after marital dissolution. Since male-headed households tend to be wealthier than female-headed households, the patrilineal culture may have a protective effect for child health (Sear, 2008).

The southern region of Malawi has a relatively larger percentage of female headed households (28%) compared to the central region (21.2%) and northern region (19.9%) (NSO-Malawi, 2012). Population representation is greater in the southern (45%) and central (42%) regions compared to the northern region (13%) (NSO-Malawi, 2008). The locations of the capital city in central region and the main commercial city in the southern region attract the movement of people especially from the northern region who are seeking employment opportunities. The northern region also has a smaller land area compared to the central and southern regions.

Another community factor that could contribute to a child's well-being is the existence of facilities such as an Agricultural Development and Marketing Corporation (ADMARC) market, a state-owned enterprise which markets agricultural products in local communities, and/or a daily market. The availability of an ADMARC market in a community not only indicates relatively better access to food but also the ability for such communities to produce surplus food which they might sell directly to the ADMARC market. It is well acknowledged that communities with an ADMARC market tend to have higher household per-capita expenditure when compared to those without an ADMARC market (Kutengule et al., 2013). On the other hand, a daily market may be more profitable than an ADMARC market since communities that have daily markets within proximity may prefer to sell their produce in the daily markets where they can fetch a higher profit than selling to ADMARC markets (Nthara, 2002). Since daily markets are not seasonal, they may serve as consumption smoothing and/or risk insurance especially amongst business owners (Carletto et al., 2007).

The presence of a well-equipped community health facility is essential for primary health care. However, in 2008, only 46% of the population in Malawi had access to a health facility within a radius of 5 km and two-thirds of the vacancies for doctors and nurses were left unfilled (WHO, 2011b). The situation is particularly acute in rural areas (Malawi-Government, 2008). The existence of a health facility within a community in rural Malawi may therefore not warrant better population health for community members.

Access to safe drinking water is another important community characteristic. In rural Malawi, the main improved water sources are a public standpipe (9.8%) and community borehole (59.1%). Only 1.8% have piped water in their households (Malawi National Statistical Office and ICF-Macro, 2011). Access to piped water and toilet facility within a residential area has been significantly associated with lower prevalence of childhood diarrhoea (Woldemicael, 2001; Osumanu, 2007) which is a risk factor for under-nutrition among children (Madise et al., 1999; Weisz et al., 2011). The provision of safe drinking water and good sanitation has been cited as one of the best approaches for dealing with child under-nutrition because they repair the intestinal mucosa (Guerrant et al., 2008). On the other hand, Chirwa and Ngalawa (2008) report some mixed findings on the role of safe water for child nutritional status in Malawi. Their study found that the use of protected or unprotected well water was associated with a higher likelihood of wasting whilst use of unprotected well was associated with a lower likelihood of stunting although this was at a 10% significance level. It is possible that the importance of access to safe drinking water to a child's nutritional status in Malawi is mediated by other factors.

These arguments provide a logical explanation of how the existence of community facilities can make a difference to ensuring better nutritional status for children. More importantly, the provision of such community facilities signifies the level of development, social networks and transportation systems in rural areas. On the other hand, the provision of telephone and postal facilities have become less important with the significant increase in mobile phone coverage across sub-Saharan Africa from 10% in 1999 to 65% in 2008 (Aker and Mbiti, 2010).

This study investigates the influence of community characteristics on stunting among children below age five using the 2004 Malawi Integrated Household Survey and the 2004 Malawi Community Survey data sets. By controlling for child and household characteristics which are closely associated with a child's nutritional status (Millard, 1994b; UNICEF, 1998) and child survival (Mosley and Chen, 1984), this study aims to establish the independent effect of community factors on a child's nutritional status in Malawi. The key research questions addressed in the context of rural Malawi are (i) how does the availability of community infrastructure and services influence child stunting in rural Malawi? And (ii) does the type of lineage defined in terms of matrilineal or patrilineal communities influence child stunting in Malawi? We hypothesise that the odds of stunting are lower amongst children residing in communities having services such as ADMARC market, daily market, protected drinking water sources, health facility, post office and telephone booth than communities without these services. Additionally, we hypothesise that children born in matrilineal communities have higher odds of stunting than those born in patrilineal communities.

2. Methods

2.1. Data

Data from the 2004 Malawi Integrated Household Survey (IHS-2) are merged with data from the 2004 Malawi Community Survey (MCS) to match the household and community level information. The 2004 MCS interviewed the most informed people in the

community such as village headmen or their spouses, headmasters of local schools, agricultural field assistants, religious leaders, local merchants and health workers. The 2004 MCS defined a community in rural areas as a village or a group of villages within a census enumeration area. The villages have boundaries, which are recognised by their inhabitants. The MCS collected data on distance to basic services such as health clinics, availability of medical staff in the clinic, availability of amenities such an ADMARC market, daily market, health facility, post office and telephone booth as well as lineage (whether the community is patrilineal or matrilineal).

The IHS-2 collected the usual variables found in many household surveys including housing characteristics (material used for roofing, walls, and floors), household amenities (source of drinking water, toilet facilities, presence of electricity), demographic characteristics of all household members (age, sex, relationship to household head), anthropometric measurements of children, and information on childhood illness in the two weeks prior to the survey. In addition, the IHS-2 also contains detailed data on household consumption patterns including food and non-food expenditure[3] in the past week, poverty[4], household experience of shocks, participation in nutrition programmes and under-five clinics, and social safety nets. The first stage in the IHS-2 data collection involved selection of enumeration areas for the rural and urban strata on the basis of probability proportional to size based on the enumeration area listing from the 1998 Population and Housing Census. In the second stage, 20 households were randomly selected from each enumeration area, which resulted in a total of 11,280 households eligible for interviews.

Interviews were conducted in 10,777 households which yielded a 96% response rate. Anthropometric data for children aged 6–59 months were collected from 5083 households, out of which 4523 households were from rural areas. The analysis considered data of 5974 children from the rural households. We excluded 1690 children because of missing information such that the final model is based on 4284 children representing 72% of the original sample. The reduced sample is mainly as a result of 25% of cases missing data on toilet facility, water source, qualification of the household head and quality of housing (having a permanent roof or improved floor). Variables on households receiving free maize, household experience of shocks, community facility and lineage (how community trace their descendants) have missing information ranging from 0.03% to 3.03%. We assume that the data missing were missing at random. The correlation coefficients between the dependent variable, height-for-age z-scores, and age of the child and annual household food expenditure for the 25% that have missing values were similar to those of the data without missing covariates. In two groups, with and without missing covariates, the correlation between the dependent variable and child's age was significant and about -0.35, while the corresponding correlation for annual household expenditure was not significant and around 0.03 Sample weights were included to adjust for differences in the final probability of selection at household level. Further details of study design and data collection are reported on the National Statistical Office of Malawi website: http://www.nsomalawi.mw/.

The interviews for the IHS-2 were conducted with household heads. Children's data were provided by their mothers or guardians if the mothers were not present or for orphaned children. The household head was defined as the breadwinner who makes economic decisions within the household. The information on household head was available by sex which made it possible to consider households headed by females. However, the data do not allow a distinction between de jure female-headed households (legal head of the household) and defacto female-headed households (those where a male household head resides elsewhere). The IHS-2 data were collected throughout the year (March 2004–March 2005) enabling the analysis of seasonal (monthly) variations in nutritional outcomes. To ensure comparability, data on food expenditure were standardised by obtaining z-scores on expenditure separately for those interviewed in the harvest and non-harvest seasons. The IHS-2 used the standard UNICEF height board to measure children's heights, whilst a salter scale was used to measure their weights. Other relevant information such as mother's weight, mother's height, child's birth weight or size of child at birth was not available in the datasets.

2.2. Description of variables

Table 1 summarises the socio-economic variables that are explored in this study. At community level, we included the following variables: presence of community facilities (health facility, post office, or telephone booth), categorised as 'none' or 'at least one facility'; presence of an ADMARC market in the community; presence of a daily market; whether or not the community is matrilineal or patrilineal; and the proportion of households in a community where more than 0.73 of households[5] used protected water sources.

Since the objective of the paper was to explore the community factors net of household and individual characteristics, it was important that we controlled for household and individual factors known to be associated with stunting among children. At the household level, the characteristics of the head of household were considered, such as age (mean=38 years), sex (18% are female headed), and highest educational level of the head of the household (11% have junior secondary or higher). Information on the number of children under the age of five years, whether or not the household has a toilet facility, and source of drinking water which was coded as 'protected' (tap water, protected well, hand pump, protected spring) and 'not protected' (for example unprotected well, rivers, streams, lakes) were considered. Other variables included in the analysis were: whether the household benefitted from free maize distribution in the past three years (28.3% received free maize) and whether the household experienced a shock. The composite variable on household's experience of shock is computed using a Principal Component Analysis (PCA) of variables on low crop yield, crop disease, business failure, large fall in sale prices for crops, birth, household dissolution, household member illness and damaged dwelling. Households with a high factor score from the PCA experienced frequent household shocks whilst those with a low factor score experienced a lower incidence of shocks. The first component is used and is categorised into three categories of low, medium and high based on the factor scores.

The variables on whether the household benefitted from free maize distribution in the past three years and whether the household experienced a shock were analysed due to their expected contribution to a household's food availability and economic status respectively. Free maize is often distributed in the hunger months to households that are vulnerable to hunger.

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[3] Annual household food expenditure is the monetary value of what the household consumed in the past 7 days of the interview day in Malawi Kwacha. It includes consumption from own production, purchases, as well as gifts and other sources.

[4] Poor households are those below the poverty line. The poverty line is defined as the expenditure required to meet the minimum calorific requirement for energy needs plus some minimum non-food expenditure.

[5] A cut off of 0.73 was chosen because it divided the sample into two categories with fair proportions worth comparing (31% of the children belong to communities where the proportion of households with access to safe water was more than 0.73 whilst 69% belong to communities where less than 0.73 of the households have access to safe water. It also indicates that the majority of the households in the community have access to safe water.

Table 1
Variables analysed.
Source: IHS-2 data.

Variable	Statistic	Number of children
Community characteristics		
% with no community facility[a]	61.6	5966
% with at least one community facility	38.4	5966
% with an ADMARC market	17.1	5966
% with a daily market	22.3	5966
% of matrilineal communities	72.3	5966
% of households where the proportion with protected water source in a community is more than 0.73	30.4	5966
Household characteristics		
Average age of household head in years	38.0	4449
% of female household heads	17.5	4449
% of households with two or more children below age 5	24.2	5974
% of households with a toilet facility	82.5	4449
% of households with a protected water source	64.8	4449
% of household heads with no education qualification	79.1	4433
% of household heads with primary education only	10.2	4433
% of household heads with junior secondary education[b] or higher	10.8	4433
% of households that are poor[c]	58.1	5974
% of households with no permanent roof and no improved floor	80.5	4436
% of households with either a permanent roof or an improved floor	8.6	4436
% of households with both a permanent roof and an improved floor	10.8	4436
% of households that received free maize in the past three years	28.3	5972
Child characteristics		
Mean age of children in months	32.0	5974
% stunted	50.4	5974
% female children	51.2	5974
% children ill in the past two weeks	41.1	5974
Other characteristics		
Region		
% from Northern region	15.9	5974
% from Central region	40.6	5974
% from Southern region	43.4	5974
Period of interview		
March to August	59.9	5974
September to February	40.1	5974

[a] The Community facilities variable is obtained by combining three variables on availability of a health clinic, post office and a telephone booth.
[b] Those with junior secondary education have only completed two years of secondary school education.
[c] Poor households are those below the poverty line. The poverty line is defined as the expenditure required to meet the minimum calorific requirement for energy needs plus some minimum non-food expenditure.

At national level, the Malawi Vulnerability Assessment Committee and the Crop and Food Supply Assessment Mission of the Food and Agriculture Organisation and the World Food Programme help identify communities that are most in need of food aid whilst district level authorities are involved in the selection of the villages worst affected by hunger (Mathys, 2004). The Village Relief Committees have the responsibility of identifying the poorest of the poor who are given free maize (Mathys, 2004).

At child level, we included age (mean age=32 months), sex (51% were females) and whether or not the child was ill within the last two weeks prior to the survey (41% were ill). Childhood illnesses comprised of diarrhoea, lower respiratory infections, upper respiratory infections, fever, and stomach aches. Our analysis also included region, 15.9% are from the Northern region, 40.6% from the Central region and 43.3% from the Southern region. Since data were collected throughout the year, we also included a time variable (period of interview) to account for differences in food availability and child's health status that may be brought about by the change of seasons, 59.9% of the children are from households interviewed from March to August, whilst 40.1% are from households that were interviewed from September to February.

2.3. Statistical analysis

We computed the height-for-age z scores using the WHO Anthro software version 3.2.2 (WHO, 2011a). Before importing

the height data into Anthro software, heights greater than 150 cm or lower than 38 cm, which constituted less than 0.5% of the total sample were set as missing due to implausibility. The z-scores were computed based on the 2006 WHO growth standards and were all within the range of -6 and 6 in line with the WHO recommendations on plausible range for height-for-age z scores. After checking the assumption of normal distribution for the height-for-age z scores and rejecting this, the dependent variable stunting was coded 1 if a child's height-for-age z-score was less than -2 standard deviations and 0 otherwise.

The statistical analyses were undertaken using STATA statistical package, version 12.1 (Statacorp, 2011), and we took into account the unequal probability of selection by using sampling weights. Chi-square tests were performed to identify variables that were significantly associated with stunting using a P Value cut off point of 0.05. Preliminary analyses given in Table 2 show that there is clustering of children within households and communities, 23% of households have two children under the age of five and the average number of children per community is 123, which suggested the need to account for potential correlation of stunting within households and within communities. We explored further the need for a multilevel model by estimating community and household level variances, and both were significant; 0.102 (standard error 0.033) and 1.63 (standard error 0.27) respectively.

Multilevel logistic regression modelling was performed with child stunting as the dependent variable. The explanatory

Table 2
Distribution of children between households and communities.
Source: IHS-2.

Characteristic	Statistic
% of households with one child	75.7
% households with two children	22.5
% of households with three children	1.7
Average number of children below age five per household	1.53 (0.61)
Average number of children below age five per community	123.04 (86.00)

Note: the figures in the parentheses show standard deviations of the mean.

Table 3
Stunting rates by community characteristics for under-five Malawian children.
Source: IHS-2.

Variable	% Stunted	Chi square P value	N
Availability of community facilities[a]			
No facility	51.5	0.046	3630
At least one facility	48.7		2336
ADMARC			
Yes	46.4	0.01	1046
No	51.3		
Daily market			
Yes	44.4	< 0.001	1373
No	52.2		4601
Lineage (How communities trace their descendants)			
Patrilineal	48.0	0.02	1889
Matrilineal	51.3		3904
Proportion of households with protected water source			
0.73 or less	52.1	< 0.001	4139
More than 0.73	46.6		1835

Chi square test.

[a] Community facilities comprise of a health clinic, a post office and a telephone booth.

variables that were significantly associated with stunting in the bivariate analysis shown in Tables 3 and 4 were entered sequentially in the model, beginning with child characteristics, followed by household characteristics, and then community characteristics which were the main variables of interest. A *P* Value of < 0.05 was used to identify variables that have a significant association with stunting. The final model includes all community variables regardless of whether they were significant or not, whilst for child and household characteristics only significant variables are left in the model with the exception of those that are known to have a relationship with child nutrition. Region of residence is also left in the model as a control variable. We checked if the variances for the household and community levels were still significant after adding the predictor variables. The community level variance remained significant but the household level was no longer significant (variance estimate 1.09 with a standard error of 4.3) and was therefore dropped from the model. In cases where the relationship between an independent variable and the dependent variable is thought to be mediated by another independent variable in the model, the existence of an interaction between the two independent variables was tested.

2.4. Modelling framework

We use the logit link $\log_e(\pi_{ij})/(1 - \pi_{ij})$, a function that models the probability that a child *i* in community *j* is stunted. We fitted a two level random intercept model, with the child as the first level and the community as the second level, since the household level variance became insignificant after the inclusion of household

Table 4
Stunting rates by child, household and location characteristics for under-five Malawian children.
Source: IHS-2.

Variable	% Stunted	Chi square P value	N
Child			
Sex			
Male	53.1	< 0.001	2915
Female	47.9		3509
Child was ill in the last two weeks			
Yes	50.9	0.59	2458
No	50.1		3516
Household			
Has both permanent roof and improved floor	41.8	< 0.001	495
Has at least one of the above	48.5		381
Has none of the above	53.4		3560
Poor	51.4	0.09	3498
Non poor	48.1		2476
Protected water source	49.7	< 0.001	2889
Unprotected water source	55.3		1540
Has a toilet facility	51.0	< 0.05	3684
Does not have any toilet facility	55.1		745
Qualification of household head			
No qualification	53.1	< 0.01	3459
Primary school certificate	49.1		480
Junior secondary school certificate or higher	44.4		494
Received free maize in the past three years[a]			
Yes	53.0	< 0.05	1,727
No	49.4		4,958
Household experience of shocks			
Low	54.1	< 0.05	1,970
Medium	49.4		1,930
High	48.3		1,887
Location			
Region of residence			
Northern	48.7	< 0.001	952
Central	53.8		2,428
Southern	47.8		2,594
Period of interview			
March to August	52.7	< 0.001	3,577
September to February	47.1		2,397

Chi square test.

[a] Free maize is given to the poorest of the poor households as identified by Village Relief Committees.

level variables. The two-level random intercept model for child *i* nested within a community *j* may be represented as follows:

$$\log_e\left(\frac{\pi_{ij}}{1 - \pi_{ij}}\right) = \beta_0 + \beta_1 x_{1ij} + \beta_2 x_{2ij} + \ldots + \beta_8 x_{8ij} + \beta_9 z_{1j} + \ldots \beta_{11} z_{5j} + u_{0j}$$

$$u_{0j} \sim N\left(0, \sigma_{\mu 0}^2\right) \quad (1)$$

where *x* and *z* represent explanatory variables for the probability that child *i* in community *j* is stunted as follows: x_1 to x_8 represent child and household level variables, z_1 to z_5 represent community variables as described in Table 1. β_0 is the overall intercept and β_1 to β_{11} are coefficients for the explanatory variables x_1 to x_8 and z_1 to z_5. U_{0j} is the community-level random effect, which represents the variation of nutrition status for children from different communities and is assumed to be normally distributed with mean equal to 0 and variance equal to $\sigma_{\mu 0}^2$.

3. Results

3.1. Descriptive analysis

Since the age of the child is the single most important variable which explains variation in height-for-age z-scores among children, we examine that relationship first at the same time distinguishing between male and female children. Fig. 1 shows the relationship between stunting and child's age and sex. For both male and female children, the proportion of children stunted increases with age in the first two years of life peaking around the ages of 25–30 months after which there is a decline, illustrating a non-linear relationship between stunting and child's age. The figure also shows that across all age groups, the proportion of children stunted is consistently higher amongst male children compared to female children.

Table 3 presents the results of the bivariate relationship between child stunting and community characteristics. There is a significant association between a child's stunting status and community characteristics such as the proportion of households with access to safe water, the availability of an ADMARC market, the availability a daily market, and lineage. However the P Value of the association between stunting and community facilities is on the borderline (0.046). The relationship between stunting and the community level variables is as what was expected, communities that have at least one facility, have an ADMARC market, have a daily market, where the proportion of households with access to safe water is more than 0.73 and those that are patrilineal have a lower percentage of children that are stunted compared to their counterparts.

Table 4 presents the results of the bivariate relationship between child stunting, and other characteristics. The results show significant association between child stunting and the sex of child, the availability of a toilet facility, the availability of a protected source of water, quality of housing, households benefitting from free maize distribution, household's experience of shocks, region, education qualification of the household head and period of interview. The direction of the relationship between a child's stunting status and all the variables is as expected with the exception of the variables on whether the household received free maize where the likelihood of stunting is higher amongst households that received free maize and on household's experience of shock where the likelihood of stunting is higher amongst households that are less likely to experience a shock. This is possibly because it is the poorest of the poor households that receive free maize and households that
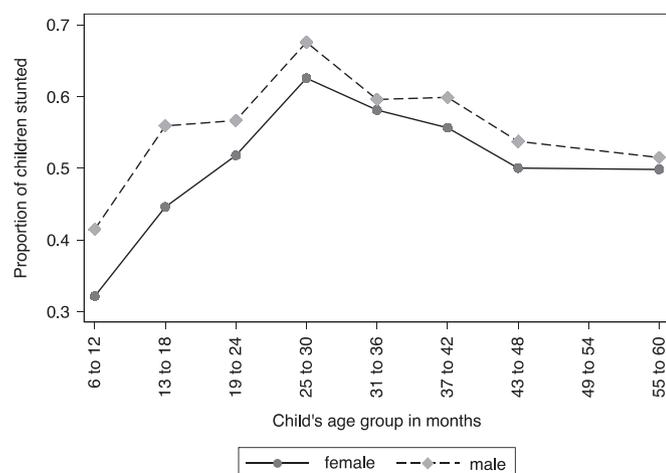
are less likely to experience economic shocks i.e. business failure, large fall in sale prices are those that are extremely poor such that they would not have resources to venture into a business. There was no significant association between a child's stunting status and variables on household poverty status and illness status.

Considering that lineage emerges as a significant community factor in the relationship with stunting, further bivariate analyses were conducted to check the variable's association with socio-economic factors such as the percentage of household heads in the community who were married, those with no formal education qualification, and the mean annual expenditure on food between matrilineal and patrilineal communities. The findings, reported in Table 5, clearly show that household heads from patrilineal communities are more likely to be married, are better educated and have higher mean annual food expenditure compared to those from matrilineal communities. There are more households headed by females in matrilineal communities compared to patrilineal communities but the difference is not statistically significant.

3.2. Regression analysis

3.2.1. Community characteristics

The results of the multilevel logistic regression are presented in Table 6. The findings confirm that net of other factors, the availability of a daily market and lineage are significantly associated with childhood stunting. Children from communities that have a daily market have a 21% lower odds of being stunted compared to children from communities that do not have access to a daily market, children from matrilineal communities have a 22% higher odds of being stunted compared to children from patrilineal communities. The variables on proportion of households with access to safe water, community facilities and ADMARC are not significant in the multivariate analysis.

3.2.2. Household and child characteristics

The quality of housing is a significant influencing factor associated with child stunting. The odds of stunting are 28% lower amongst children living in households with an improved floor and permanent roof compared to those living in households without a permanent roof nor an improved floor. The annual household food expenditure is significantly associated with child stunting; a one unit increase in the household's mean z-score of food expenditure reduces the odds of stunting by 9%. The variable on the education level of the household head was not significant, which suggests the dominant offset effect of food expenditure and household conditions in determining stunting. The variables on whether the household received free maize, household's experience of shock and whether the household has a toilet facility or not were not

Fig. 1. Proportion of children stunted by child's age group.
Source: IHS-2.

Table 5
Differences in socio-economic factors by how communities trace their descendants.
Source: IHS-2.

Variable	Patrilineal	Matrilineal	Chi square P value
% of household heads with no qualification	69.7%	81.9%	< 0.001
Mean z score on annual expenditure on food	0.044	−0.121	< 0.001
% of household heads that are not married[a]	13.1%	16.6%	< 0.01
% of household heads that are female	15.7%	18.1%	0.06

[a] Those not married include the never married, divorced, separated and widowed. This variable should be used with caution since it excludes households with missing information which were 28% amongst those from patrilineal communities and 24% from matrilineal communities.

significant and are not included in the results. The regression results confirm the significance of the association between stunting and a child's age and sex. Female children have 19% lower odds of stunting compared to male children and the likelihood of stunting increases with age but the relationship between child stunting and age is non linear.

3.2.3. Other relevant characteristics

The period of interview is also significantly associated with stunting. Interestingly, children from households interviewed between September and February (non-harvest season) have 18% lower odds of being stunted compared to children from households interviewed in the months of March to August (harvest season). This finding indicates that there are possibly other factors which vary across the seasons which may contribute to higher stunting levels during the harvest time. The region of residence was not significant in the regression analysis.

Table 6
Multivariate analysis results for stunting model.
Source: IHS-2.

Variable	Odds ratio stunting	95% confidence interval
Community characteristics		
Proportion of households with protected		
water source is greater than 0.73	0.83	(0.65,1.01)
Community has a daily market	0.79**	(0.63,0.96)
Community has an ADMARC market	0.90	(0.72,1.09)
Community has at least one community facility[a]	1.05	(0.90,1.20)
Matrilineal	1.22*	(1.04, 1.40)
Household characteristics		
Quality of housing (reference: none)		
Has either a roof or permanent floor	0.82	(0.60,1.04)
Has both roof and permanent floor	0.72**	(0.51,0.94)
Household annual food expenditure	0.91*	(0.83,0.98)
Has protected water source	0.89	(0.75,1.03)
Child characteristics		
Female	0.81**	(0.69,0.94)
Age	1.30***	(1.23,1.37)
Agesquared	0.70***	(0.62,0.77)
Other characterstics		
Period of interview		
September to February:	0.82**	(0.69,0.95)
Region (reference: Northern)		
Central	1.00	(0.76,1.24)
Southern	0.85	(0.60,1.09)

[a] Community facilities are a health clinic, post office and a telephone booth.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$

3.2.4. Random effects

The variance in stunting is significant across communities before and after adding child, household and community variables (Table 7). The addition of child and household level variables reduced the community level variance from 0.102 to 0.069. The community level variance reduced further to 0.063, when the variable on access to daily market is added. Interestingly, the community level variance increased slightly after adding the lineage variable suggesting that controlling for lineage increases the between-community variance in the probability of stunting.

4. Discussion

This study has provided evidence of significant variation in childhood stunting between communities in Malawi. Among the community variables, only the presence of a community daily market is significantly associated with lower odds of being stunted among under-five children, while a large proportion of the community with access to protected water is marginally insignificant. Thus, our first hypothesis is partially confirmed. There are many possible explanations why the presence of a daily market is associated with better nutritional status of children. While we have controlled for household socioeconomic status in the multivariate analysis, the community's socioeconomic status may confer additional effects on the nutritional status of children in that community. An obvious pathway could be through access to higher quality and quantity of food. Secondly, a daily market may offer rural people more dietary diversity over and beyond what they produce in their gardens. This is linked with better nutritional status for mothers (Savy et al., 2006) and children (Arimond and Ruel, 2004). To further explain why a daily market rather than an ADMARC market is more beneficial for children's nutrition status, it should be noted that daily markets can provide weaning foods including milk and eggs while ADMARC markets are predominantly for the bulk sale of surplus food during the harvest season, the purchase of agricultural inputs, or wholesale purchase of food crops. Indeed in Malawi, previous studies have shown that whilst ADMARC facilities have a positive impact on household welfare, the importance of an ADMARC market to household welfare may be diluted by the existence of a local market (Kutengule et al., 2013) and that farmers may prefer to sell their produce in local markets than ADMARC markets because they can fetch a higher price (Nthara, 2002). These arguments therefore, explain why in rural settings, the presence of a community daily market is more important to children's nutritional status than government owned agricultural markets like an ADMARC market.

Community access to safe water is not significantly associated with a child's stunting status. Findings from the study by Chirwa and Ngalawa (2008) conducted in Malawi, reported mixed findings on the association between access to water and a child's nutritional status, however, access to potable water can reduce the likelihood of illnesses such as diarrhoea and therefore lead to

Table 7
Results of the random part of the stunting model at community level.
Source: IHS-2.

Model	Stunting model variance	Standard error	Wald's test statistic Chi square P value
Null model	0.102	0.033	0.002
All variables except community level variables included (model 1)	0.069	0.029	0.02
Model 1+Daily market	0.063	0.028	0.02
Model 1+Lineage	0.079	0.031	0.01
Model 1+Daily market+Lineage	0.070	0.029	0.02

better nutritional status among children (Madise et al., 1999; Checkley et al., 2008; Weisz et al., 2011; Osumanu, 2007; Woldemicael, 2001). The lack of significant association between community access to safe water and child nutritional status therefore could be due to the fact that socio-economic status variables such as household food expenditure and access to a daily market which are taken into account in the modelling have a stronger contribution to a child's nutritional status than community access to safe water but also that households and communities that are better off economically are more likely to have better access to safe water.

A possible explanation for the lack of significant association between childhood stunting and the availability of other community facilities such as a health facility, post office or telephone booth is that some facilities may be of poor quality and therefore their presence does not necessarily confer a benefit for the welfare of children. Health facilities in many rural areas in Africa (and Malawi is no exception) often do not have essential medicines or sufficient staff (WHO, 2011b). Similarly, post offices or telephone booths are often non-operational. In such circumstances, community members may have to travel to distant places where such facilities are available. The expanded coverage of mobile phones in rural areas which are increasingly used for communication services may also explain this finding (Aker and Mbiti, 2010).

This study shows that children born in matrilineal societies are nutritionally disadvantaged than those born in patrilineal societies, thus confirming our second hypothesis. Compared to household heads in patrilineal communities, household heads in matrilineal communities are less educated, have a lower mean annual expenditure on food and are less likely to be married, which shows that on average matrilineal households have a lower socio-economic status compared to patrilineal households. The importance of household socio-economic status in child nutritional status has been widely reported (Hong et al., 2006; Hong and Mishra, 2006; Chirwa and Ngalawa, 2008). Customarily, fathers in matrilineal communities are obliged to provide financial assistance to their sisters' children, which is not the case with fathers from patrilineal communities. This custom could result in lower commitment from fathers in providing financial support to their own children as they expect the maternal uncles of their children to provide support to their children. Fathers in matrilineal societies are less likely to own land as they are expected to farm on their wives' land which is subsequently inherited by the daughters (Sear, 2008; Peters, 2010). According to some writers this custom may make men reluctant to invest effort and money towards the improvement of the land allocated to their families (Phiri, 2009). The economic status of households from matrilineal communities may be further challenged by the fact that women from such communities are mostly likely to be divorced (Arnado, 2004; Takyi and Gyimah, 2007).

Due to data limitation, it was not possible to establish if there are differences in the intra-household and inter-household allocation of resources between households from matrilineal and patrilineal communities. However, the fact that household heads from matrilineal communities are more likely to have no qualifications compared to household heads from patrilineal communities indicates that one contributing factor to the lower socio-economic status of household heads from matrilineal communities could be lower employment opportunities due to lower educational qualifications. In Malawi more men have primary education or higher (39.5%) compared to women (29.3%) (Malawi National Statistical Office and ICF-Macro, 2011) and the results of this study show that there are more female headed households in matrilineal communities compared to patrilineal communities although the difference is not statistically significant.

To turn to other results, the importance of the relationship between stunting and household socio-economic status as measured by the annual household expenditure on food is what we expected. Own food production has been associated with a lower likelihood of stunting in Malawi (Chirwa and Ngalawa, 2008). However, the continuous access to food throughout the year is critical and not necessarily the seasonal variations in food availability. Children are more likely to be stunted in the harvest season (March–August) compared to the lean season (September–February). Although this pattern is unexpected, the findings are in line with studies that report better nutritional status in a wet season compared to dry season (Bechir et al., 2010; Egata et al., 2013) since the harvest season in Malawi is dry whilst the lean season is wet. It is therefore possible that although during the wet season there is less maize (the staple food) and other agricultural produce, the abundance of fruits and vegetables rich in vitamin A and C that naturally grow with the rains could be supporting the nutritional needs of children in Malawi and contributing to the relatively better nutritional status of children during this season. Other studies on seasonality of child nutritional status have shown that busy harvesting times could result in reduced child care (Huffman et al., 1980) which may impact on a child's nutritional status (Mebrahtu et al., 1995) and that seasonal child nutritional status may follow a pattern of seasonal child morbidity and not necessarily seasonal food availability (Ferro-Luzzi et al., 2001; Panter-Brick, 1997; Rowland et al., 1977).

The findings of this study are limited because factors such as mother's weight, mother's height and size of child at birth which are important for explaining variation in child nutritional status were not controlled for in the modelling process because they were not collected during the survey. However, it is unlikely that the inclusion of these variables could have significantly affected the results since in previous studies socio-economic factors have emerged as more important factors for childhood stunting than biological factors (Hong and Mishra, 2006; Janevic et al., 2010). Another limitation is that there are 25% cases with missing household data on toilet facility, access to water, type of roofing, type of floor and qualification of household head. However our assumption that data were missing at random is supported by the results of correlation tests which show that there is no significant difference in the relationship between the outcome variable and covariates such as child's age, and housheold annual expenditure between the group with missing data and that without missing data.

5. Conclusion

We learn from this study that community characteristics such as availability of a daily market and lineage are important determinants of child stunting in Malawi. One important difference between patrilineal and matrilineal communities is that patrilineal communities have higher household annual expenditure on food compared to matrilineal households, and a household's annual expenditure on food is significantly associated with child stunting. To tackle the problem of stunting in Malawi, the Malawi Government should consider implementing strategies that empower communities and households economically, for example through supporting the establishment of community daily markets but also promoting household income generating opportunities. Future studies could investigate differences in the intra-household and inter-household allocation of household resources between matrilineal and patrilineal communities and whether such differences may contribute to the differences in child nutritional status between matrilineal and patrilineal communities in Malawi.

Acknowledgements

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