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Abstract

Background: This study examined the relationships between child, maternal, household, and gender inequality characteristics and child stunting in Kenya and Cambodia. Globally, an estimated 171 million children are stunted, including 167 million in low- and middle-income countries, with especially high prevalence levels in Africa and Asia. Child stunting reflects chronic undernutrition, which often begins before birth and is almost irreversible after the second year of life.

Methods: The study analyzed data from the 2014 Demographic and Health Surveys (DHS surveys) in Kenya and Cambodia for children under age 2. Bivariate and logistic regression analyses were performed to find associations between the variables and child stunting.

Results: The prevalence of stunting among children under age 2 in Kenya was 22%, and in Cambodia, 25%. Child's age, perceived birth size, family wealth status, and region of residence were significantly associated with stunting. In both countries children from the richest households had 0.4 times lower odds of being stunted compared with those from the poorest households. In Kenya alone, female children had 0.6 times lower odds of being stunted compared with male children. In Cambodia alone, children from rural areas had 0.6 times lower odds of being stunted compared with those from urban areas, while children whose mothers were underweight had 1.7 times higher odds of being stunted than children whose mothers were not underweight. In both countries, there was general lack of a strong and significant relationship between gender inequality and child stunting.

Conclusions: Children's characteristics were more important in predicting stunting than factors related to mothers, households, or gender. More extensive analysis of the DHS data should be done to include other aspects of gender inequality, such as decisions on choice and preparation of food and purchase of household goods.

Keywords: stunting, Kenya, Cambodia, gender inequality

1. Introduction

1.1. Background

Globally, an estimated 171 million children are stunted, including 167 million children in low- and middle-income countries (Black et al. 2013; de Onis, Blössner, and Borghi 2012). Stunting is defined as having a height-for-age *Z*-score (HAZ) that is more than two standard deviations below the age–sex median for a well-nourished reference population. Stunting has remained widespread in low- and middle-income countries (Hoddinott et al. 2013), with the majority of stunted children living in Asia and sub-Saharan Africa (de Onis et al. 2012). The factors underlying this high prevalence of malnutrition include low birth weight, maternal health problems, poor child care related to dynamics within the family, and inequality between men and women (Ramalingaswami, Jonsson, and Rohde 1997)

Globally, the percentage of children under age 5 who are stunted has decreased, from 40% in 1990 to 28% in 2010, with an anticipated further drop to 22% (142 million) by 2020 (de Onis et al. 2012). In Africa, however, prevalence of stunting among children under age 5 was 36% compared with 27% in Asia, estimated in 2011. It is projected that by 2020, Asia and Africa will have almost similar numbers of stunted children (68 million and 60 million, respectively). These levels are much higher than the number of children stunted in Latin America, at 7 million in 2010 (de Onis, Blössner, and Borghi 2012).

The higher prevalence of child stunting in Africa and Asia is a public health problem that has often gone unrecognized. Child stunting reflects a failure to receive adequate nutrition over a long period of time and may be affected by intrauterine growth retardation, poor feeding practices, and frequent exposure to infections (Long and Mulatu 2013). When stunting spans generations, it results in grave consequences that include poor quality of life, morbidity, and mortality (Black et al. 2013; Shroff et al. 2009).

The 2014 Demographic and Health Surveys (DHS surveys) for Kenya and Cambodia showed that the prevalence of stunting among children under age 2 was 22% and 25% respectively. The prevalence of stunting in children under age 5 in Kenya and Cambodia was higher, at 32% and 26% respectively (National Institute of Statistics et al. 2015; KDHS 2014). A focus on stunting prevalence in the under-5 age group as a whole masks the early onset of stunting among children; the key "window of opportunity" for reducing stunting is the first 1,000 days of life, from conception until age 2 (Victora et al. 2010). The greatest potential for reducing child stunting is intervention under age 2. The benefit is greatest if nutrition and health interventions focus on the first 1,000 days (Ruel and Alderman 2013). So far, however, the nutritional interventions made during this crucial time have had a modest impact on child stunting and growth (Bhutta et al. 2013).

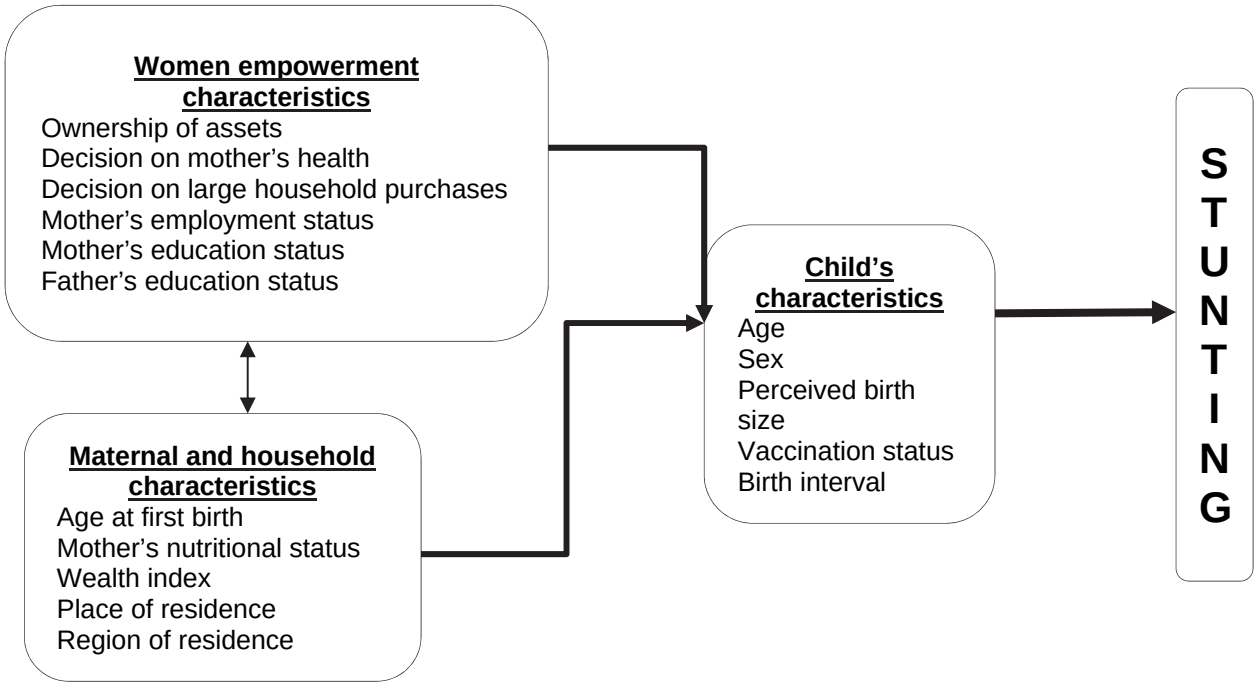
A number of studies have identified risk factors for stunting in this crucial period (Semba et al. 2016). Researchers have found that poverty, poor health and nutrition, and social factors are associated with risks to child growth. These factors have prevented over 200 million children in developing countries from attaining their full potential (Walker et al. 2007). A 2006 UNICEF report found a link between children's nutritional status and women's decision-making power. In developing countries, where mostly women are denied a voice in household decisions, they are most likely to be undernourished themselves and less likely to have access to resources that can be directed toward children's nutrition (UNICEF 2006). Therefore, women should be given a chance to participate in household decisions, which might also have a positive impact on the nutritional status of their children (Ramalingaswami, Jonsson, and Rohde 1997). There is a need to investigate maternal and gender factors that could be associated with child stunting.

International goals to reduce stunting (Alkire and Samman 2014; de Onis et al. 2013) cannot be achieved if factors specific to stunting in children under age 2 are ignored. The World Health Assembly aims to reduce the level of child stunting in the world by 40% by 2025 (World Health Organization 2012). Because sub-Saharan Africa has the highest share of child stunting in the world, followed by Asia, there is a need to investigate the factors associated with the high prevalence of child stunting in these regions.

Reduction in child stunting is a key indicator for achievement of Sustainable Development Goal Number 2 (Murray 2015) and is considered a good indicator of chronic malnutrition that is associated with inadequate nutrition and infectious disease (Richard et al. 2012). If malnutrition is addressed before age 24 months, accelerated growth can occur and the original height trajectory can be achieved (Van IJzendoorn, Bakermans-Kranenburg, and Juffer 2007).

This study therefore investigated the maternal, household, and gender factors that are associated with stunting among children under age 2 in Kenya and Cambodia, using data from the 2014 DHS survey in each country.

Conceptual Framework



1.2. Research Questions

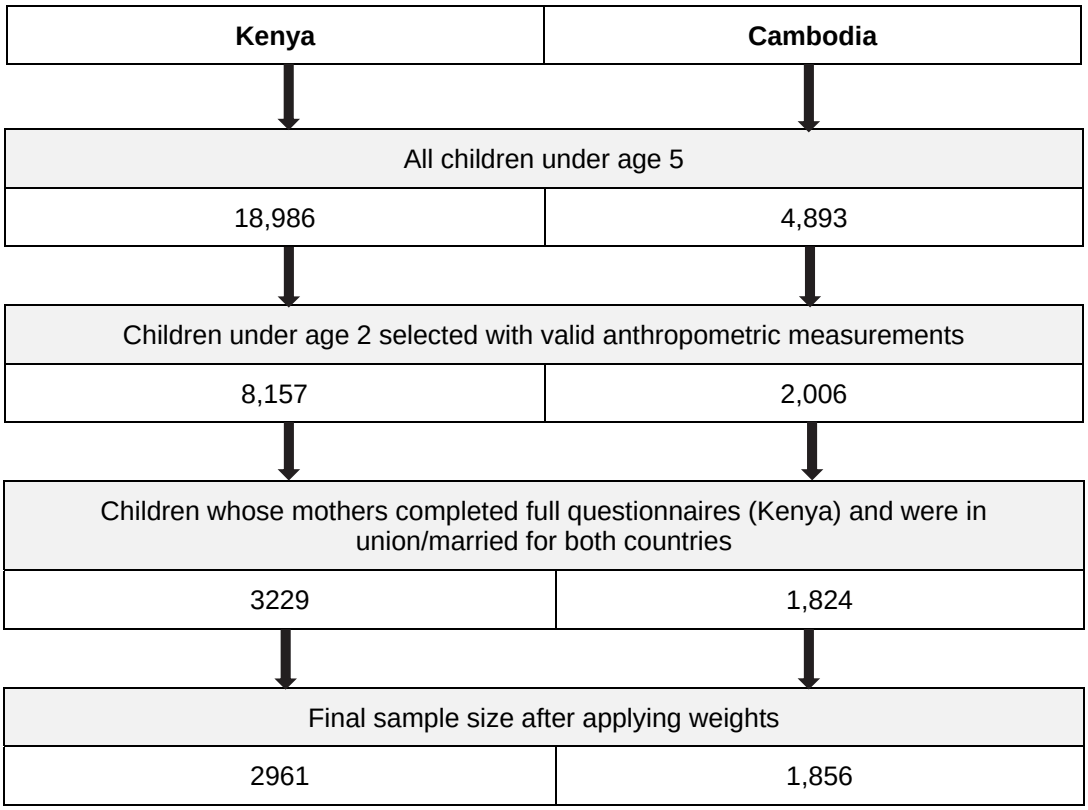
1. Are factors associated with stunting in children under age 2 different for Kenya compared with Cambodia?
2. To what extent are gender inequalities in Kenya and Cambodia a significant factor for stunting in children under age 2?

2. Data and Methods

The study used data from the 2014 Kenya and Cambodia DHS surveys. The 2014 Kenya DHS contained both a long and short questionnaire. For this analysis, the data for Kenya were all from the long questionnaire, which included many variables used in the analysis (namely the gender inequality variables, father's education level, perceived birth size, and mother's nutritional status). DHS data are cross-sectional in nature, and data about children are obtained from their mothers.

Our study specifically examined stunting among children under age 2 and its association with child, maternal, household, and gender factors. The sample size was limited to children under age 2 with valid anthropometric measurements and whose parents were married and or declared that they were in a union. Information that is collected only from women in union in the surveys is required to construct gender variables. In addition, when constructing the mother's nutritional status variable, pregnant women and women with a child under age 2 months were coded as missing. This created 325 missing cases for this variable in Kenya and 202 in Cambodia. Figure 1 shows the procedure for sample size determination.

Figure 1. Analysis of sample derivation



2.1. Dependent Variable

Stunting: The 2014 Kenya and Cambodia DHS measured stunting by height-for-age according to WHO recommendations (WHO 2006). To increase data quality and minimize errors, the field staff were thoroughly trained and a pilot study was done prior to the main survey. Height-for-age, Z-scores were tabulated. A Z-score less than -2 standard deviations (SD) for height-for-age indicated stunting based on the WHO/National Center for Health Statistics reference (WHO 2006). A binary variable was created to define stunting, "not stunted" (Z-score greater than -2 SD), and "stunted" (Z- score less than and equal to -2 SD).

2.2. Independent Variables

2.2.1. Child characteristics

The child variables included children's age in months (0-24 months), sex, perceived birth size by the mother (small, average and large), and the birth interval between the current child of interest and the previous birth, counting twins as one and giving an interval of zero for first births. Vaccination status was used to measure whether the child had received all the necessary DPT, measles, polio, and BCG vaccinations at the time of the survey. The perceived size of the child at birth was used instead of the actual size at birth, as there were a large number of missing responses from mothers who were asked the exact weight of their child at birth.

2.2.2. Maternal and household characteristics

The maternal variables included mother's age at first birth, mother's nutritional status, which was based on body mass index (BMI), defined as weight in kilograms divided by the height squared in meters (W/H^2). Women who were pregnant and women with a child under age 2 months were excluded from the BMI calculation. The BMI was then used to identify mothers as either underweight (BMI less than 18.5) or not.

The household variables included wealth index, place of residence (urban-rural), and region.

2.2.3. Gender inequality characteristics

Decisions on the mother's healthcare: In the survey, women were asked if they make decisions about their own health alone or jointly with their husbands or partners. Women's responses that they made decisions alone or jointly with their husbands or partners were categorized as yes, while responses that the husbands, partners, or others made the decisions were categorized as no.

Ownership of assets: Women were asked if they owned any land or a house. If they owned property alone or jointly with their husbands or partners, we categorized this as yes, but if their husbands or partners owned such assets alone, we categorized it as no.

Mother's work status: Women were asked if they ever worked in the last 12 months. Those who reported not working were categorized as no, and those worked in the past 12 months or were currently working or on leave from work were categorized as yes.

Education level: This category, for both women and men, was defined as the highest education level attended: no education, primary, secondary, and higher. The categories of secondary and higher were combined to create a category of secondary and above.

2.3. Statistical Analysis

Statistical analyses were carried out using STATA 14. The datasets for households and women were used and the "sample weight" variable was used to adjust for disproportionate sampling and nonresponse. Two-stage sampling design was used, where clusters were selected first and then the households to be interviewed were chosen. Univariate analysis was performed to describe all the variables (Table 1). Bivariate analysis with Chi-square statistics was performed to test the independence of distribution between the independent variables and the dependent variable (Table 2), and a final logistic regression was done to assess the net associations of all variables with stunting. Three models were generated—(1) a model with child characteristics only; (2) a model with child, maternal, and household characteristics; and (3) a model with the all of the characteristics, including gender inequality variables (Table 3). The associations between the outcome and main explanatory variables were considered to be statistically significant when the p-value <0.05.

3. Results

The final sample size for Kenya was 2,961 women and for Cambodia 1,856 women who were interviewed in the 2014 DHS, had children under age 2, and were in a union at the time of the survey. Table 1 presents the descriptive statistics of the child, maternal, household, and gender inequality variables. The prevalence of stunting among children under age 2 was 22% in Kenya and 25% in Cambodia. In Kenya, 50% of the children were male, with a majority age 18-24 months (28%), compared with 52% of males in Cambodia, with 29% age 18-24 months. According to their mothers' perceptions, 57% of children in Kenya and 55% in Cambodia were born with average size.

An estimated 62% of Kenyan mothers and 69% of Cambodian mothers reported giving birth to their first child at age 18-24. The great majority of mothers were not underweight (Kenya 90% and Cambodia 86%). In both countries, almost a quarter of children were from households in the poorest wealth category. In addition, 64% of Kenyan children and 86% of Cambodian children lived in rural areas.

In both countries most women responded in the DHS that they had a say in decisions on their own health care, at 76% in Kenya and 91% in Cambodia. In Cambodia, 92% of women were involved in the purchase of large household items compared with 66% in Kenya. Concerning ownership of property, in Kenya 60% of women reported owning a house and 53% owned land, while in Cambodia 63% owned a house and 55% owned land. Both countries had similar percentages for women who were working, at 64%, and the level of education attained was also similar, with primary highest at 54%. Forty percent of the fathers in Kenya and 46% in Cambodia had secondary and above as the highest level of education.

Table 1. Descriptive characteristics of the sample in Kenya and Cambodia, 2014 DHS

	KENYA			CAMBODIA		
Variable	**%**	**CI**	**N**	**%**	**CI**	**N**
Nutritional status						
Not stunted	77.9	[75.8,80.0]	2,308	75.5	[73.0,77.9]	1,402
Stunted	22.1	[20.0,24.2]	653	24.5	[22.1,27.0]	454
Age of child						
Under 6 months	25.5	[23.4,27.6]	772	28.3	[25.8,30.9]	552
6-8 months	8.7	[7.4,10.1]	263	8.1	[6.6,10.0]	159
9-11 months	12.4	[11.0,13.9]	374	11.4	[9.7,13.4]	223
12-17 months	26.0	[23.8,28.4]	789	23.1	[20.8,25.6]	451
18-24 months	27.5	[25.5,29.5]	833	29.1	[26.7,31.6]	567
Child's birth size						
Small	16.2	[14.5,18.0]	485	10.8	[9.0,12.9]	209
Average	57.4	[54.9,59.8]	1,722	54.8	[51.7,57.8]	1,062
Large	26.5	[24.4,28.6]	794	34.4	[31.5,37.4]	667
Birth interval						
<24	32.5	[30.4,34.7]	985	8.4	[6.9,10.1]	164
24-47	40.0	[37.7,42.5]	1,214	24.4	[22.0,27.0]	477
47+	27.5	[25.4,29.7]	833	67.2	[64.3,69.9]	1,311
Received all required vaccinations (DPT, polio, BCG, and measles)						
Yes	58.4	[56.1,60.8]	1,771	56.4	[53.4,59.4]	1,101
No	41.6	[39.2,43.9]	1,260	43.6	[40.6,46.6]	851
Sex of child						
Male	50.5	[48.1,52.9]	1,531	52.4	[49.2,55.5]	1,022
Female	49.5	[47.1,51.9]	1,500	47.6	[44.5,50.8]	930
Mother's nutritional status						
Not underweight	90.9	[89.5,92.1]	2,459	85.9	[83.6,87.9]	1,503
Underweight	9.1	[7.9,10.5]	246	14.1	[12.1,16.4]	247
Mother's age at 1st birth						
<18	29.4	[27.3,31.6]	891	8.4	[7.0,10.1]	164
18-24	61.5	[59.2,63.8]	1,865	68.9	[66.3,71.5]	1,346
25+	9.1	[7.8,10.6]	275	22.6	[20.2,25.2]	442
Wealth index						
Poorest	25.5	[23.1,28.1]	773	24.7	[21.3,28.3]	481
Poorer	19.8	[18.0,21.8]	601	19.6	[17.3,22.2]	383
Middle	16.8	[15.2,18.6]	511	20.1	[17.7,22.8]	393
Richer	17.1	[15.1,19.3]	517	17.6	[15.2,20.3]	344
Richest	20.8	[18.2,23.5]	629	18.0	[15.6,20.6]	351
Region, Kenya						
Coast	10.3	[8.7,12.2]	313			
North Eastern	3.8	[3.1,4.8]	116			
Eastern	12.1	[10.6,13.8]	368			
Central	9.2	[7.8,10.9]	279			
Rift Valley	29.2	[27.0,31.6]	886			
Western	11.9	[10.0,14.1]	360			
Nyanza	13.3	[11.8,14.9]	403			
Nairobi	10.1	[8.3,12.3]	307			

(Continued…)

Table 1—*Continued*

Variable	KENYA %	KENYA CI	KENYA N	CAMBODIA %	CAMBODIA CI	CAMBODIA N
Region, Cambodia						
Banteay mean chey				3.8	[2.8,5.0]	74
Kampong cham				12.8	[10.6,15.5]	250
Kampong chhnang				3.8	[3.2,4.5]	74
Kampong speu				6.8	[5.1,8.9]	132
Kampong thom				4.8	[4.0,5.9]	95
Kandal				6.8	[5.4,8.5]	132
Kratie				3.9	[2.6,5.7]	76
Phnom Penh				8.4	[6.8,10.3]	164
Prey Veng				6.9	[5.6,8.3]	134
Pursat				4.4	[3.3,5.9]	86
Siem Reap				6.8	[5.4,8.5]	133
Svay Rieng				3.8	[3.1,4.7]	75
Takeo				5.4	[4.4,6.6]	106
Otdar Mean Chey				2.0	[1.6,2.4]	38
Battambang & Pailin				7.7	[5.3,11.2]	151
Kampot & Kep				4.3	[3.5,5.1]	83
Preah Sihanouk & Kaoh Kong				2.1	[1.7,2.6]	40
Preah Vihear & Steung Treng				3.0	[2.3,4.0]	59
Mondol Kiri & Rattanak Kiri				2.6	[2.0,3.3]	51
Type of place of residence						
Urban	36.0	[33.4,38.6]	1,090	13.9	[12.2,15.7]	271
Rural	64.0	[61.4,66.6]	1,941	86.1	[84.3,87.8]	1,680
Mother decides on own healthcare (alone or jointly)						
No	24.8	[22.8,27.0]	752	9.4	[7.8,11.4]	184
Yes	75.2	[73.0,77.2]	2,276	90.6	[88.6,92.2]	1,767
Mother decides on household large purchases (alone or jointly)						
No	34.0	[31.4,36.7]	1,029	8.5	[7.0,10.3]	167
Yes	66.0	[63.3,68.6]	1,998	91.5	[89.7,93.0]	1,784
Mother owns house (alone or jointly)						
No	39.9	[37.0,42.7]	1,206	37.3	[34.4,40.3]	728
Yes	60.1	[57.3,63.0]	1,820	62.7	[59.7,65.6]	1,224
Mother owns land (alone or jointly)						
No	46.6	[44.0,49.3]	1,411	45.4	[42.2,48.6]	886
Yes	53.4	[50.7,56.0]	1,616	54.6	[51.4,57.8]	1,066
Mother worked in the past 12 months						
No	36.5	[34.0,39.0]	1,106	35	[31.6,38.5]	683
Yes	63.5	[61.0,66.0]	1,925	65	[61.5,68.4]	1,269
Mother's education						
No education	13.3	[11.6,15.4]	405	12.6	[10.6,14.8]	245
Primary	54.0	[51.1,56.8]	1,635	53.9	[50.9,56.9]	1,053
Secondary +	32.7	[30.0,35.5]	991	33.5	[30.6,36.5]	653
Father's education						
No education	9.8	[8.4,11.5]	296	9.8	[7.9,12.2]	191
Primary	50.6	[48.0,53.1]	1,524	44.1	[41.2,47.1]	856
Secondary +	39.6	[37.1,42.2]	1,194	46.1	[43.0,49.2]	894

Table 2 shows the results of bivariate analysis on the association between background characteristics of the sample and child stunting. In both Kenya and Cambodia the factors associated with stunting were child's age, perceived birth size, vaccination status, place of residence, father's highest education attained, and wealth index. The following factors were significant in Kenya alone: child's birth interval, sex of the child, mother's age, and mother's highest education attained. In Cambodia alone significant factors included region and mother's ownership of a house. The associations between the variables and stunting were considered to be statistically significant when P <0.05.

Table 2. Percentage of children under age 2 who were stunted by child, maternal, household, and gender variables in Kenya and Cambodia, 2014 DHS

	KENYA			CAMBODIA		
	Stunted			Stunted		
Variable	**%**	**CI**	**p-value**	**%**	**CI**	**p-value**
Age of child						
Under 6 months	9.9	[7.7,12.7]	<0.001	15.2	[11.4,20.0]	<0.001
6-8 months	11.6	[7.7,17.1]		15.3	[9.0,24.7]	
9-11 months	16.2	[12.1,21.2]		18.0	[12.5,25.2]	
12-17 months	28.8	[24.6,33.2]		29.4	[24.1,35.2]	
18-24 months	32.6	[28.5,36.9]		33.9	[29.0,39.2]	
Child's birth size						
Small	34.3	[28.5,40.5]	<0.001	45.0	[36.5,53.8]	<0.001
Average	20.8	[18.4,23.5]		24.6	[21.4,28.1]	
Large	17.2	[13.9,21.0]		17.7	[14.3,21.6]	
Birth interval						
<24	24.2	[20.8,27.9]	0.006	28.5	[20.9,37.6]	0.149
24-47	23.9	[20.9,27.1]		27.8	[23.1,33.1]	
47+	16.9	[13.6,20.8]		22.8	[19.7,26.1]	
Received all required vaccinations (DPT, polio, BCG, and measles)						
Yes	19.7	[17.3,22.3]	0.002	22.0	[18.8,25.5]	0.024
No	25.4	[22.4,28.7]		27.6	[24.2,31.2]	
Sex of child						
Male	25.0	[22.1,28.2]	<0.001	26.5	[23.3,29.9]	0.057
Female	19.1	[16.7,21.7]		22.2	[19.1,25.7]	
Nutritional status						
Not underweight	21.7	[19.5,24.1]	0.509	23.1	[20.4,26.1]	<0.001
Underweight	23.6	[18.8,29.2]		37.0	[29.6,45.0]	
Mothers age at 1st birth						
<18	27.3	[23.7,31.4]	0.001	22.2	[15.0,31.4]	0.407
18-24	20.4	[18.0,23.1]		25.6	[22.8,28.6]	
25+	15.9	[11.1,22.2]		21.9	[17.2,27.3]	
Wealth index						
Poorest	29.2	[25.8,32.7]	<0.001	35.5	[30.3,41.2]	<0.001
Poorer	24.6	[20.6,29.2]		26.7	[21.8,32.3]	
Middle	17.8	[14.3,22.0]		23.5	[18.4,29.5]	
Richer	21.4	[16.8,27.0]		18.7	[14.0,24.6]	
Richest	15.0	[10.2,21.5]		13.8	[9.9,18.9]	

(Continued…)

Table 2—*Continued*

	KENYA			CAMBODIA		
	Stunted			Stunted		
Variable	**%**	**CI**	**p-value**	**%**	**CI**	**p-value**
Type of place of residence						
Urban	18.2	[14.7,22.3]	0.014	18.8	[14.8,23.7]	0.02
Rural	24.2	[21.8,26.8]		25.4	[22.7,28.2]	
Mother decides on own health care (alone or jointly)						
No	22.7	[19.1,26.7]	0.7	20.9	[14.6,28.9]	0.324
Yes	21.9	[19.6,24.3]		24.8	[22.4,27.5]	
Mother decides on household large purchases (alone or jointly)						
No	21.2	[18.0,24.8]	0.565	18.9	[12.8,27.1]	0.144
Yes	22.5	[19.9,25.3]		25.0	[22.5,27.6]	
Mother owns house (alone or jointly)						
No	20.4	[16.8,24.5]	0.223	20.6	[17.2,24.4]	0.011
Yes	23.2	[21.0,25.7]		26.8	[23.8,30.1]	
Mother owns land (alone or jointly)						
No	21.7	[18.4,25.3]	0.2574	22.5	[18.9,26.4]	0.16
Yes	22.4	[20.0,25.0]		26.1	[23.0,29.6]	
Mother worked in the past 12 months						
No	23.5	[20.1,27.3]	0.29	23.1	[19.5,27.1]	0.365
Yes	21.2	[18.9,23.8]		25.2	[22.4,28.2]	
Mother's education						
No education	26.0	[21.3,31.2]	0.005	29.1	[22.1,37.4]	0.064
Primary	24.1	[21.5,27.0]		25.8	[22.5,29.4]	
Secondary +	17.2	[13.6,21.4]		20.6	[17.1,24.5]	
Father's education						
No education	26.0	[20.6,32.2]	0.001	34.0	[25.2,44.0]	0.048
Primary	24.9	[22.2,27.9]		24.1	[20.4,28.3]	
Secondary +	17.5	[14.3,21.2]		22.3	[19.2,25.8]	

*** p<0.001, ** p<0.01, * p<0.05

Table 3 summarizes the results of the three logistic regression models to assess the net association of all variables with stunting. As mentioned, the first model included child characteristics only, the second included child, maternal, and household characteristics, and the third contained all of the characteristics, including gender inequality variables. Before running the regression, the correlations between the independent variables used in the analysis were checked, and none of the variables were highly correlated.

In the first model, the child characteristics that were significantly associated with stunting for both countries were age, sex, and perceived birth size, and for Kenya alone, birth interval. In Kenya, children age 18-24 months had 5.6 times higher odds of being stunted compared with children under age 6 months [OR= 5.6; CI 3.6,8.7], and in Cambodia, 3.8 times higher odds [OR 3.8; CI 2.3,6.2]. Children with average perceived birth size had 0.5 and 0.4 times lower odds, for Kenya and Cambodia respectively, of being stunted compared with children whose mothers perceived

them to be small at birth [OR = 0.5; CI 0.3, 0.6 for Kenya, and OR = 0.4; CI 0.3, 0.6 for Cambodia]. Female children had lower odds of being stunted compared with male children [OR = 0.6; CI 0.5, 0.8 for Kenya and OR = 0.8; CI 0.6, 1.0 for Cambodia]. In Kenya, children whose birth was followed by a subsequent birth more than 47 months later had 0.6 times lower odds of being stunted compared with children with a subsequent birth interval of less than 24 months.

In the second model, the variables for child, maternal, and household characteristics that were significantly associated with stunting in both countries included child's age, perceived birth size, wealth index, and region of residence. For the child characteristics that remained significant in the second model, the odds ratios did not change substantially from the first model. In the second model child's sex was no longer significant in Cambodia, and child's birth interval was not significant in either country. In Kenya alone, child's sex was significant for predicting stunting, and in Cambodia alone the significant variables were mother's nutritional status and child's place of residence. In both countries, children in the richest households had 0.4 times lower odds of being stunted compared with children in the poorest households [Kenya OR 0.4; CI 0.2-0.7 and Cambodia OR 0.4; CI 0.2-0.8]. In Cambodia alone, children in rural areas had 0.6 times lower odds of being stunted compared with children in urban areas [OR 0.6; CI 0.4-0.9], while children whose mothers were underweight had 1.7 times higher odds of being stunted compared with children whose mothers were not underweight [OR 1.7; CI 1.1-2.7]

In the third model, which included all child, maternal, household, and gender characteristics, none of the gender inequality variables were significantly associated with child stunting, for both countries. Child's age, perceived birth size, household wealth status, and region of residence showed some significance, with stunting in both countries, while child's sex was significant in Kenya alone, and mother's nutritional status and child's place of residence were significant in Cambodia alone.

Table 3. Results of logistic regressions of child stunting on child, maternal, household, and gender variables in Kenya and Cambodia, 2014 DHS

	MODEL 1				MODEL 2				MODEL 3			
	KENYA		CAMBODIA		KENYA		CAMBODIA		KENYA		CAMBODIA	
Characteristics	**OR**	**CI**	**OR**	**CI**	**OR**	**CI**	**OR**	**CI**	**OR**	**CI**	**OR**	CI
Age of child												
Under 6 months	1.0		1.0		1.0		1.0		1.0		1.0	
6-8 months	1.1	0.6 - 1.9	1.0	0.5 - 1.9	1.2	0.7 - 2.0	0.9	0.5 - 1.6	1.1	0.6 - 2.0	0.8	0.5 - 1.5
9-11 months	2.0**	1.3 - 3.2	1.4	0.8 - 2.5	2.1**	1.3 - 3.4	1.2	0.6 - 2.2	2.1**	1.3 - 3.5	1.2	0.6 - 2.2
12-17 months	4.6***	3.0 - 7.2	2.7***	1.7 - 4.4	4.5***	2.7 - 7.6	2.3**	1.3 - 3.8	4.6***	2.7 - 7.7	2.2**	1.3 - 3.8
18-24 months	5.6***	3.6 - 8.7	3.8***	2.3 - 6.2	5.2***	3.2 - 8.5	3.2***	1.9 - 5.3	5.3***	3.2 - 8.8	3.1***	1.8 - 5.3
Child birth size												
Small	1.0		1.0		1.0		1.0		1.0		1.0	
Average	0.5***	0.3 - 0.6	0.4***	0.3 - 0.6	0.4***	0.3 - 0.6	0.4***	0.2 - 0.6	0.4***	0.3 - 0.6	0.4***	0.2 - 0.6
Large	0.3***	0.2 - 0.5	0.2***	0.2 - 0.4	0.3***	0.2 - 0.5	0.3***	0.2 - 0.5	0.3***	0.2 - 0.5	0.3***	0.2 - 0.5
Birth interval												
<24	1.0		1.0		1.0		1.0		1.0		1.0	
24-47	0.8	0.6 - 1.2	1.2	0.7 - 2.0	0.9	0.6 - 1.3	1.1	0.6 - 2.0	0.9	0.6 - 1.3	1.1	0.6 - 1.9
47+	0.6*	0.4 - 0.9	0.8	0.5 - 1.3	0.7	0.5 - 1.1	0.8	0.5 - 1.4	0.8	0.5 - 1.2	0.8	0.5 - 1.4
Received all required vaccinations (DPT, polio, BCG, and measles)												
No	1.0		1.0		1.0		1.0		1.0		1.0	
Yes	0.8	0.6 - 1.1	0.7*	0.5 - 1.0	0.8	0.6 - 1.2	0.8	0.6 - 1.2	0.8	0.6 - 1.2	0.8	0.6 - 1.2
Sex of child												
Male	1.0		1.0		1.0		1.0		1.0		1.0	
Female	0.6***	0.5 - 0.8	0.8*	0.6 - 1.0	0.6***	0.5 - 0.8	0.8	0.6 - 1.0	0.6***	0.5 - 0.8	0.8	0.6 - 1.0
Mother's nutritional status												
Not underweight					1.0		1.0		1.0		1.0	
Underweight					0.8	0.6 - 1.1	1.7*	1.1 - 2.7	0.8	0.6 - 1.1	1.8*	1.1 - 2.8
Mothers age at 1st birth												
25 years +					1.0		1.0		1.0		1.0	
18 – 24 years					1.2	0.7 - 2.0	1.1	0.8 - 1.6	1.2	0.7 - 2.0	1.0	0.7 - 1.5
< 18 years					1.6	0.9 - 2.7	0.8	0.4 - 1.5	1.5	0.8 - 2.6	0.8	0.4 - 1.5
Wealth index												
Poorest					1.0		1.0		1.0		1.0	
Poorer					0.8	0.6 - 1.1	0.7	0.5 - 1.1	0.8	0.6 - 1.1	0.7	0.5 - 1.1
Middle					0.6**	0.4 - 0.8	0.6	0.4 - 1.0	0.6**	0.4 - 0.9	0.6*	0.4 - 0.9
Richer					0.7	0.4 - 1.0	0.5*	0.3 - 0.9	0.7	0.4 - 1.1	0.5**	0.3 - 0.8
Richest					0.4**	0.2 - 0.7	0.4**	0.2 - 0.8	0.4**	0.2 - 0.8	0.3**	0.2 - 0.7
Type of place of residence												
Urban					1.0		1.0		1.0		1.0	
Rural					1.3	0.9 - 1.8	0.6*	0.4 - 0.9	1.3	1.0 - 1.9	0.6*	0.4 - 1.0
Mother decides on own health care (alone or jointly)												
No									1.0		1.0	
Yes									1.0	0.7 - 1.4	0.9	0.5 - 1.4
Mother decides on household large purchases (alone or jointly)												
No									1.0		1.0	
Yes									1.3	0.9 - 1.8	1.4	0.8 - 2.6
Mother owns house (alone or jointly)												
No									1.0		1.0	
Yes									1.1	0.8 - 1.6	1.1	0.7 - 1.8

(Continued…)

Table 3—*Continued*

	MODEL 1				MODEL 2				MODEL 3			
	KENYA		CAMBODIA		KENYA		CAMBODIA		KENYA		CAMBODIA	
Characteristics	**OR**	**CI**	**OR**	**CI**	**OR**	**CI**	**OR**	**CI**	**OR**	**CI**	**OR**	CI
Mother owns land (alone or jointly)												
No									1.0		1.0	
Yes									0.8	0.6 - 1.1	1.1	0.7 - 1.8
Mother worked in the past 12 months												
No									1.0		1.0	
Yes									0.8	0.6 - 1.1	0.9	0.6 - 1.3
Mother's education												
No education									1.0		1.0	
Primary									1.0	0.6 - 1.6	1.1	0.7 - 1.7
Secondary +									0.9	0.5 - 1.6	1.1	0.6 - 1.9
Father's education												
No education									1.0		1.0	
Primary									1.3	0.7 - 2.2	0.9	0.6 - 1.6
Secondary +									1.1	0.6 - 2.0	1.3	0.7 - 2.3

*** p<0.001, ** p<0.01, * p<0.05
Notes: Model II and Model III control for region of residence.

4. Discussion

The first 1,000 days of an infant's life, from conception until age 2, are a crucial period in which inadequate nutrition and bouts of infection can result in stunting that is then largely irreversible (Save the Children 2012) . Long-term effects of stunting include diminished cognitive and physical development, reduced productive capacity, and poor health.

In Kenya and Cambodia the prevalence of stunting among children under age 2 was 22% and 25% respectively, and stunting became even more prevalent among children age 18-24 months, at 33% in Kenya and 34% in Cambodia. This rising risk of stunting with age suggests that for young children the window of opportunity for reversing the negative effects of stunting might be lost forever. After 6 months of exclusive breastfeeding, children should be introduced to complementary feeds even as they continue being fed with breast milk. In poor settings, however, the quality of these complimentary feeds may be compromised. Because young children have increased nutritional needs due to their rapid growth, inadequate nutrition might negatively affect their chances for growth. It is therefore important that expectant mothers get vital nutrients, babies be breastfed exclusively for 6 months, and adequate solid foods be introduced at the right time. Throughout childhood, adequate health care and good hygiene and sanitation are vital.

In both Kenya and Cambodia, child's age, perceived birth size, wealth index, and region of residence were significantly associated with stunting. In Cambodia alone, mother's nutritional status was also significantly associated with stunting. This finding was in tandem with a study in Cambodia in 2013 that found age, wealth, and maternal nutritional status to be associated with child stunting (Ikeda, Irie, and Shibuya 2013).

Our study agrees with a study by Miller and Rodgers that found no association between either child vaccination or perceived birth size with child stunting (Miller and Rodgers 2009), but it contradicts a study in Nigeria that found child vaccination was associated with child stunting (Adekanmbi, Kayode, and Uthman 2013). With vaccination, there is usually a buildup of the immune system, which has a positive effect on the nutritional status of children. This study also contradicts a study by Black and colleagues that had shown that 20% of stunted children in low- and middle-income countries had small size at birth (Black et al. 2013).

The study found higher risk for stunting among males compared with females in Kenya than in Cambodia. Studies have shown that males are more likely to become stunted in their first year of life, and females are likely to become stunted in their second year (Adair and Guilkey 1997). Male children may have early exposure to early inappropriate weaning practices and complimentary feedings especially in low- and middle-income countries and in African culture.

Stunting is generally an indicator of chronic under-nutrition. Studies have shown that stunting is more common among children who live in poor households (Ikeda, Irie, and Shibuya 2013). Our study also found that children from the poorest families were more likely to be stunted. This could be because they lack the resources for obtaining health-care services and for adequate nutrition.

Gender, as it relates to women's empowerment, may be a key factor responsible for influencing children's nutritional status (Shroff et al. 2009). Ownership of assets by women has increasingly been put forth as a way to empower women, increase their productivity, and improve their welfare. A study by Bhutta and colleagues (2013) found that women who owned land were significantly more likely to have the final say in household decisions, which is a measure of empowerment. Similarly, children of mothers who own land were significantly less likely to be severely underweight (Bhutta et al. 2013). A study in Indonesia and Bangladesh concluded that both maternal and paternal education were strong determinants of child stunting (Semba et al. 2008).

These findings do not agree with our findings of no association between gender characteristics and child stunting in Kenya and Cambodia. This difference may be related to the way data are structured and collected and the relatively longer pathway from gender inequality to stunting in comparison with more direct factors, such as children's characteristics. Current survey data on women's empowerment are limited in scope and focus only on married couples. Most data are collected from only one household member, and thus the DHS may not capture intra-household gender inequalities.

Conclusions

Nutrition is key to children's survival, growth, and development. Well-nourished children are healthier than undernourished children, they can grow and develop to their full potential, and they perform better in school and as adults. Despite many interventions in improving child stunting, about a quarter of children under age 2 in Kenya (22%) and Cambodia (25%) are stunted. In both countries stunting appears to be strongly associated with child's age, perceived birth size, household wealth index, and region of residence. In our study, factors related to women's empowerment were not associated with stunting, but additional studies could further examine other data on women's empowerment in the DHS to explore whether they show an association with child stunting.

Policy Recommendation

Since stunting is a key measure obtained in DHS surveys, we suggest that its usefulness as a measure of achievement of the UN Sustainable Development Goals would be enhanced if future survey instruments could incorporate an easy linkage of stunting to more comprehensive data on gender. Just as The DHS Program has the Service Provision Assessment (SPA) and Geographic

Information Systems (GIS) tools, there may be a need for developing an Assessment of Gender Inequality tool (AGI). The Women's Empowerment in Agricultural Index (WEAI) has such an instrument. There is also a need for governments to introduce nutrition interventions that target children under age 2 to combat stunting and malnutrition among this key group. This would be of great importance in achieving the Sustainable Development Goals.

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