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Moderate and severe household food insecurity predicts stunting and severe stunting among Rwanda children aged 6–59 months residing in Gicumbi district

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Abstract

Household food insecurity (HFI) plays an important role in child malnutrition in many low-income countries. We determined the association between HFI and stunting and severe stunting among Rwandan children from the Gicumbi district, aged 6–59 months using a cross-sectional study of 2,222 children. HFI factor was calculated by summing all seven HFI (access) frequency questions and was categorised into food security, mildly food insecurity, moderately food insecurity, and severe food insecurity. The association between stunting, severe stunting, and HFI was determined using the multiple logistic regression analyses that adjust for clustering and sampling weights. The odds of moderate and severe HFI were significantly higher among stunted children aged 6–59 months than those who were not stunted (adjusted odds ratio [AOR] = 1.43; 95% confidence interval [CI] [1.11, 1.84] and AOR = 1.35; 95% CI [1.08, 1.69], respectively). Children from households with moderate food insecurity were 2.47 times more likely to be severely stunted (AOR = 2.47; 95% CI [1.77, 3.46]), and those from households with severe food insecurity were more likely to be severely stunted (AOR = 1.82; 95% CI [1.34, 2.48]), compared with children aged 6–59 months from households with food security. Other factors included male children and children who did not attend monthly growth monitoring sessions. This study showed that moderate and severe HFI correlated with stunting and severe stunting. Interventions to improve stunting in Gicumbi children should also focus on male children, children who did not attend monthly growth monitoring sessions, and households with moderate and severe food insecurity.

KEYWORDS

deaths, food security, Gicumbi district, malnutrition, Rwanda, stunting

1 | INTRODUCTION

Household food insecurity (HFI) is the inability of household to have both physical and economic access to nutritious food (Food and Agriculture Organization, 1996) and remains a serious public health issue, particularly in low- and middle-income countries, including Rwanda. Moderate and severe HFI often leads to malnutrition and hunger, which may result in death triggered by malnutrition. Globally, about 45% of under-five deaths in 2015 were attributed to malnutrition (World Health Organization [WHO], 2014), and over two thirds of these deaths occurred in rural areas (Black et al., 2008). Approximately 25% of the world's children are malnourished (WHO/United Nations International Children's Emergency Fund [UNICEF], 2012), and past reviews have shown that poor nutritional intake among children under

5 years of age may have severe health outcomes such as underweight, retarded growth, and poor organ and development (Cook et al., 2004).

HFI affects nearly half a million households in Rwanda (United States Agency for International Development [USAID], 2016), and the majority of these households live in the Northern Province, including Gicumbi district, which is the focus of the study. Inadequate access to nutritious food impacts negatively on health and well-being. A recent cost of hunger study conducted in Rwanda revealed that approximately 22% of child mortality is associated with undernutrition (USAID, 2016). Undernutrition has been linked to stunting, wasting, and underweight especially in children younger than 5 years of age. More than 45% of rural children are stunted in Rwanda (Rwanda Demographic and Health Survey, 2014). Poverty and hunger remain a huge challenge in rural Rwanda. For instance, the rural poverty rate was thrice greater than that of urban (Berglund, 2012; USAID, 2016). A recent report, human development index report, indicated that Rwanda remains a poor nation, ranking 151 out of 187 poorest countries worldwide (United Nations Development Programme, 2014).

Agriculture remains the bedrock of Rwanda gross domestic product contributing approximately 33% to the national revenue and employs more than two thirds of the labour force (USAID, 2016). Over 85% of households residing in rural communities continue to rely on agriculture activities as their main source of livelihood (Habyarimana, 2015), and the majority of their farms are located in hilly or slope terrains, which are prone to soil erosion and inadequate soil fertility. These problems limit the amount of agricultural produce, which may result to moderate or severe food insecurity.

In recognition of the adverse effect associated with food insecurity, the Rwandan government has formulated and implemented a range of policies such as the National Multi-Sectoral Strategy to Eliminate Malnutrition, Economic Development and Poverty Reduction Strategy, District Plans to Eliminate Malnutrition, and National Protocol on Management of Malnutrition (RDHS, 2014). Despite these strategic and policy initiatives, evidence suggests that over a 10-year-period stunting prevalence among children under-fives has declined from 51% in 2005 to 38% in 2014 (RDHS, 2014), indicating more work is needed to improve nutrition among children under-five especially among children that lived in rural communities. To improve existing policies and practices on the management of malnutrition in Rwanda especially in Gicumbi, there is a call for further assessment on how well moderate and severe HFI correlates with stunting and severe stunting among children aged 6–59 months residing in Gicumbi district.

This current study sought to examine the association between HFI and stunting and severe stunting among Rwandan children aged 6–59 months residing in Gicumbi district. The findings from this study will enable policymakers and public health researchers in reviewing and designing better interventions aimed at reducing the prevalence of stunted children triggered by HFI and to direct resources to the most vulnerable segments of the Gicumbi population.

1.1 | Ethical statement

Ethical clearance was obtained from the Ministry of Health in Kigali, and necessary permission was also obtained from the Gicumbi regional health office and the Gicumbi health office and local administrators. Participants were given informed consent to sign before taking part in the survey, including assurance of anonymity and a description of how the data would be used. For illiterate participants, informed consent information was read aloud and signed. Mothers and children with serious illness were referred to the nearby health facilities. The data in this article presented as aggregate to ensure all respondents' identification information is obscured.

Key messages

- Moderate and severe household food security correlated strongly with stunting and severe stunting.
- Children who did not attend monthly growth monitoring sessions were associated with stunting and severe stunting.
- Children who had access to unprotected sources of drinking water were more likely to be severely stunted.
- There were large sectorial variations in stunting and severe stunting across Gicumbi district due to poor quality of care from the rural health services.
- Male children were more likely to be stunted and severely stunted because male children tend to expend large amount of energy due to more physically active than female children.

2 | METHODS AND MATERIALS

2.1 | Study area

Gicumbi district is located in the northern province of Rwanda closer to the border with Uganda. Gicumbi district comprises 21 sectors, 109 cells, and 630 villages (Imidugudu). The population is more of rural than urban. The topography of Gicumbi is more of steep slopes and mountainous but surrounded by steep ravines with small valleys segmented by multiple swamps.

2.2 | Study setting and period

A cross-sectional study was conducted during harvest period, from January 21 to 31, 2016, in Gicumbi district covering 32 villages as part of World Vision Rwanda's funding service agreement to generate evidence to influence maternal and child health programmes. The study population shared similar characteristics (homogeneous, i.e., all household from a low socio-economic group). The respondents were enrolled in a Maternal Newborn Child Health intervention at the household level with the specific criteria for household inclusion being a presence of a pregnant woman or breastfeeding mother.

2.3 | Sample design

The sampling frame produced by the 2010 Rwanda Population and Housing Census projection was used in the sampling process of the survey (RDHS, 2010; Rurangirwa, Mogren, Nyirazinyoye, Ntaganira, & Krantz, 2017). The survey sample was selected in two stages. In the first stage, a total of 20 villages (clusters) were selected from the cells. In the second stage, 32 households were randomly selected in each selected villages (clusters). All selected villages were visited, and none was replaced, regardless of reason(s) encountered or given. The total sample of the survey consists of 20 clusters. All 660 (including nonresponse rate) households completed the mother's/caregiver interviews, yielding a response rate of 100%. The high response rate for this survey was because before conducting the interview, World Vision Rwanda mobilised the local leaders, community health workers, and team leaders of community health workers for the survey. For reporting district-level results, sample weights will be used, and sampling weight was calculated by the product of the reciprocal of the sampling fractions employed in the selection of cells and villages.

2.4 | Sample size

For the analysis to be achieved, it is important to calculate the required sample size that will be enough to detect any statistical difference. We estimate that this sample has 90% power and alpha level of 5%, to detect an odds ratio (OR) of at least 1.6, assuming an alpha level of 5%, prevalence of <4 times antenatal care (ANC) of 55% (Rurangirwa et al., 2017), a design effect of 3.2 (based on the average of 32 children per cluster and expected relative difference of about 10%) and a total sample of about 664 households is required for the study, and we consider this sufficient statistical power to examine differences in <4 times ANC that would be of public health significance.

2.5 | Data management

The questionnaires that were used in the survey included household information, which was used to collect information on household members (usual residents), and women's questionnaire administered to mothers or caretakers for all children under 5 years. The women or caretaker's questionnaire included the women or caretaker's demographic characteristics: antenatal, delivery, and post-natal care, breastfeeding, and child nutrition. The questionnaires were installed on tablets using the Open Data Kit. Open Data Kit is a suite tool that allows data collection using mobile devices and data submission to an online server. World Vision office in Kigali provided the tablets that were used in the data collection exercise. Data were posted daily after fieldwork, and this enabled daily review of work done to check for inconsistencies and errors.

In the child nutrition questionnaire, measurements of height were obtained for children under the age of five in all of the selected households. Each enumerator carried a scale and measuring board. Measurements were made using lightweight SECA scales (with digital screens) designed and manufactured under the authority of the UNICEF. The measuring boards employed were specially made by Shorr Productions for use in survey settings. Children under the age of 2 were measured lying down on the board (recumbent length), and standing height was measured for all other children.

2.6 | Outcome variables

The primary outcome variables were stunting and severe stunting. The outcome variables were expressed as a dichotomous variable, that is, Category 0 (*not stunted* [greater than −2 standard deviations {*SD*s} of the WHO Child Growth Standards median] or *not severely stunted* [greater than −3 *SD*]) and Category 1 (*stunted* [less than −2 *SD*] or *severely stunted* [less than −3 *SD*]).

2.7 | The main study factor

The household food security tool consists of seven questions, which are aimed at extracting information required for defining the household's food security status. The responses are “rarely,” “something,” or “often” or “rarely” in the past 12 months. The HFI factor was calculated by summing all the seven HFI (access) frequency questions with scores ranging from 0 to 21. The households were also categorised into four groups, such as *food secure* (0), *mildly food insecure* (1–2), *moderately food insecure* (3–10), and *severely food insecure* (more than 10; Swindale & Bilinsky, 2007).

2.8 | Potential confounders

Our choice of potential confounding factors was based on similar studies that examined the relationship between stunting and severe stunting by food security status in developing countries (Ali et al., 2013; Ali Naser et al., 2014; Singh, Singh, & Ram, 2014). These potential confounders were classified into four distinct groups: socio-economic and demographic (sectors, primary caregiver, education level, marital status, and household wealth index); child (sex of baby and child's age in months); maternal and child health (ANC, duration of breastfeeding, and attended child monthly growth monitoring sessions); and health services and environmental factors (quality of care from health services, place of delivery, water available all year, sources of drinking water, and type of toilet facility).

The household wealth index variable measures basic household needs for all children 5–18 years. The household wealth index was constructed by assigning weights to three basic household needs for children 5–18 years (i.e., difficulty providing at least two sets of clothes for all children aged 5–18 years living in the household, difficulty providing a pair of shoes for all children aged 5–18 years living in the household, and difficulty paying school fees or school contribution for all children aged 5–18 years living in the household) using the principle components analysis. The household wealth index was divided into three categories (poorest, middle and least poor; Filmer & Pritchett, 2001), and improved and unimproved sources of drinking water and type of toilet facility were categorised based on the WHO and UNICEF Joint Monitoring Programme guidelines (WHO/UNICEF, 2014).

2.9 | Statistical analyses

Data analysis was performed using the survey (SVY) commands of Stata version 14.1 (Stata Corp, College Station, TX, USA), which adjust for sampling weights and cluster sampling design and the calculation of standard errors. Preliminary analyses involved percentage and frequency count of all selected characteristics; this was followed by estimation of prevalence of stunting and severe stunting by HFI among children aged 6–59 months. The Taylor series linearization method was used in the surveys when estimating 95% confidence intervals (CIs) around prevalence estimates.

Survey logistic regression that adjusted for cluster and survey weights was used to determine the association between HFI and stunting and severe stunting among Rwandan children aged 6–59 months. First, univariate binary logistic regression analysis was performed to examine the unadjusted OR.

A staged modelling technique was employed for the multiple logistic regression analyses. In the first stage, the socio-economic and demographic factors were entered into the baseline multiple logistic regression model to examine their association with the study outcome. After that, a manual elimination process was performed, and variables that were associated with the study outcomes were retained in the model. Second, child factors were added into significant model retained in the first stage. In the third and fourth stages, maternal and child's health factors and health services and environmental factors were added to the significant variable retained in the second stage. As before, those factors with p values <0.05 were retained. In the final stage of the analysis, the main study factor (HFI) was added to the significant variables obtained from the third and fourth stages, and variables with a p value <0.05 were retained in the final.

The ORs and their 95% CIs obtained from the adjusted multiple logistics model were used to determine the association of HFI fuels on stunting and severe stunting.

3 | RESULTS

The present analysis included 2,222 (weighted total) children aged between 6 and 59 months in Gicumbi district of Rwanda. Table 1 lists the socio-economic and demographic, child, maternal and child's health, health services and environmental factors and household food security-level characteristics of these children. Approximately one third (33.7%) of the participants lived in Kageyo sectors, and only 8.0% of mothers/caregivers had secondary or higher level of education, and 55% were from the poorest households.

A large proportion (88%) of the children attended monthly growth monitoring sessions, and 97% of children were delivered at the government health unit. Both male and female children were nearly equally represented in the sample. A total of 51.9% of the participants had made four or more antenatal clinic visit during the pregnancy, and about 70% of the participants reported any kind of food insecurity.

Figure 1 shows the prevalence and 95% CIs of stunting and severe stunting by HFI status among children aged 6–59 months. The prevalence of stunting and severe stunting by HFI status among children aged 6–59 months indicated that stunting and severe

TABLE 1 Characteristics of the sample

Variables	*n*	%
Socio-economic and demographic factors		
Sectors		
Kageyo	749	33.7
Nyankenke	1,010	45.5
Rutare	463	20.8
Primary caregiver		
Mother	1,849	97.1
Others	56	2.9
Education level		
No schooling	819	36.9
Primary	1,224	55.1
Secondary+	178	8.0
Marital status		
Never married	1,061	47.8
Currently married	1,100	49.5
Formerly married	60	2.7
Household wealth index		
Poorest	1,221	55.0
Middle	275	12.4
Least poor	726	32.7
Child factors		
Sex of the baby		
Male	973	47.7
Female	1,067	52.3
Child's age in months		
6–23	1,328	65.1
24–59	712	34.9
Maternal and child's health factors		
Antenatal care		
Inadequate (<4 visits)	1,068	48.1
Adequate (4+ visits)	1,154	51.9
Duration of breastfeeding		
Up to 12 months	948	46.5
>12 months	1,092	53.5
Attended child monthly growth monitoring sessions		
Yes	1,677	88.0
No	228	12.0
Health services and environmental factors		
Quality of care from health services		
Very good	835	40.9
Good	836	41.0
Not good	369	18.1
Place of delivery		
Government health unit	1,984	97.3
Others	56	2.8
Water availability all year		
Yes	1,677	75.5
No	545	24.5
Sources of drinking water		
Improved	862	38.8
Unimproved	1,360	61.2

(Continues)

TABLE 1 (Continued)

Variables	*n*	%
Type of toilet facility		
Improved	30	1.4
Covered latrine	1,180	53.1
Unimproved	1,012	45.5
Household food security		
Food security	639	28.7
Mild	70	3.2
Moderate	528	23.8
Severe food insecurity	986	44.4

stunting were significantly higher (21% for severe stunting, 46% for stunting) among children whose family reported severe food insecurity than those children who reported food security (12% for severe stunting, 38% for stunting). These results could be translated to a significant drop of about 9% and 8%, respectively, in severe stunted and stunted children who lived in food secure households when compared with children who lived in severe food insecure households.

Table 2 presents the unadjusted and adjusted ORs for the association between HFI and stunting in children aged 6–59 months. Children aged 6–59 months from the household who reported moderate and severe food insecurity were significantly more likely to be stunted. Children aged 24–59 months (adjusted OR = 1.78; 95% CI [1.47, 2.15]; $p < 0.001$) were more likely to be stunted compared with children aged 5–23 months.

Children aged 24–59 months (adjusted OR = 1.78; 95% CI [1.47, 2.15]; $p < 0.001$) were more likely to be stunted compared with children aged 6–23 months, and children who do not attend monthly growth monitoring sessions were 2.27 times more likely to be stunted than those children who attended monthly monitoring sessions. Children aged 6–59 months from households without all-year access to water (adjusted OR = 1.30; 95% CI [1.05, 1.61]; $p = 0.015$) were more likely to be stunted than those who have the ability to access water all year. The result indicated that children aged 6–59 months who lived in Rutare sector were 30% less likely to be stunted compared with children who lived in Kageyo sector. Female children (adjusted OR = 0.53; 95% CI [0.44, 0.63]; $p < 0.001$) were less likely to be stunted than male children.

Table 3 illustrates the unadjusted and adjusted ORs for the association between HFI and severe stunting in children aged 6–59 months. Children from households with moderate food insecurity were 2.47 times more likely to be severely stunted, and those from households with severe food insecurity were 1.82 times more likely to be severely stunted.

Children aged 6–59 months who had no access to protected drinking water were 1.56 times more likely to be stunted than those who had access to protected drinking water. Children who do not attend monthly growth monitoring sessions (adjusted OR = 1.56; 95% CI [1.22, 1.99]; $p < 0.001$) were significantly more likely to be stunted than those children who attended monthly monitoring sessions. Children from households who reported poor quality of care from the health service provider (adjusted OR = 1.55; 95% CI [1.13, 2.13]; $p = 0.007$) were significantly more likely to be severely stunted than those children from households who reported very good quality of care from the health service provider.

Compared with male children aged 6–59 months, the odds for severely stunted among female children aged 6–59 months decreased significantly by 34% (adjusted OR = 0.66; 95% CI [0.52, 0.83]; $p < 0.001$). Children aged 0–59 months who reside in the Rutare sector (adjusted OR = 0.35; 95% CI [0.24, 0.52]; $p < 0.001$) were significantly less likely to be severely stunted than those children aged 6–59 months that lived in Kageyo sector.

4 | DISCUSSION

We set out to examine the relationship between HFI and stunting among Rwandese children aged from 6 to 59 months residing in Gicumbi district, Northern Province. The findings suggested that moderate and severe HFI were associated with both stunted and severely stunted infants and young children in Gicumbi. This outcome is consistent with a cross-sectional study done in three low- and middle-income countries (Bangladesh, Ethiopia, and Vietnam) in 2013, which showed that children from severely food insecure households were more likely to be stunted (Ali et al., 2013). This result was also in agreement with a study carried out in Malaysia by Ali Naser et al. (2014) and the study in Nepal by Abhishek Singh et al. (2014), which indicated that children from severely food insecure households

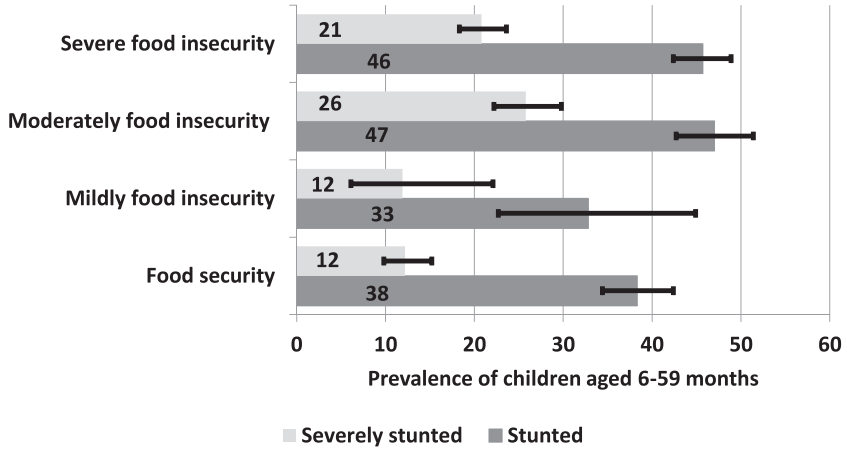

FIGURE 1 Prevalence and 95% confidence Intervals of stunting and severe stunting by household food insecurity status among children aged 6–59 months.

TABLE 2 Association between household food insecurity and stunting in children aged 6–59 months

	Stunted							
	Unadjusted				Adjusted			
Variables	OR	95% CI		p value	AOR	95% CI		p value
Socio-economic and demographic factors								
Sectors								
Kageyo	1.00				1.00			
Nyankenke	0.91	0.75	1.11	0.342	0.97	0.78	1.19	0.759
Rutare	0.76	0.59	0.97	0.030	0.70	0.54	0.91	0.007
Primary caregiver								
Mother	1.00							
Others	0.4	0.2	0.82	0.01				
Education level								
No schooling								
Primary	1.01	0.83	1.21	0.958				
Secondary+	1.01	0.72	1.42	0.937				
Marital status								
Never married	1.00							
Currently married	0.99	0.83	1.18	0.873				
Formerly married	1.05	0.62	1.78	0.842				
Household wealth index								
Poorest	1.00							
Middle	0.81	0.61	1.07	0.134				
Least poor	1.18	0.98	1.43	0.088				
Child factors								
Sex of the baby								
Male	1.00				1.00			
Female	0.51	0.43	0.61	<0.001	0.53	0.44	0.63	<0.001
Child's age in months								
6–23	1.00				1.00			
24–59	1.69	1.41	2.03	<0.001	1.78	1.47	2.15	<0.001
Maternal and child's health factors								
Antenatal care								
Inadequate (<4 visits)	1.00							
Adequate (4+ visits)	1.00	0.84	1.19	0.990				
Duration of breastfeeding								
Up to 12 months	1.00							
>12 months	1.19	1.00	1.42	0.053				
Attended child monthly growth monitoring sessions								
Yes	1.00				1.00			
No	2.25	1.66	3.06	<0.001	2.27	1.65	3.12	<0.001
Health services and environmental factors								
Quality of care from health services								
Very good	1.00							
Good	1.19	0.98	1.44	0.087				
Not good	1.55	1.21	1.98	0.001				
Place of delivery								
Government health unit	1.00							
Others	1.21	0.71	2.07	0.474				
Water availability all year								
Yes	1.00				1.00			
No	1.24	1.01	1.52	0.040	1.30	1.05	1.61	0.015
Sources of drinking water								

(Continues)

TABLE 2 (Continued)

	Stunted							
	Unadjusted				Adjusted			
Variables	OR	95% CI		*p* value	AOR	95% CI		*p* value
Improved	1.00							
Unimproved	0.77	0.65	0.92	0.004				
Type of toilet facility								
Improved	1.00							
Covered latrine	1.24	0.55	2.80	0.611				
Unimproved	1.77	0.78	4.02	0.170				
Household food security								
Food security	1.00				1.00			
Mild	0.79	0.46	1.35	0.384	0.99	0.57	1.74	0.985
Moderate	1.43	1.12	1.82	0.004	1.43	1.11	1.84	0.006
Severe food insecurity	1.35	1.09	1.68	0.006	1.35	1.08	1.69	0.008

Note. AOR: adjusted odds ratio; CI: confidence interval; OR: odds ratio.

were significantly associated with stunting. However, this finding is in contrast with a similar study conducted in Kailali district, Nepal, by Osei et al. (2010) who found no significant relationship between HFI and malnutrition measured by stunting and underweight. A plausible reason for this difference may be attributed to a range of infant's age included in the two studies. Our study used 6–59 months of age, whereas that of Osei et al. (2010) included 6–23 months of age. Thus, our study included 24 to 59 months of age because a recent 2014 RDHS report on stunting by age group showed that severely stunted children aged from 24 to 59 months remain high. For example, in the 2014 RDHS, where approximately 19% of severely stunted children were from age group "24–35 months," this number declined to 14% for children aged "36–47 months" and was approximately 13% for age group "48–59 months" (RDHS, 2014).

Explanations for the strong association between severe HFI and severe stunting noted in this study may include a contribution from the main lean period (October to December) before the survey and exorbitant food prices due to seasonal variability, where food prices increased up to harvest period and then start to drop gradually, as well as drought due to erratic rainfall during planting and weeding period, resulting in lower food crops. However, stunting in children especially those younger than 5 years of age is linked not only to HFI but also to inadequate consumption of micronutrients. Approximately 80% of Rwanda children consume food not rich in iron, which affects growth and cognitive development (RDHS, 2010), and the majority of these children reside in rural areas. Around 47% of stunted children in Rwanda are from rural areas, as compared with 27% of urban areas (USAID, 2016).

In addition to moderate and severe HFI, other characteristics that were significantly associated with an increased risk of stunting in Gicumbi included child sex, child's age (24–59 months), sources of drinking water, quality of health care services, and place of residence.

Male infants younger than 5 years of age had a significantly greater risk of stunting and severe stunting in Gicumbi district compared with their female counterpart. This outcome is in agreement with a recent cross-sectional study conducted in Nigeria in 2016, which showed that male infants were more likely to be stunted than female infants (Akombi et al., 2017). Also, a cross-sectional study carried out in Madagascar in 2016 indicated a decreased stunting risk for female infants compared with male counterpart (Rakotomanana, Gates, Hildebrand, & Stoecker, 2017), and a recent systematic review on undernutrition in sub-Saharan Africa reported that male child was one of the most consistent factors associated with childhood undernutrition (Akombi et al., 2017). Similar results were obtained from a meta-analysis of 16 demographic and health surveys, and the study revealed that boys are more stunted than girls (Wamani, Åstrøm, Peterson, Tumwine, & Tylleskär, 2007). The observed sex differences in stunting may be attributed to cultural differences, level of education, and gender dynamics within a community. In some cultural settings in the sub-Saharan Africa region including Rwanda, girls are favoured to consume more nutritious foods and better educated than boys because of higher bride prices (Muvunyi, 2017).

Infants with age range 24–59 months had 1.47 times increased risk of stunting than those infants whose age lies between 6 and 23 months, but this was not significant with severe stunting. This study is consistent with a similar study conducted in 2014 in Meskan district, south Ethiopia (Fikadu, Assegid, & Dube, 2014). The increased risk observed in this study may be attributed to the unsuitable timing of introduction of complementary food to infants, resulting in poor nutritional intake as their digestive and immune systems are still developing.

The current study also indicated that place of residence in Gicumbi was associated with increased risk of stunting. Children who lived in Kageyo sector were more likely to be stunted than those who reside in Nyankenke or Rutare sectors. The possible reason may be linked to the fact that Kageyo is a resettlement sector created in 2007 for returning Rwanda refugees overseas who fled the Rwanda genocide in 1959 (Africa New Life Ministries, 2018). In Kageyo, food shortage persists, and paid jobs are hard to find. The food shortage in Kageyo could be due to limited land for farming as reflected in the high population density of 697 people per square kilometre. Additionally, there is a Congolese refugee camp that was established in 1997 by the UNHCR that has had a negative impact on the environment in terms of high soil erosion and poor sanitation. Furthermore,

TABLE 3 Association between household food insecurity and severe stunting in children aged 6–59 months

	Severely stunted							
	Unadjusted				Adjusted			
Variables	OR	95% CI		p value	AOR	95% CI		p value
Socio-economic and demographic factors								
Sectors								
Kageyo	1.00				1.00			
Nyankenke	0.83	0.65	1.05	0.116	0.92	0.71	1.19	0.503
Rutare	0.39	0.27	0.56	<0.001	0.35	0.24	0.52	<0.001
Primary caregiver								
Mother	1.00							
Others	0.24	0.07	0.77	0.017				
Education level								
No schooling	1.00							
Primary	1.05	0.83	1.33	0.665				
Secondary+	0.92	0.59	1.42	0.701				
Marital status								
Never married	1.00							
Currently married	0.97	0.78	1.22	0.823				
Formerly married	2.00	1.13	3.53	0.017				
Household wealth index								
Poorest	1.00							
Middle	0.81	0.56	1.18	0.273				
Least poor	1.14	0.90	1.44	0.285				
Child factors								
Sex of the baby								
Male	1.00				1.00			
Female	0.60	0.48	0.75	<0.001	0.66	0.52	0.83	<0.001
Child's age in months								
6–23	1.00							
24–59	1.28	1.02	1.60	0.033				
Maternal and child's health factors								
Antenatal care								
Inadequate (<4 visits)	1.00							
Adequate (4+ visits)	0.76	0.61	0.95	0.014				
Duration of breastfeeding								
Up to 12 months	1.00							
>12 months	0.48	0.38	0.60	<0.001				
Attended child monthly growth monitoring sessions								
Yes	1.00				1.00			
No	3.44	2.52	4.70	<0.001	3.52	2.50	4.96	<0.001
Health services and environmental factors								
Quality of care from health services								
Very good	1.00				1.00			
Good	1.14	0.89	1.46	0.316	1.23	0.94	1.60	0.129
Not good	1.57	1.17	2.11	0.003	1.55	1.13	2.13	0.007
Place of delivery								
Government health unit	1.00							
Others	0.90	0.45	1.81	0.773				
Water availability all year								
Yes	1.00							
No	0.90	0.69	1.17	0.441				
Sources of drinking water								

(Continues)

TABLE 3 (Continued)

	Severely stunted							
	Unadjusted				Adjusted			
Variables	OR	95% CI		*p* value	AOR	95% CI		*p* value
Improved	1.00				1.00			
Unimproved	1.46	1.16	1.84	0.001	1.56	1.22	1.99	<0.001
Type of toilet facility								
Improved	1.00							
Covered latrine	0.39	0.17	0.88	0.024				
Unimproved	0.52	0.23	1.19	0.123				
Household food security								
Food security	1.00				1.00			
Mildly insecurity	0.97	0.45	2.12	0.945	1.29	0.58	2.88	0.531
Moderately insecurity	2.49	1.81	3.44	<0.001	2.47	1.77	3.46	<0.001
Severely insecurity	1.88	1.40	2.54	<0.001	1.82	1.34	2.48	<0.001

Note. AOR: adjusted odds ratio; CI: confidence interval; OR: odds ratio.

the poor access to Kageyo may be a factor in the movement of goods such as food and services such as primary health care. Kageyo has only 8 km of the paved road out of the total 83.1 km of roads (Fink, Günther, & Hill, 2011).

Unimproved source of drinking water was found to be strongly associated with severe stunting. A similar cross-sectional study with combined data sets from 70 low- and middle-income countries conducted in 2011 also indicated that access to improved water was associated with a lower risk of mild or severe stunting (Fink et al., 2011). Nearly one third of rural households in Rwanda uses an unprotected water sources for both drinking and cooking (RDHS, 2014), and this proportion may scale up during the dry season. The current study also indicated that lack of availability of water all year had 1.30 times increased the risk of children being stunted.

Infants and young children whose mothers reported inadequate quality of care received from health services were at a higher risk of severe stunting than those children whose mothers had very good or good quality of care. Limited availability of health facilities in rural Rwanda may have hinder rural dwellers from adequately receiving health care services, leading to an increased likelihood of severe stunting. Approximately, 40% of Rwanda rural women live at least an hour away from a health facility (Worley, 2016). Lack of adequate availability of well-equipped health facilities in the rural areas may have also contributed to mothers infrequent monitoring of monthly child growth in the health facility. This study confirmed that infants and children whose mothers reported non-attendance of child monthly growth sessions had a 2.27 and 3.52 times greater risk of stunting and severe stunting, respectively, compared with those who attended growth monitoring sessions.

Limitations of this study are as follows: (a) Detailed medical assessments such as micronutrient deficiencies and parasitic infection of the child were not obtained during the survey; (b) birth order was not collected, and higher birth order child may result to undernutrition because income could be associated with child nutritional status; and (c) information on child's dietary patterns was not collected as HFI may often lead to rationing and skipping of meals. A study in South Africa has shown that these changes correlate with households with severe food insecurity (Misselhorn, 2005).

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

CONTRIBUTIONS

This study was designed by KEA, and JKK carried out the analysis and drafted the manuscript. KEA, CM, MM, MN, IM, MD, and JKK were involved in the design of the questionnaire, revision, and editing of the manuscript. All authors read and approved the final manuscript.

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