ORIGINAL RESEARCH

CURRENT DEVELOPMENTS IN NUTRITION

Community and Global Nutrition

Malnutrition and Associated Risk Factors among Children 6–59 Months Old in the Landslide-Prone Bududa District, Eastern Uganda: A Cohort Study

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ABSTRACT

Background: The United Nations Sustainable Development Goal 2.2 calls for an end to all forms of malnutrition. This might be derailed due to persistent landslide disasters in low-income countries like Uganda.

Objectives: The prevalence of malnutrition and the impact of seasonal variations and associated factors were assessed among children aged 6–59 mo in the landslide-affected households in Bududa District, eastern Uganda.

Methods: A prospective cohort study using a 2-stage simple random technique was applied to select 422 households including 392 children during May–August (food-plenty season) 2019. After 6 mo, in January–March (food-poor season) 2020, 388 households and 366 children were assessed. Socioeconomic and demographic data were collected using structured questionnaires. Child malnutrition outcomes were defined according to WHO criteria. Factors associated with malnutrition outcomes were identified by bivariate and multivariate logistic regression.

Results: Stunting, underweight, wasting, and overweight prevalences were 37.7%, 13.3%, 3.6%, and 4.3%, respectively, in the food-plenty season and 42.6%, 14.2%, 2.1%, and 2.7%, respectively, in the food-poor season. Residing in the landslide-affected sub-county increased the odds for stunting [adjusted OR (aOR): 1.68; 95% CI: 1.08, 2.59; $P = 0.025$] and underweight (aOR = 4.25; 95% CI: 1.10, 15.36; $P = 0.032$) for children in the food-plenty season. Child age, sex, breastfeeding status, a nonimproved drinking water source, migration of any household member, and parents' education were significant risk factors in the food-plenty season. In the food-poor season, parents' education status, loss of any household member, child sex, and child age were significant risk factors.

Conclusions: Stunting and underweight were more prevalent in the food-poor season while wasting and overweight were more prevalent in the food-plenty season. With the exception of child age, child sex, and parents' education, child malnutrition risk factors differed between food-plenty and food-poor seasons. There is a need to address seasonality factors in program interventions targeting children <5 y in landslide-prone areas. *Curr Dev Nutr* 2022;6:nzac005.

Keywords: children, malnutrition, landslides, overweight, stunting, Uganda, wasting

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Supplemental Tables 1–3 are available from the "Supplementary data" link in the online posting of the article and from the same link in the online table of contents at https://academic.oup.com/cdn/.

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Abbreviations used: aOR, adjusted OR; MUAC, midupper arm circumference; USD, US dollars; VIF, variance inflation factor.

Introduction

Malnutrition risk due to natural disasters among children is rarely quantified despite the fundamental rights of the child to adequate food, nutrition, care, and an adequate standard of living, recognized under the Convention on the Rights of the Child (1) and other international human rights instruments (2). Natural disasters are detrimental events that occur beyond the control of humans (3). Globally, natural disasters are increasing (4, 5) with devastating effects, particularly among low- and middle-income countries (6, 7). Between 2000 and 2019, disaster events worldwide killed 1.23 million people, resulted in 2.97 trillion US dollars (USD) in economic losses and left 4.03 billion people injured, homeless, displaced, or in need of emergency assistance, including food (4). Similarly, in 2020, climate-related disasters resulted in 171.3 billion USD in economic losses and 98.4 million deaths and 15,080 people were affected (5).

Notably, 40% of the world's poor are living in sub-Saharan Africa where natural disasters have a profound socioeconomic impact, by increasing food insecurity, poverty, and inequality (8). The effects are more devastating to the poor rural populations and households (8). Uganda has, over the past years, experienced frequent disasters (landslides, floods, droughts, locusts, and hailstorms, among others) (9). During 2019–2020, excluding coronavirus disease 2019 (COVID-19) impacts, disaster events in 70 districts affected 800,000 people, displaced 21,000 families, and resulted in 152.2 million USD in economic losses (10).

Globally, malnutrition is still high among children under 5 y (11). By 2020, approximately 149 million (22.0%) were stunted, 45.4 million (6.7%) had wasting, and 38.9 million (5.7%) were overweight (11). In Africa, the majority of stunted children (21.2 million) live in eastern Africa (11). These high levels of under-5 malnutrition are intensified by frequent natural disasters and related shocks. Such effects occurring during critical periods in a child's development can be detrimental to human capital development and future generations (12). Consequently, the progress towards the achievement of the United Nations Sustainable Development Goal number 2 of zero hunger and ending all forms of malnutrition (13–15) is being hindered. Similarly, global nutrition initiatives emphasizing the "1000-days window of opportunity" from conception to the child's second birthday (16) and the global 2025 nutrition targets of reducing under-5 child malnutrition (17) might be derailed. Equally, the realization of the right to adequate food (2, 18) and the right of the child to the highest attainable standard of health care, including combating disease and malnutrition (1), is disrupted by persistent disasters.

Uganda is burdened by hunger (19, 20) and malnutrition (11, 21, 22). By 2017, most Ugandans (51.5%) were consuming fewer number of meals with fewer calories per day than recommended (23). Similarly, approximately 29% of children under 5 y in Uganda are stunted, 10.5% are underweight, 3.6% are wasted, and 3.7% are overweight (21). This problem was more pronounced in rural than in urban areas, like Bugisu subregion in eastern Uganda (24), often worse affected by landslides (25). The Bududa District in the Bugisu subregion is particularly prone to recurrent landslides (26). In this subregion, under-5 malnutrition is still a challenge, with stunting, underweight, wasting, and overweight levels at 35.9%, 14.8%, 5.0%, and 3.8%, respectively (21).

Bududa District has experienced devastating landslides since 1933 (27). The most serious landslide occurred in 2010 at Nametsi Parish in Bukalasi sub-county. It killed 350 people and caused the displacement of people and the destruction of infrastructure, food crops, and livestock (25, 27). Another major incident that occurred in the same sub-county in 2018 killed 60 people, displaced 858 people, and washed away 144 houses (28).

Although landslides are frequent in Uganda, there are limited linkages and considerations in targeted nutrition interventions (18, 29). Studies on landslides in eastern Uganda have mostly examined farmers' perceptions and mortality risk (30), food security and diet diversity (31), and perceptions on the right to adequate food (32). However, there is limited information on how landslides affect the nutritional status of children under 5 y in the country, also in relation to seasonal variations in food supply. Hence, this study aimed to assess the prevalence and factors associated with possible seasonal variations in malnutrition among children 6–59 mo in the landslide-prone communities 8 y after the major 2010 landslide disaster and after the occurrence of another 2018 landslide in Bududa District.

The age group was chosen to take into account the introduction of complementary feeding at 6 mo, a fragile period when children are at high risk of malnutrition (33). Moreover, household food shortages that are common in the aftermath of disasters are likely to have more adverse effects on the nutritional status of children under 5 y (12) because young children are a vulnerable group undergoing rapid growth and development that demand higher nutritional needs (33). Also, young children depend on adults or caretakers for all decisions or actions pertaining to their food and nutrition security (12). Natural disasters cause disruptions in the availability, accessibility, stability, and utilization of food for the household (6), which consequently affects the children's nutritional health. In addition, natural disasters, especially landslides, increase exposure and susceptibility to infections such as diarrhea and acute respiratory diseases, which may further compromise the nutritional status of young children (12).

Methods

Study design, setting, and participants

This prospective cohort survey was performed during May–August (food-plenty season) 2019 and January–March (food-poor season) 2020. The study participants were the heads of households in the survey area, usually women. One index child from each sampled household was assessed for nutritional status. In households with more than 1 eligible child, the youngest in the category of those aged 6–59 mo was selected because the youngest is the most vulnerable in case nutritional needs are not met. In the case of a household whose eligible children were twins, both were assessed. The assessments of children were performed in the Nutrition Unit of Bududa District Hospital. All assessments were performed to account for variations between food-plenty and food-poor seasons.

The study site was the Bududa District in the Bukalasi sub-county, whereas the Bubiita sub-county acted as the control since it is the neighboring sub-county to Bukalasi sub-county. Bududa District is located on the foot of the southwestern slopes of Mount Elgon, approximately 250 km from Kampala. The district's elevated topography subjects the Mount Elgon region to regular disastrous floods and landslides (34). The average precipitation of the area is above 1500 mm of rainfall per year (27). The district's population is 210,173 (24), with a high population density of approximately 952 persons per square kilometer. The continued agricultural activities on the steep slopes of Mount Elgon, with V-shaped valleys and river incisions, pose a high risk for landslides in the area (27). The majority of the population is rural and relies mainly on subsistence agriculture (24, 27).

The sample-size estimator for households and children was the prevalence of stunting. A sample size of 418 households with eligible children was targeted based on the 35.9% stunting level among children aged 6–59 mo in the Bugisu subregion (21). We assumed a 10% higher (44.9%) prevalence in the landslide-exposed communities. The precision values included a power of 80% and a P value of 0.05, plus a margin of 3% to cater for nonresponse. Hence, an extra 12 households were added to each group in each sub-county to cater for the possible nonresponse. Therefore, 215 households were targeted per sub-county.

In each of the parishes that constitute a sub-county, a 3-stage simple random sampling technique was adopted to select villages and eligible households using probability proportion to size techniques—that is, more households were sampled in villages with a relatively high number of households. In the first stage, from the affected and control sub-counties, all of the villages in each of the designated affected and control areas were listed and households were assigned to 20 villages using probability proportion size—hence, a total of 40 villages per sub-county. This was followed by randomly selecting 11 representative households in each village from the household lists that were generated with the assistance of the area local councils and the research assistants during the household mapping and listing exercise.

The study was approved by the Uganda National Council for Science and Technology (UNCST) (no. SS 4967), Makerere School of Health Sciences Research Ethics Committee (no. 2018–082), and the Norwegian Regional Committee for Medical and Health Research Ethics (no. 2019/917). Participation in the study was by voluntary written or thumb-print consent.

Data collection and measurements

Socioeconomic and demographic characteristics of the household and child were collected by trained research assistants through face-to-face interviews with the heads of the households using pretested and structured questionnaires that were translated from English to the local language (Lumasaba) and back-translated into English.

Anthropometry measurements were performed following standard WHO guidelines (35, 36). Weight was measured to the nearest 0.1 kg with an electronic scale (Seca 876). Standing height for children older than 2 y was measured with a portable stadiometer (Seca 213), whereas recumbent length for children younger than 2 years was measured with a measuring board to the nearest 0.1 cm. Head circumference was measured with a non-stretchable measuring tape while midupper arm circumference (MUAC) was measured with a nonstretchable MUAC tape at the midpoint between the acromion and the olecranon to the nearest 0.1 cm. The child's date of birth was obtained from child immunization cards. In children without the cards, a record of events was used to determine the approximate date of birth.

Outcomes and risk factors

The outcome variables for childhood malnutrition were stunting, underweight, wasting, and overweight/obesity treated as dichotomous variables (yes/no) in the analysis. The main independent variable of interest was exposure to landslides (affected sub-county vs. control sub-county).

The risk-covariate factors included child-level, household head–related, and household factors selected based on previous literature that examined risk factors of under-5 malnutrition in low- and middle-income countries (37–40). Child-level factors comprised sex, parity, history of illness in the past 30 d before the survey, child breastfeeding status, and age of introduction of semi-solid food, which were treated as dichotomous variables in the analysis. Child age was categorized as 6–11, 12–23, 24–35, 36–47, or 48–59 mo.

Household head–related factors included marital status, sex, education status, and household source of livelihood. Marital status and sex were treated as dichotomous variables. Educational status was defined as primary level and less and secondary level and more of education. Household source of livelihood was classified as a farmer or nonfarmer.

The household factors included household size, number of under-5 children, ownership of assets, season of survey, availability and access to an improved toilet facility, access to improved water sources, reported migration, and death of any member in the past 12 mo preceding the survey. These were treated as dichotomous variables. Source of drinking water was categorized as improved or nonimproved.

Statistical analysis

Anthropometric data were processed using WHO Anthro version 3.2.2 (41) and WHO AnthroPlus version 1.0.4 (42), respectively, to generate height-for-age, weight-for-age, weight-for-height, MUAC-for-age, and head circumference-for-age z scores. Stunting, underweight, and wasting were defined as a z score less than −2 SDs of the median of the WHO reference population (35). Values less than −3 were categorized as severe, −3 to −2 as moderate, and −2 or more as normal nutritional status. Overweight/obesity was defined as weight-for-height z score greater than +2 SDs (35). Head-circumference-for-age z scores less than −2 SDs of the median of the reference population indicated the presence of microcephaly (43).

Descriptive statistics are presented as proportions, means, and SDs. Pearson's chi-square tests and unadjusted logistic regression models were used to examine bivariate associations between the outcome variables (stunting, underweight, wasting, and overweight) and independent variables. The independent variables with a significant P value in the bivariate analysis were entered into the multivariate analysis for effect determination of each explanatory variable on outcome variable and to control for covariates. Similarly, relevant variables that have been shown to cause or increase the risk for child malnutrition (44) were considered for multivariate analysis even if the P value was not significant in the bivariate analysis. Multivariate binary logistic regressions were fitted by using the backward-elimination technique. Both crude OR and adjusted OR (aOR) with the corresponding 95% CI were obtained to show the strength of association. The statistical association was assumed significant at $P < 0.05$. The model fit in the multivariate binary logistic regression was assessed using the Hosmer-Lemeshow goodness-of-fit test. When the computed chi-square probability value of the model was not significant ($P > 0.05$), the model was considered a good fit.

Multicollinearity between covariates were checked by the variance inflation factor (VIF). Covariates with VIF greater than 10 were considered having multicollinearity effect and hence not included in the multivariate analyses. Sensitivity analysis compared results of model performance from an analysis of the fitted model with complete data with an analysis of the fitted model with missing data (45). Analyses were conducted using Stata version 16.1 statistical software (StataCorp) (46).

Results

Among the targeted 430 households, 424 were interviewed, whereas 6 households declined to participate. Complete response was obtained for 422 households and 392 children in the food-plenty season and 388 households including 366 children in the food-poor season (**Figure 1**).

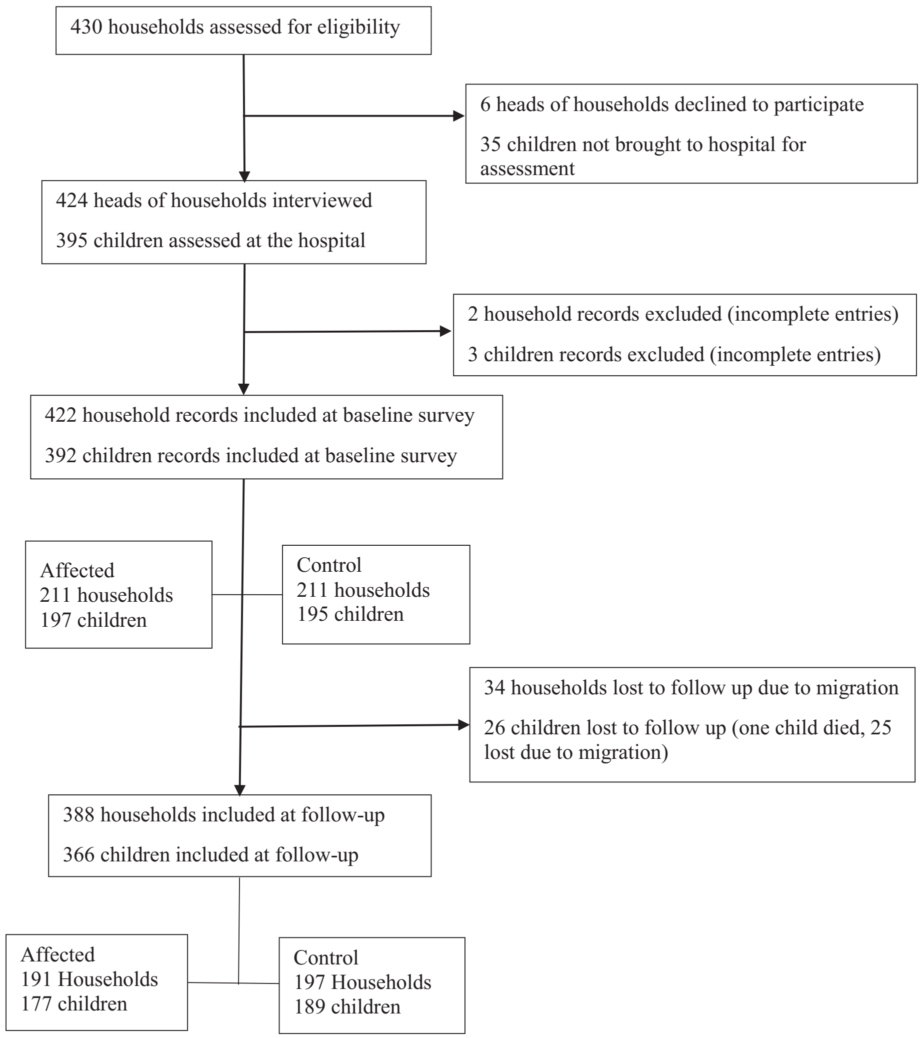

FIGURE 1 Flowchart showing the enrollment of study participants into the study.

Most interviewed heads of households were mothers in the food-plenty season and fathers in the food-poor season. The majority of the participants were married and relied on farming as the main income source. Participants' ages ranged from 15 to 84 y in the food-plenty season and from 16 to 77 y in the food-poor season. The educational level of most participants was primary school education. Household ownership of assets was relatively higher in the food-plenty season and decreased by more than half in the food-poor season among the affected sub-county (**Table 1**).

Sex distribution was statistically significant between affected and control groups with more females (55.3%) than males (48.7%) in the food-plenty season and more males (52.9%) than females (47.1%) in the food-poor season (**Table 2**). A majority of the children were still breastfeeding in the food-plenty season.

Prevalence of malnutrition

There were significantly more stunted children among the affected group than in the controls in the food-plenty season, but not in the food-poor season (**Table 3**). In contrast, the prevalence of underweight was significantly higher among the affected group compared with the controls in both food seasons, whereas there were no significant differences between the 2 study groups at either time point regarding wasting, overweight, or the combined anthropometrical deficiencies (stunting + wasting and stunting + overweight) (Table 3). Over half of the stunted (51.4%), underweight (55.8%), and wasted (71.4%) children were males in the food-plenty season, whereas over half of the stunted (58.3%), underweight (69.2%), and wasted (57.1%) children were females in the food-poor season (**Supplemental Table 1**).

Risk factors associated with child malnutrition

Residing in the landslide-affected area, parents' education status, child sex, child age, and breastfeeding status of the child were significantly associated with stunting in the food-plenty season (**Table 4**). Children residing in the landslide-affected sub-county were 1.68 times more likely to be stunted than children residing in the control sub-county. Similarly, boys were 1.19 times more likely to be stunted than girls. Also, children aged 12–23 mo were 3.41 times more likely to be stunted than children aged 48–59 mo in the food-plenty season. On the contrary, age of the

TABLE 1 Characteristics of the participating households[1]

Variables	Food-plenty season (n = 422) Affected (n = 211)	Control (n = 211)	Total (n = 422)	P^2	Food-poor season (n = 388) Affected (n = 191)	Control (n = 197)	Total (n = 388)	P^3	P^4
Interviewed household head									
Father	40 (18.9)	17 (8.1)	57 (13.5)	0.003*	134 (70.2)	157 (79.7)	291 (75.0)	0.11	0.000*
Mother	161(76.3)	174 (82.5)	335(79.4)		40 (20.9)	25 (12.7)	65 (16.8)		
Others[5]	10 (4.8)	20 (9.5)	30 (7.1)		17 (8.9)	15 (7.6)	32 (8.2)		
Age, y	32.1 ± 11.7	32.3 ± 11.5	32.2 ± 11.6	0.71	33.2 ± 11.9	33.9 ± 11.8	33.6 ± 11.9	0.56	0.095
Marital status									
Married	187 (88.6)	162 (76.8)	349 (82.7)	0.002*	166 (86.9)	176 (89.3)	342 (88.1)	0.12	0.000*
Not married	24 (11.4)	49 (23.2)	73 (17.3)		25 (13.1)	21 (10.7)	46 (11.9)		
Household size	6.5 ± 2.5	6.3 ± 2.3	6.2 ± 2.5	0.014*	6.6 ± 2.6	6.32 ± .3	6.5 ± 2.5	0.16	0.22
Main source of livelihood									
Farming	174 (82.5)	125 (59.2)	299 (70.9)	0.000*	178 (93.2)	173 (87.8)	351 (90.5)	0.04*	0.000*
Trading	17 (8.1)	18 (8.5)	35 (8.3)		4 (2.1)	13 (6.6)	17 (4.4)		
Casual laborer	16 (7.6)	44 (20.9)	60 (14.2)		9 (4.7)	7 (3.6)	16 (4.1)		
Others[6]	4 (1.8)	24 (11.4)	28 (6.6)		0 (0.0)	4 (2.0)	4 (1.0)		
Main source of food									
Own production	150 (71.1)	80 (37.9)	230 (54.5)	0.000*	100 (52.4)	61 (30.9)	161 (41.5)	0.000*	0.000*
Purchase	33 (15.6)	121(57.3)	154 (36.5)		90 (47.1)	133 (67.6)	223 (57.5)		
Own labor	28 (13.3)	10 (4.7)	38 (9.0)		1 (0.5)	3 (1.5)	4 (1.0)		
Education status of head of household									
None	14 (6.7)	13 (6.2)	27 (6.4)	0.18	6 (3.1)	18 (9.1)	24 (6.2)	0.21	0.660
Primary	156 (73.9)	145 (68.7)	301 (71.3)		150 (78.6)	142 (72.1)	292 (75.3)		
Secondary	39 (18.5)	47 (22.3)	86 (20.4)		33 (17.3)	32 (16.2)	65 (16.7)		
≥College	2 (0.9)	6 (2.8)	8 (1.9)		2 (1.0)	5 (2.5)	7 (1.8)		
Lost any household members in the past 12 mo preceding the survey									
Yes	32 (15.2)	38 (18.0)	70 (16.6)	0.56	8 (4.2)	17 (8.6)	25 (6.4)	0.07	0.000*
No	179 (84.8)	173 (81.9)	352 (83.4)		183 (95.8)	180 (91.4)	363 (93.6)		
The lost household member was playing a key role in securing food for the household									
Yes	22 (68.7)	24 (63.2)	46 (65.7)	0.001*	6 (75.0)	11(64.7)	17 (68.0)	0.61	0.001*
No	10 (31.3)	14 (36.8)	24 (34.3)		2 (25.0)	6 (35.3)	8 (32.0)		
Migration of any member of the household in the past 12 mo preceding the survey									
Yes	19 (9.0)	54 (25.6)	73 (17.3)	0.000*	38 (19.9)	16 (8.1)	54 (13.9)	0.001*	0.32
No	193 (91.0)	157 (74.4)	350 (82.7)		153 (80.1)	181 (91.9)	334 (86.1)		
Household ownership of assets or entitlements[7]									
Yes	137 (64.9)	143 (67.8)	280 (66.4)	0.21	57 (29.8)	121 (61.4)	178 (45.9)	0.000*	0.000*
No	74 (35.1)	68 (32.2)	142 (33.6)		134 (70.2)	76 (38.6)	210 (54.1)		
Main source of drinking water for the household									
Improved[8]	112 (53.1)	95 (45.0)	207 (49.1)	0.000*	103 (53.9)	189 (95.9)	292 (75.3)	0.000*	0.000*
Nonimproved[9]	99 (46.9)	117 (55.0)	215 (50.9)		88 (46.1)	8 (4.1)	96 (24.7)		
Type of toilet facility used by the household									
Improved pit[10]	3 (1.4)	7 (3.3)	10 (2.4)	0.22	0 (0.0)	5 (2.5)	5 (1.3)	0.08	0.25
Open pit	208 (98.6)	204 (96.7)	412 (97.6)		191 (100.0)	192 (97.5)	383 (98.7)		

[1] Values are n (%) or means ± SDs. *$P < 0.05$.
[2] P value is for chi-square or t test between affected and control groups in the food-plenty season.
[3] P value is for chi-square or t test between affected and control groups in the food-poor season.
[4] P value is for chi-square or t test between the food-plenty and food-poor seasons.
[5] Refers to grandparents or elderly siblings.
[6] Refers to fishing or wage employee.
[7] Such as farm, livestock, poultry, motorcycle, bicycle.
[8] Defined as piped/tap, protected well/spring, and borehole water.
[9] Defined as surface water, river, stream, gravity flow water, rainwater, and water from open well or spring.
[10] Defined as flush toilet, ventilated improved pit latrine, or pit latrine with slab and cover.

TABLE 2 Socioeconomic demographics of the participating children[1]

Variables	Food-plenty season (n = 392)				Food-poor season (n = 366)				
	Affected (n = 197)	Control (n = 195)	Total (n = 392)	P[2]	Affected (n = 175)	Control (n = 191)	Total (n = 366)	P[3]	P[4]
Sex									
Male	88 (44.7)	108 (55.4)	196 (50.0)	0.034*	73 (41.7)	101 (52.9)	174 (47.5)	0.042*	0.48
Female	109 (55.3)	87 (44.6)	196 (50.0)		102 (58.3)	91 (47.6)	192 (52.5)		
Age (mo)									
6–11	48 (24.4)	28 (14.4)	76 (19.4)	0.003*				0.008*	0.003*
12–23	63 (31.9)	53 (27.2)	116 (29.6)		67 (38.3)	51 (26.7)	118 (32.2)		
24–35	37 (18.8)	45 (23.1)	82 (20.9)		53 (30.3)	45 (23.6)	100 (27.3)		
36–47	26 (13.2)	45 (23.1)	71 (18.1)		29 (16.6)	52 (27.2)	81 (22.1)		
48–59	22 (11.2)	27 (13.8)	47(11.9)		16 (9.1)	32 (16.7)	50 (13.7)		
>60					8 (4.6)	9 (4.7)	17 (4.6)		
Child parity	4.0 ± 2.8	3.5 ± 2.3	3.8 ± 2.6	0.059	4.0 ± 2.8	3.6 ± 2.3	3.8 ± 2.6	0.11	0.95
Child still breastfeeding, n	111	78			61	48	109		
Yes	88 (79.3)	61 (78.2)		0.32	42 (68.85)	25 (58.08)	67 (64.4)	0.14	0.000*
No	23 (20.72	17 (21.79)			19 (31.14)	23 (47.91)	42 (38.5)		
Age of introduction of solid and semi-solid food									
Below 6 mo	53 (49.5)	36 (44.4)	89 (47.1)	0.41	42 (47.2)	27 (54.0)	69 (49.6)	0.52	0.000*
Above 6 mo	55 (51.4)	45 (55.5)	100 (52.9)		47 (52.8)	23 (46.0)	70 (50.3)		
Child suffered any illness in the last 30 d preceding the survey									
Yes[5]	132 (67.0)	114 (58.5)	246 (62.8)	0.11	66 (37.1)	82 (42.9)	148 (40.4)	0.31	0.000*
No	65 (33.5)	81 (41.54)	146 (37.2)		109 (62.28)	109 (57.06)	218 (59.6)		

[1]Values are n (%) or means ± SDs. *$P < 0.05$.
[2]P value is for chi-square or t test between affected and control groups in the food-plenty season.
[3]P value is for chi-square or t test between affected and control groups in the food-poor season.
[4]P value is for chi-square or t test between the food-plenty and food-poor seasons.
[5]Illness conditions included malaria, upper respiratory infection, diarrhea, measles, and fever.

TABLE 3 Child malnutrition indicators[1]

Variables	Food-plenty season (n = 392) Affected (n = 197)	Control (n = 195)	Total (n = 392)	P^3	Food-poor season (n = 366)[2] Affected (n = 177)	Control (n = 189)	Total (n = 366)	P^4	P^5
Stunted (HAZ < −2)	84 (42.6)	64 (32.8)	148 (37.7)	0.045*	87 (49.1)	78 (41.2)	156 (42.6)	0.11	0.11
HAZ	−1.6 ± 1.6	−1.4 ± 1.3	−1.5 ± 1.5		−1.8 ± 1.3	−1.6 ± 1.4	−1.7 ± 1.4		
Underweight (WAZ < −2)	36 (18.3)	16 (8.2)	52 (13.3)	0.003*	32 (18.1)	20 (10.5)	52 (14.2)	0.032*	0.62
WAZ	−0.8 ± 1.3	−0.6 ± 1.1	−0.7 ± 1.2		−0.9 ± 1.1	−0.8 ± 1.0	−0.8 ± 1.1		
Wasted (WHZ < −2)	9 (4.5)	5 (2.5)	14 (3.6)	0.29	4 (2.3)	3 (1.6)	7 (2.0)	0.62	0.18
WHZ	0.4 ± 1.1	0.3 ± 1.5	0.2 ± 1.1		0.1 ± 0.9	0.2 ± 1.0	0.2 ± 1.0		
Overweight (WHZ > +2)	7 (3.5)	10 (5.1)	17 (4.3)	0.44	5 (2.9)	6 (3.2)	10 (2.7)	0.89	0.23
Concurrent stunting and wasting	5 (2.5)	2 (1.0)	7 (1.8)	0.25	3 (1.7)	0 (0.0)	3 (1.7)		0.25
Concurrent stunting and overweight	3 (1.5)	2 (1.0)	5 (1.3)	0.66	4 (2.3)	7 (3.9)	11(3.2)	0.42	0.08
Low MUAC[6]	13 (6.6)	5 (2.5)	18 (4.6)	0.056	5 (2.6)	3 (1.6)	8 (2.3)	0.48	0.07
MUACZ	−0.5 ± 1.1	−0.3 ± 1.0	−0.4 ± 1.0		−0.5 ± 1.0	−0.4 ± 0.9	−0.9 ± 0.9		
Low HC (HCZ < −2)	12 (6.1)	1 (0.5)	13 (3.3)	0.002*	11 (5.6)	1 (0.5)	12 (3.4)	0.002*	0.76
HCZ	−0.0 ± 1.3	0.2 ± 1.1	0.1 ± 1.2		−0.4 ± 1.4	0.0 ± 0.9	0.0 ± 1.2		

[1]Values are n (%) or mean ± SDs. *P < 0.05. HAZ, height-for-age z score; HC, head circumference; HCZ, HC-for-age z score; MUAC, midupper arm circumference; MUACZ, MUAC-for-age z score; WAZ, weight-for-age z score; WHZ, weight-for-height z score.
[2]Percentages differed according to the age of the children included in the study in the food-poor season.
[3]P value is for chi-square or t test between affected and control in the food-plenty season.
[4]P value is for chi-square or t test between affected and control in the food-poor season.
[5]P value is for chi-square or t test between the food-plenty and food-poor seasons.
[6]Low MUAC is defined as MUAC <125 mm, an indicator of wasting/acute malnutrition.

child, particularly 36–47 mo, came with minimum odds for stunting (aOR = 0.34), whereas parents' education status came with higher odds for stunting (aOR = 2.32) at follow-up (Table 4).

Children residing in the landslide-affected sub-county were 4.25 times more likely to be underweight than children residing in the control sub-county (**Table 5**). Similarly, male children were 1.48 times more likely to be underweight than female children in the food-plenty season, while children from households with a nonimproved drinking water source were 2.74 times more likely to be underweight compared with children from households with an improved drinking water source in the food-plenty season. On the other hand, being male came with a minimum risk (aOR = 0.42) for being underweight, whereas children whose parents had attained primary-level education or less were 4.74 times more likely to be underweight in the food-poor season (Table 5).

Children from households that had reported migration of any household member in the past 12 mo preceding the survey were 7.78 times more likely to be wasted in the food-plenty season than children from households that had not reported such migration (**Table 6**). Children from households that had reported loss of any household member in the past 12 mo preceding the survey were 8.08 times more likely to be wasted in the food-poor season than children from households that had not reported loss of any household member in the past 12 mo preceding the survey.

Results further showed that parents' education status of secondary level and above (aOR = 2.97) and parents' marital status of not being married (aOR = 3.46) were significantly associated with child overweight in the food-plenty season (**Table 7**). There were no significantly associated risk factors of overweight observed in the food-poor season. The results of the sensitivity analyses on model performance were similar to those of the primary analyses (**Supplemental Tables 2** and **3**).

Discussion

Our current study demonstrates seasonal variations in the prevalence and associated risk factors of under-5 child malnutrition in the landslide-prone Bududa District, eastern Uganda. Specifically, we found a high prevalence of stunting and underweight in both food seasons based on the WHO classification (47). Moreover, this high stunting prevalence was higher compared with that of *1*) the Bugisu subregion, *2*) the national average based on the 2016 Uganda Demographic Health Survey (21), and *3*) a pooled prevalence of 33.3% in the recent multilevel analysis in 12 East African countries (38). This implies that there has probably been an increased prevalence of the 2 forms of child undernutrition in the landslide-prone community from 2010 to 2020, possibly attributed to many factors, including the persistent landslides in the district, and there were deprivation effects on livelihoods and the right to adequate food. Arguably, natural disasters often unmask pre-existing poor nutritional status in children, particularly in low-income settings, that could be well above the emergency threshold (48).

The most interviewed heads of households were mothers in the food-plenty season and fathers in the food-poor season. Perhaps the one-on-one nutrition-sensitization and nutrition-education sessions that took place at the Nutrition Unit in Bududa Hospital during data collection in the food-plenty season with the household heads could

TABLE 4 Factors associated with child stunting[1]

	Food-plenty season ($n = 392$)						Food-poor season ($n = 366$)					
	Stunting						Stunting					
Variable	Yes	No	cOR (95% CI)	*P*	aOR (95% CI)[2]	*P*	Yes	No	cOR (95% CI)	*P*	aOR (95% CI)[2]	*P*
Sub-county												
Affected	84	113	1.52 (1.01, 2.29)	0.045*	1.68 (1.08, 2.59)	0.019*	87	89	1.40 (0.92, 2.12)	0.11	1.10 (0.68, 1.17)	0.69
Control	64	131	1		1		78	112	1		1	
Child's sex												
Male	76	120	1.09 (0.72, 1.64)	0.67	1.19 (1.02, 2.83)	0.040*	69	104	0.66 (0.44, 1.01)	0.053*	0.68 (0.43, 1.07)	0.09
Female	72	124	1		1		96	96	1		1	
Age of the child (mo)												
6–11	17	59	1		1							
12–23	52	64	2.82 (1.46, 5.41)	0.002*	3.41 (1.67, 6.94)	0.001*	61	57	1			
24–35	34	48	2.45 (1.22, 4.92)	0.011*	2.87 (1.33, 6.19)	0.007*	45	55	0.75 (0.43, 1.28)	0.29	0.74 (0.42, 1.31)	0.31
36–47	26	45	2.13 (1.03, 4.38)	0.040*	2.57 (1.17, 5.66)	0.018*	21	60	0.32 (0.17, 0.59)	0.000*	0.34 (0.18, 0.66)	0.008*
48–59	18	29	2.15 (0.96, 4.78)	0.059	2.40 (1.01, 5.69)	0.046*	21	29	0.66 (0.34, 1.29)	0.23	0.64 (0.32, 1.29)	0.22
≥60							16	01				
	Child still breastfeeding ($n = 198$)						Child breastfeeding ($n = 125$)					
Yes	46	103	1		1		40	25	1		1	
No	26	23	2.53 (1.31, 4.84)	0.006*	2.16 (1.01, 4.60)	0.042*	36	24	0.91 (0.44, 1.87)	0.80	0.90 (0.45, 1.81)	0.78
Age of introduction of solid and semi-solid food												
Below 6 mo	37	52	1		1		30	38	1		1	
Above 6 mo	33	67	0.69 (0.39, 1.25)	0.22	0.60 (0.31, 1.15)	0.13	19	38	0.64 (0.42, 1.34)	0.52	0.93 (0.59, 1.47)	0.77
Number of under-5 children in the household												
≤3	133	230	1		1		156	196	1		1	
≥4	15	14	1.85 (0.86, 3.95)	0.11	2.04 (0.89, 4.68)	0.09	09	06	1.87 (0.65, 5.38)	0.24	1.63 (0.52, 5.07)	0.39
Parents' education status												
≤Primary	123	182	1.67 (1.00, 2.81)	0.050*	1.73 (1.01, 2.97)	0.044*	135	153	2.26 (1.32, 3.89)	0.003*	2.28 (1.26, 4.12)	0.006*
≥Secondary	25	62	1		1		21	57	1		1	
Household size												
≤5 members	62	117	1		1		92	115	1		1	
≥6 members	86	127	1.03 (0.66, 1.62)	0.26	1.13 (0.73, 1.75)	0.86	73	86	1.06 (0.70, 1.61)	0.78	1.04 (0.63, 1.63)	0.95

[1] *$P < 0.05$. aOR, adjusted OR; cOR, crude OR.
[2] Adjusted for child sex, age, breastfeeding, age of introduction of solid and semi-solid food, parents' education status, and household size.

TABLE 5 Factors associated with child underweight[1]

Variables	Food-plenty season (n = 392)						Food-poor season (n = 366)					
	Underweight						Underweight					
	Yes	No	cOR (95% CI)	*P*	aOR (95% CI)[2]	*P*	Yes	No	cOR (95% CI)	*P*	aOR (95% CI)[2]	*P*
Subcounty												
Affected	36	161	2.50 (1.34, 4.67)	0.004*	4.25 (1.10–15.36)	0.032*	32	143	1.91 (1.04, 3.49)	0.034*	1.18 (0.53–2.63)	0.67
Control	16	179	1		1		20	171	1		1	
Child's sex												
Male	29	167	1.31 (0.73, 2.33)	0.37	1.48 (1.12–4.47)	0.024*	16	157	0.44 (0.23, 0.83)	0.012*	0.42 (0.21, 0.81)	0.010*
Female	23	173	1		1		36	157	1		1	
Age of the child (mo)												
6–11	11	65	1		1							
12–23	17	99	1.01 (0.44, 2.30)	0.97			18	100	1		1	
24–35	07	75	0.55 (0.20, 1.50)	0.24	1.66 (0.60, 4.63)	0.33	16	84	1.05 (0.51, 2.20)	0.88	1.12 (0.52, 2.44)	0.76
36–47	07	64	0.64 (0.23, 1.77)	0.39	4.06 (0.29, 56.21)	0.29	08	73	0.61 (0.25, 1.47)	0.27	0.74 (0.29, 1.89)	0.53
48–59	10	37	1.59 (0.62, 4.11)	0.33			05	45	0.61 (0.22, 1.76)	0.36	0.62 (0.2, 1.92)	0.41
≥60							05	12	2.31(0.72, 7.36	0.15	2.79 (2.77, 10.10)	0.11
Age of introduction of solid and semi-solid food												
Below 6 mo	19	70	1		1		24	169	1		1	
Below 6 mo	10	90	0.41 (0.81, 0.92)	0.031*	0.44 (0.18, 1.06)	0.06	28	145	1.35 (0.75, 2.44)	0.31	1.55 (0.82, 2.93)	0.17
Number of under-5 children in the household												
≤3	43	320	1		1		49	302	1		1	
≥4	09	20	3.35 (1.43, 7.82)	0.005*	2.67 (0.80, 8.84)	0.11	03	12	1.54 (0.42, 5.65)	0.52	1.12 (0.28, 4.35)	0.86
Parents' education status												
≤Primary	44	261	1.61 (0.76, 3.62)	0.20	1.42 (0.43, 2.49)	0.28	49	239	5.12 (1.64, 15.92)	0.003*	4.74 (1.40, 16.03)	0.012*
≥Secondary	08	79	1		1		03	75	1		1	
Main source of drinking water												
Improved	28	253	1		1		32	243	1		1	
Nonimproved	23	84	2.47 (1.35, 4.52)	0.003*	2.74 (1.04, 7.18)	0.041*	20	71	2.14 (1.15, 3.96)	0.016*	1.87 (0.86, 4.09)	0.11
Main source of food												
Purchasing	24	152	1		1		28	182	1		1	
Own production	28	188	0.94 (0.53, 1.69)	0.85	0.53 (0.19, 1.46)	0.22	24	132	1.18 (0.65, 2.13)	0.57	1.23 (0.63, 2.41)	0.53

[1] *$P < 0.05$. aOR, adjusted OR; cOR, crude OR.

[2] Adjusted for child sex, age, age of introduction of solid and semi-solid food, number of under-5 children in the household, parents' education status, source of drinking water, and source of food.

TABLE 6 Factors associated with child wasting[1]

Variables	Food-plenty season (n = 392) Wasting Yes	No	cOR (95% CI)	*P*	aOR (95% CI)[2]	*P*	Food-poor season (n = 366) Wasting Yes	No	cOR (95% CI)	*P*	aOR (95% CI)[3]	*P*
Subcounty												
Affected	09	188	1.82 (0.62, 5.27)	0.28	2.70 (0.51, 14.32)	0.24	04	163	1.12 (0.36, 5.93)	0.90	1.37 (0.17, 7.15)	0.71
Control	05	190	1		1		03	179	1		1	
Sex of the child												
Male	10	186 1	2.58 (0.83, 7.91)	0.10	2.06 (0.53, 9.94)	0.29	03	163	0.82 (0.18, 3.73)	0.80	0.78 (0.16, 3.76)	0.76
Female	04	192	1		1		04	179	1		1	
Age of introduction of semi-solid food												
Below 6 mo	07	82	1		1		03	163	1		1	
Above 6 mo	04	96	0.48 (0.14, 1.73)	0.26	0.44 (0.10, 1.81)	0.25	04	179	1.46 (0.32, 6.64)	0.62	1.62 (0.34, 7.66)	0.54
Suffered any illness in the past 30 d preceding the survey												
Yes	12	233	3.71 (0.81, 16.80)	0.089	6.16 (0.70, 53.72)	0.10						
No	02	144	1		1							
Parents' education status												
≤Primary	13	292	3.82 (0.63, 0.01)	0.16	3.05 (0.35, 26.29)	0.31	06	268	1.65 (0.25, 0.01)	0.63	1.82 (0.20, 16.26)	0.58
≥Secondary	01	86	1		1		01	74	1		1	
Reported migration of any household member in the past 12 mo												
Yes	06	57	3.82 (1.28, 11.4)	0.016*	7.78 (1.16, 37.59)	0.011*	01	47	1.05 (0.12, 8.88)	0.96	0.73 (0.07, 7.01)	0.79
No	08	317	1		1		06	295	1		1	
Reported to have lost any household member in the past 12 mo												
Yes	01	62	0.39 (0.01, 2.39)	0.35			02	323	6.8 (1.23, 37.36)	0.027*	8.08 (1.37, 27.71)	0.021*
No	13	316	1	0.35			05	19	1		1	
Main source of drinking water												
Improved	08	273	1		1		04	258	1		1	
Nonimproved	06	101	2.03 (0.68, 5.98)	0.20	1.68 (0.36, 7.75)	0.25	03	84	2.30 (0.50, 10.50)	0.28	2.58 (0.41, 16.18)	0.31

[1]*P < 0.05. aOR, adjusted OR; cOR, crude OR.

[2]Adjusted for child sex, age of introduction of solid and semi-solid food, child suffered any illness, parents' education status, migration of any household member, and main source of drinking water.

[3]Adjusted for child sex, age of introduction of solid and semi-solid food, parents' education status, migration of any household member, and main source of drinking water.

TABLE 7 Factors associated with child overweight[1]

	Food-plenty season ($n = 392$)						Food-poor season ($n = 366$)					
	Overweight						Overweight					
Variables	Yes	No	cOR (95% CI)	*P*	aOR (95% CI)[2]	*P*	Yes	No	cOR (95% CI)	*P*	aOR (95% CI)[3]	*P*
Subcounty												
Affected	07	190	0.68 (0.26, 1.77)	0.44	0.91 (0.30, 2.73)	0.81	05	162	1.09 (0.33, 3.59)	0.89	0.95 (0.25, 3.59)	0.94
Control	10	185	1		1		05	177	1		1	
Sex of the child												
Male	09	187	1.13 (0.44, 2.90)	0.80	1.08 (0.39, 3.01)	0.87	05	161	1.1 (0.33, 3.63)	0.87	1.22 (0.34, 4.42)	0.75
Female	08	188	1		1		05	178	1		1	
Child parity												
1	03	89	0.68 (0.19, 2.45)	0.56	0.54 (0.14, 2.06)	0.37	01	73	0.41 (0.05, 3.24)	0.39	0.41 (0.05, 3.39)	0.41
≥2	14	286	1		1		09	266	1		1	
Parents' education status												
≤Primary	10	295	1		1		06	268	1		1	
≥Secondary	07	80	2.58 (0.98, 6.78)	0.054*	2.97 (1.02, 8.58)	0.041*	04	71	2.51 (0.74, 8.55)	0.15	2.61 (0.69, 9.88)	0.16
Pa rents' marital status												
Married	11	315	1		1							
Not married	06	60	2.86 (1.02, 8.03)	0.046*	3.46 (1.12,10.73)	0.031*						
Household main source of livelihood												
Farming	10	265	0.59 (0.22, 1.54)	0.29	0.53 (0.17, 1.63)	0.23	04	150	0.84 (0.23, 3.03)	0.79	0.65 (0.17, 2.51)	0.54
Other	07	110	1		1		06	189	1		1	

[1] *$P < 0.05$. aOR, adjusted OR; cOR, crude OR.
[2] Adjusted for child sex, child parity, parents' education status, parents' marital status and household source of livelihood.
[3] Adjusted for child sex, child parity, parents' education status and household source of livelihood.

have created awareness among the mothers who managed to convince the fathers to participate in the follow-up survey of data collection. Also, probably, the ethically approved transport reimbursement that was issued to each household head at baseline for bringing the eligible child to the hospital for standard anthropometric assessment could have motivated more fathers to participate in the follow-up survey of data collection.

Although those affected by landslides seem to be more at risk, stunting and underweight prevalence was higher in the food-poor season while wasting and overweight prevalence was higher in the food-plenty season. The prevalence of wasting (3.6%) in the food-plenty season was in the same range as the national prevalence (21). This shows that, even amidst the food-plenty season, some households in the study area were consuming a less diversified diet, a proxy measure of nutrient adequacy, as shown by the prevalence of wasting among the children.

Children residing in the landslide-affected area had higher odds of stunting and underweight than children in the control area. These results are consistent with findings in India (49) and Nepal (50), which showed that exposure to floods increased the likelihood of child malnutrition. This probably indicates that exposure to the persistent landslides in the landslide-prone community contributed to the malnutrition prevalence levels among children in the landslide-affected community. Persistent exposure to natural disasters such as landslides exposes the community to reduced food supply; restricted access to safe and nutritious food; reduced quantity and quality of food consumed; and disrupted access to health, safe water, and sanitation facilities, thus increasing child malnutrition (6, 12, 51). Furthermore, the landslide-affected community is located on steep mountainous terrain, restricting accessibility to maternal and child health care services, such as health facility delivery, antenatal, and postnatal care visits that could otherwise raise community awareness to provide quality complementary feeding and access to child immunization and growth-monitoring services.

Children aged 12–23 mo had higher odds of stunting than those in the older age group of 24–59 mo in the food-plenty season. This contradicts findings in Zambia (51) in which children aged 12–23 mo had lower odds of stunting than those aged 24–59 mo. Moreover, the stunting peak in the 2016 Uganda Demographic and Health Survey was 37% in the age category of 18–35 mo (20). This mismatch is probably because growth and development of children are most rapid when children are younger than 24 mo, with relatively high nutritional needs, and any food shortage due to disasters and related shocks makes the younger age group of children more vulnerable to malnutrition.

Being male was associated with higher odds of stunting and underweight in the food-plenty season, which is in agreement with similar trends from sub-Saharan Africa (38, 52). This might be due to preferences in feeding practices such as early weaning of boys (53) and children's behaviors, whereby girls might stay closer to the home and have more access to food being cooked, while boys play outside and, in turn, eat less while expending more energy (53). This is also because in the first months of life, the growth of boys is slightly more rapid and affected by nutritional deficiencies (54) or other exposures like lower respiratory infections and malaria (55) than girls. Likewise, this could be partially attributed to the exposure effects of the 2018 landslide that occurred 6–7 mo before data collection in the food-plenty season, possibly affecting the food and nutrition security of households and thus the manifestation of malnutrition among the children in the food-plenty season.

Our analysis further showed that parental education was associated with stunting, underweight, and overweight. Children of parents who had attained primary-level education or less were more likely to be stunted and underweight compared with children of parents who had attained secondary-level education and above. This is supported by findings of an association of lower parental education with poor growth outcomes of children in low- and middle-income countries (39, 40, 56). Parents' education status is one of the most important determinants of under-5 malnutrition (57). Parental education not only influences health-seeking behaviors (39, 58), such as timely and full childhood vaccinations and use of health facility services (39), but also affects household income and resource allocation towards children's health (58). Less educated parents tend to have lower household income and a higher poverty level and thus spend less on proper nutrition, and their children are more susceptible to growth failure due to insufficient access to adequate food and basic health care services and greater exposure to poor living conditions and diseases (39, 58).

Children who were not breastfeeding had higher odds of being stunted than the children who were breastfeeding at baseline. Findings from Mexico (59) reported similar trends of child breastfeeding as a protective factor for stunting. This is, at least in part, due to the breast-milk's immune-protective factors reducing the risk of infections such as diarrhea and acute respiratory diseases (60). Moreover, delayed early introduction to complementary feeding is linked to intake of low-nutrient-density foods and recurrent infections resulting in child malnutrition (60).

Children whose drinking water sources were nonimproved were more likely to be underweight than those with an improved drinking water source. Arguably, unsafe water has been reported to be among the determinants of childhood undernutrition (60, 61). Nonimproved water sources may be contaminated and thus increase the risk of waterborne diseases and infections (e.g., diarrhea and cholera) (60–62), which not only affect the children's dietary intake and nutrient utilization but also lead to dehydration, thus resulting in child undernutrition such as wasting and stunting.

Migration of any household member in the past month preceding the survey was a risk factor for child wasting. This corroborates with findings (63) that reported increased risk of wasting among children left behind by their parents in low- and middle-income countries. Migration is an indicator of an extreme-food-insecurity coping strategy in the household (64) and possibly the persons who had migrated were vital in ensuring the household's food security. Reportedly, migration is often the last option left to household members at a risk of starvation (64). Notably, migration not only increases psychological stress to the children left behind but also reduces the time allocated to child care, including changed feeding practices (63).

The main strength of our current study is the cohort design that allowed for variations in the prevalence and risk factors of child malnutrition during both food seasons. Additionally, the study had a fairly large and representative sample size; thus, these findings might be generalizable to the current context of landslide disasters in Uganda and probably elsewhere in different disaster, geographical, and cultural contexts. The major limitation was loss to follow-up and the possibility of recall and reporting bias in socioeconomic and demographic variables of the household and the child, although we used a short recall period to reduce such bias. The different caretakers who brought the children for assessment, especially the phenomenon of more male caretakers on follow-up, could also have introduced information bias about factors relating to the child. Moreover, we do not have actual data on actual food intake, detailed body composition, or biomarkers of nutrient intake among the study participants. Also, the sample size was estimated to detect expected prevalence of anthropometric outcomes, and not based on associations tested in the study.

In conclusion, with the exception of overweight/obesity, various forms of child malnutrition were observed in the study area. The affected children were more at risk for malnutrition than the controls and the risk factors differed between the food-plenty and food-poor seasons. Therefore, underlying determinants and exposures to malnutrition in children should be concurrently addressed in an integral manner during disaster management. Moreover, our study outcomes imply that there is a gap in the availability, access, and/or delivery of postnatal nutrition support and growth-monitoring and promotion services in the study areas.

National development plans especially the current Uganda National Development III 2020/2021–2024/2025, the overarching macroeconomic development policy framework, as well as multisectoral policies, especially the Uganda Disaster Preparedness and Management Policy 2010 and the Uganda Nutrition Action II 2020/2021–2024/2025, should give greater attention to the serious and growing problem of landslides, a problem linked to climate change, which is affecting the safety, livelihood, and survival of the poor rural communities including vulnerable children aged 6–59 mo. Policy actions that promote landslide victims' accessibility to and ownership of land that is not prone to landslides are crucial. Similarly, policies that promote food production, diet diversification, empowerment of households with income-generating activities, and concrete, legally appropriated, disaster-specific public social safety nets such as unconditional cash transfers are of essence.

Equally, elimination of poverty and improving parental education, access to improved water sources, health care services, and early child care and development programs and policies are key in the improvement in the nutritional status of children in the disaster-prone areas if we are to combat hunger and end all forms of malnutrition as stated by Sustainable Development Goal 2.2. Policies and programs should align with the Uganda National Development III 2020/2021–2024/2025, the Uganda Nutrition Action Plan II (2020–2025), the Maternal Infant and Young Child and Adolescent Nutrition Strategy and Guidelines 2021, and the international nutrition commitments from the UN Food Systems Summit, the Conference of the Parties 26 (COP 26) and the Nutrition For Growth Summit 2021. It is also important that there is political support in relevant Ugandan ministries, directorates, and at the local/regional level for such policies and programs. Finally, our study findings illustrate how crucial food and nutrition security are for human and planetary health in the context of climate change and vice versa.

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Data Availability

Data described in the manuscript, code book, and analytic code will be made available upon request pending application and approval.

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