Determinants of stunting and underweight among children aged 6 to 59 months in Bussi Islands of Wakiso District, Uganda: a cross-sectional study

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Abstract

Background: Child malnutrition in rural hard to reach areas of Uganda is higher than that in urban areas and it leads to increased risk of death. It is assumed that the condition is worse in Islands, however, limited research has been conducted on the prevalence and determinants of stunting and underweight among children in the Islands of Uganda. This study assessed the prevalence and determinants of stunting and underweight among children aged 6 to 59 months in Bussi Islands of Wakiso District in Uganda.

Methods: A cross-sectional survey using quantitative methods was conducted in the Islands of Wakiso District. 409 households and 409 caretaker-child pairs of children aged 6 to 59 months were got using simple random sampling. Modified poisson regression generated Unadjusted and Adjusted Prevalence Ratios with 95% confidence intervals.

Results: Prevalence of stunting and underweight among children was 29.8% and 16.1% respectively. Determinants of stunting were child age of 12 to 23 months and 24 to 35 months (APR: 2.28; 95% CI: 1.29, 4.03 and APR: 1.97; 95% CI: 1.09, 3.56 respectively); household food insecurity (APR: 1.67; 95% CI: 1.15, 2.43); utilisation of more than 80 litres of water in a day by a household (APR: 0.48; 95% CI: 0.24, 0.95); suffering from diarrhoea (APR: 1.79; 95% CI: 1.28, 2.50); receiving of deworming tablets every six months by children (APR: 0.58; 95% CI: 0.42, 0.81) and not suffering from measles (APR: 0.62; 95% CI: 0.42, 0.92). Determinants of underweight were child age of 24 to 35 months (APR: 2.30; 95% CI: 1.13, 5.33), suffering from diarrhoea (APR: 2.06; 95% CI: 1.30, 3.27) and having more than nine household members (APR: 3.18; 95% CI: 1.10, 10.6).

Conclusions: Child stunting and underweight are public health problems in Bussi Islands of Wakiso District. Therefore, nutrition interventions in the Islands should focus on the determinants that were identified by this study.
Background

Child malnutrition remains a global challenge with rural hard to reach areas of low and middle income countries being the most affected (1). It contributes to 11% of Disability Adjusted Life Years (DALYs) and about 45% of deaths among children under 5 years of age (1, 2). Child malnutrition is also the leading contributor to increased risk of death, learning difficulties in school, earning less as adults, having weakened immunity, increased susceptibility to infections as well as long term developmental delays (3).

Globally, an estimated 22.2% (150.8 million), 7.5% (50.5 million) and 5.6% (38.3 million) children under five years were stunted, wasted and overweight respectively in 2017. In the same year, it was estimated that 39% (58.7 million), 27% (13.8 million) and 25% (9.7 million) of all stunted, wasted and overweight children under five years respectively lived in Africa. It was, furthermore, estimated that 35. 6% (23.9 million), 6% (4 million) and 4.4% (3 million) of all children under five years in East Africa were stunted, wasted and overweight respectively (4). In 2016, it was estimated that, of all children under five years in Uganda, 29%, 11% and 4% were stunted, underweight and wasted respectively.

Children in rural hard to reach areas of Uganda are more likely to be stunted than those in urban areas. The current prevalence of stunting in rural Uganda is 30% compared to 24% in the urban areas (5). This could be attributed to a number of causes which include but are not limited to diseases, inadequate dietary intake, household food insecurity, poor child care, poor health services and unhealthy environments (2).

If the problem of malnutrition is not addressed, consequences, including but not limited to increased risk of death, learning difficulties in school and increased susceptibility to infections will continue to affect the children even in their adult age (3).

Nationally interventions like the Uganda expanded program on Immunisation (UNEPI) and operation wealth creation (OWC) activities have been done with a target of reducing the
high rates of malnutrition, however, limited success has been registered (6). Locally interventions like routine immunisation, nutrition education of child caretakers on IYCF feeding guidelines, deworming and Vitamin A supplementation to children has been done with limited success.

Bussi Islands have unique challenges that cripple nutrition and health related services. While the Islands are about 10 Kilometres away from Entebbe (the entry point of international visitors), accessibility by both road and water is quite challenging. Safe water coverage in Bussi is among the least in the country at 20%. Lack of electricity, limited access to quality health services and strict regulation of livelihood activities like fishing are some of the challenges faced by people leaving in the Islands. Land for agriculture is also limited and yet the population is high (7).

In spite of the contextual challenges which exacerbate the poor nutrition status of children, no research had been done in this context to generate scientific evidence on the prevalence and determinants of stunting and underweight among children to inform decision making on the interventions.

This study thus determined the prevalence and determinants of stunting and underweight among children aged 6 to 59 months in Bussi Islands. The findings of this study would therefore be used to formulate and integrate nutrition interventions by stakeholders in health service delivery through focussing on those identified determinants in order to improve the nutrition status of the children.

Methods

**Study area, design, period and population**

The study was conducted in Bussi Islands which are located in Wakiso district of Uganda. There are five Islands that make up Bussi Islands. The Islands have an approximate catchment population of 10,000 people, they are completely surrounded by Lake Victoria
and are located approximately 41 kilometres (24.6 miles) south of Kampala City (8, 9). A cross-sectional survey that used quantitative methods of data collection from the community was conducted in Bussi Islands from the 13th to the 18th of April 2019. The study respondents were child caretakers in households which had at least one child aged 6 to 59 months as the study population were children aged 6 to 59 months in Bussi Islands.

**Sample size**

An adjusted sample size of 409 households with at least a child aged 6 to 59 was estimated using the Kish Leslie formula (10). The prevalence of stunting in rural areas of Uganda which was 30% (5), a 95% confidence interval and a maximum acceptable error of 5% were used to estimate the sample size. A design effect of 1.2 and a 5% potential non response are the adjustments that were performed.

**Inclusion and exclusion criteria**

Households in Bussi Islands that had at least a child aged 6 to 59 months were eligible for inclusion. Households in which child caretakers were unavailable after two follow up visits and those households that had children who were eligible for inclusion but had physical body deformities that would have interfered with anthropometric assessment results.

**Sampling procedure**

The sample was got from three out of the five Islands that make up Bussi Islands. With the help of the local leaders, all households with at least one child aged 6 to 59 months were identified from which the sample households were randomly selected using simple random sampling method. Sample selection was done proportionate to the number of households with children aged 6 to 59 months in each Island. Where there was more than one child aged 6 to 59 months in the household, balloting method was used to select the child to take part in the study.

**Study Variables**
**Outcome variables:** This was malnutrition in the form of stunting and underweight. The basic information and anthropometric measurements that were used to assess for stunting and underweight in children aged 6 to 59 months were: age, sex, weight and height/length. Following the WHO recommendations, the decision to measure height or length depended on age and physical condition of the child. Height was measured for children who were aged ≥24 months and length for children who were aged <24 month. In cases where the exact age of the child was not known, height was measured for children ≥87 cm and length was measured for children <87 cm. In cases where a child ≥24 months of age was too sick to stand, length of the child was measured and 0.7 cm were subtracted from it. Weight for Height/Length (WFH/L) Z-scores were used to identify stunting and a child was stunted when the WFH/LZ-scores were < -2 Standard Deviations (SD). Weight for Age (WFA) Z-scores were used to identify underweight and a child was underweight when the WFAZ-scores were < -2 SD (11, 12).

**Exposure variables:** These were the independent variables and they included:

**Child characteristics**

(a) Dietary intake and child characteristics: Indicated by introduction of solid, semi-solid or soft foods, feeding method, breast feeding status, child meal frequency, age, sex, delivery place, delivery attendant, birth type and birth order.

(b) Child health status characteristics: Indicated by immunisation; sickness (diarrhoea, fever, respiratory diseases and measles); Vitamin A supplementation and deworming statuses.

**Household food security status characteristics**

a) Food access; indicated by the modified HFIAS levels, household dietary diversity scores (HDDS), food consumption scores (FCS), household members earning an income and household food source.
b) **Food availability:** indicated by agricultural land access; crop growth and purpose; fishing and fish purpose; food stocks; livestock ownership and livestock purpose.

**Health system characteristics:** indicated by transport mode to health facility, ownership of transport means, transport cost to health facility.

**WASH characteristics:** indicated by drinking water source, amount of water used in household per day, waste disposal method, child's hand washing before feeding and drinking water treatment method.

**Socio-demographic and economic characteristics:** indicated by caretaker age, sex, type, marital status and education; maternal parity, pregnancy and breastfeeding status (where the caretaker was the biological mother); income source of household head; household members; children aged < 60 months in households and household lighting type.

**Data collection**

A face to face interview method was used to collect data on child dietary intake factors, child health status factors, child characteristics, household food security status (food access and food availability) factors, health system factors and WASH factors as well as socio-demographic/economic factors. The Anthropometric assessment data was obtained by measuring the child’s height/length, weight, MUAC, assessing for bilateral pitting oedema and recording of the date of birth.

A structured questionnaire written in English was developed into an ODK software form on mobile phones and was used to collect data from the households. A translated version of the questionnaire in Luganda (local language) was also availed to the research assistants.

**Data management**

The questionnaire was pre-coded at the time of proposal development and the codes were used in the development of the ODK software questionnaire forms. A fully compiled
dataset in form of an excel sheet from an online server where the ODK forms were uploaded at the time of data collection was sent to the principal investigator. The anthropometric data was first entered into ENA SMART version 2011 where nutrition status classification according to the 2006 WHO growth standards was done. It was then joined to the rest of the data in an excel sheet, after which the excel sheet was exported to STATA version 14 for cleaning and subsequent descriptive and statistical analyses.

Data analysis

Univariate, bivariate and multivariate analyses of the results was done and the results were presented using summary tables and narrative texts.

Objective I: To assess the prevalence of stunting and underweight among children aged 6 to 59 months in Bussi Islands.

The child anthropometric indices were analysed by classifying stunting and underweight according to 2006 WHO child growth standards using the ENA SMART software. The prevalence of stunting and underweight was then got by dividing the number of children who were stunted and underweight respectively with the total number of children in the study expressed as a percentage.

Objective II: To assess the determinants of stunting and underweight among children aged 6 to 59 months in Bussi Islands.

All characteristics in this study that are known from literature to be associated with stunting and underweight were analysed as categorical variables but means and their corresponding standard deviations were also provided in the text for those characteristics that were collected as continuous variables. Frequencies and percentages were also used. The measure of association between the outcomes of interest (stunting and underweight) with the independent variables were the Prevalence Ratios (PRs) at their 95% confidence intervals and p-values of <0.05 showed statistically significant associations between the
outcomes and the independent variables. The PRs were used instead of Odds Ratios (ORs) because the prevalence rates of stunting and underweight were more than 10%. The ORs tend to overestimate the strength of association in such scenarios (13, 14).

PRs at both the bivariate and multivariate analysis level were estimated using the Modified Poisson regression analysis model, with robust standard errors, via generalized linear models with family (Poisson) and link (log) (15). After testing for co-linearity, covariates with p-value ≤ 0.2 at the bivariate analysis were considered for the multivariable model.

At multivariable level, modified Poisson regression was done to identify adjusted estimates for the determinants of stunting and underweight. Variables, which when included resulted in loss of significance were removed. The final model selection was based on Akaike Information Criteria (AIC), with smaller AIC value suggesting a better model. Covariates with p-values < 0.05 after multivariable analysis were considered as determinants of stunting and underweight.

Results

A total of 409 households, having at least one child aged 6 to 59 months, were included in the survey. Complete data was got from all the 409 child caretaker-child pairs, thus final analysis was based on the calculated sample size with a response rate of 100%.

**Socio-demographic and economic characteristics of the respondents**

Table 1 shows the socio-demographic and economic characteristics of the respondents. Majority of the child caretakers (91.9%) were females and half (50.6%) of them had ages ranging from 20 to 29 years. Slightly more than three quarters (78.2%) of the child caretakers were the biological mothers of the children included in the study as more than half of them (53.4%) were multiparous (having two to four children). Half of the biological mothers (50.0%) reported that they were not pregnant and were not breastfeeding at the
time of the survey. Slightly more than three quarters (77.0%) of the child caretakers were married. Two thirds (65.8%) of the households had a family size of two to five people with a mean family size of 5 (± 2) people. Majority of the child caretakers had basic primary (50.6%) and secondary (27.9%) education. The major sources of income of the household heads were sale of agricultural produce (38.1%) and fishing (24.7%). The mean number of children less than five years in the households was 2 (±1). A quarter of the households were so poor in that they could not afford a source of lighting which is safer than a Tadoba (25.7%) or candles (2.9%).

Child characteristics

Table 2 shows dietary intake and child characteristics of the children in the study. Girls were slightly more than the boys with a percentage of 51.6% and the ratio of boys to girls was 0.9. The highest percentage of children included in the study (31.3%) was from the age group of 12 to 23 months and the mean age of all the children was 26.7 (±12.9) months. Close to three quarters (73.8%) of the children were delivered in a health facility as a quarter of the children were not delivered by health workers with 66 (16%) being delivered by Traditional Birth Attendants (TBAs) and 38 (9.3%) by family members. Only 1.5% of the children were born as twins while the others were born as single babies. Half (50.1%) of the children ranged from being 2nd to 4th born of their mothers. Child caretakers reported that nearly all the children (96.8%) included in the survey had ever been breastfed. Only 36.0% of the children aged 6 to 23 months had breastfed in the 24 hours preceding the survey date. Only 4.2% of the children had not yet been introduced to complementary foods and yet they were supposed to have been introduced to those foods at their 6th month of age. Almost all the children (98.5%) who had ever been introduced to complementary foods were fed on complementary foods in the 24 hours preceding the survey date. The methods of feeding on the complementary foods
comprised mostly of hand feeding (94.4%) and cup feeding (75.8%). Majority (55.8%) of the children were fed three times a day and the mean number of times that children were fed was 3(±1) times.

Table 3, shows health statistics of children in the study. A majority (86.8%) of the children had received the immunisation they were supposed to receive at their age at the time of the survey. In the two weeks preceding the survey, 36.4% of the children suffered from Diarrhoea, 43.3% suffered from fever and 88.8% suffered from respiratory diseases as 32% had suffered from measles in the six months preceding the survey. Close to three quarters of the children had received Vitamin A supplementation (72.1%) and deworming tablets (71.4%) in the six months preceding the survey.

**Household food security status characteristics**

Table 4, shows the household food security characteristics of the households in the study. Results of analysis of the Household Food Insecurity Access Scale (HFIAS) showed that 11% of the households were food insecure with a HFIAS score ranging from 17 to 27 and the mean HFIAS score for all the households of 8.7 (±5.7). More than half of the households (55.0%) had a poor Household Dietary Diversity Score (HDDS) of less than 5.4 which was the mean HDDS. More than two thirds of the households had an acceptable Food Consumption Score (FCS) of greater than thirty five as the mean FCS was 45.3 (±15.9). Close to two thirds (64.3%) of the households had only one member who was earning an income with a majority of the households (71.4%) reporting that they got some or all their food through purchasing.

Two thirds (66.5%) of the households included in the study reported that they owned or had access to agricultural land. Similarly, two thirds of the households included in the study had crops that were being grown (65.8%) and kept livestock (64.1%) at the time of the survey. Half of those households reported that the crops grown (50.6%) and the
livestock kept (54.6%) were for both home consumption and for sale. Only 29.3% of the households had a member who carried out fishing with almost all the fish caught being for both home consumption and for sale. It was also reported that only 21.8% of the households included in the study had a stock of food in the houses or in the kitchens which was to be eaten in the following days.

**Health system characteristics**

Table 5 shows Health systems characteristics of the respondents. The main means of transport in Bussi Islands was the use of Motor cycles (Boda bodas) with a majority (71.9%) of the respondents reporting that they used the boda bodas to transport them to Bussi HC III. A few households (30.3%) owned a means of transport and almost half of them (48.4%) owned motor cycles. Quiet a big percentage of respondents (45.7%) reported that they used five thousand shillings or more to travel to and from Bussi HC III.

**WASH characteristics**

Table 6 shows the WASH (Water Sanitation and Hygiene) characteristics of the households in the study. Three quarters (74.3%) of the households used 40 to 80 litres of water per day and a majority (81.4%) of them got their water from boreholes. Some of the households (22.5%) used untreated water for drinking either all the time or some of the times. Three quarters (73.4%) of the child caretakers reported that they only washed their hands some of the times before providing food to the children. There were several methods of household waste disposal but open field disposal was the mostly used method with 33.7% of the households reporting that they used it.

**Prevalence of stunting and underweight**

Table 7 shows the prevalence of underweight and stunting among children aged 6 to 59 months in Bussi Islands. The overall prevalence of stunting was 29.8% and underweight was 16.1%. The boys had higher prevalence of stunting and underweight as compared to
their female counterparts.

**Determinants of stunting**

Table 8 shows the determinants of stunting among children aged 6 to 59 months in Bussi Islands. Children aged 12 to 23 months and 24 to 35 months had prevalence rates of stunting which were two times that among children aged 6 to 11 months (Adjusted PR: 2.28; 95% CI: 1.29, 4.03 and Adjusted PR: 1.97; 95% CI: 1.09, 3.56 respectively). Similarly, children from food insecure households had a prevalence of stunting which was about two times that among children from food secure households (Adjusted PR: 1.67; 95% CI: 1.15, 2.43). Conversely, the prevalence of stunting was 52% lower among children from households which used more than eighty litres of water per day as compared to that among children from households which used less than forty litres of water per day (Adjusted PR: 0.48; 95% CI: 0.24, 0.95).

The prevalence of stunting among children who suffered from diarrhoea in the two weeks preceding the survey was about two times that among children who did not suffer from diarrhoea in the two weeks preceding the survey (Adjusted PR: 1.79; 95% CI: 1.28, 2.50). The prevalence of stunting was 42% lower among children who had received deworming tablets in the six months preceding the survey as compared to that among children who had not received the deworming tablets in the six months preceding the survey (Adjusted PR: 0.58; 95% CI: 0.42, 0.81). The prevalence of measles was 38% lower among children who did not suffer from measles in the six months preceding the survey as compared to those who suffered from measles in the six months preceding the survey (Adjusted PR: 0.62; 95% CI: 0.42, 0.92).

**Determinants of underweight**

Table 9 shows the determinants of underweight among children aged 6 to 59 months in Bussi Islands. The prevalence of underweight among children aged 24 to 35 months was
two times that among children aged 6 to 11 months (Adjusted PR: 2.30; 95% CI: 1.13, 5.33). Similarly, children who suffered from diarrhoea in the two weeks preceding the survey had a prevalence of underweight which was two times that among children who did not suffer from diarrhoea (Adjusted PR: 2.06; 95% CI: 1.30, 3.27). Additionally, the prevalence of underweight among children from households with more than nine members was three times that among children from households with two to five members (Adjusted PR: 3.18; 95% CI: 1.10, 10.16).

Discussion

This was a cross sectional study that was carried out in the community; it assessed the prevalence and determinants of stunting and underweight among children aged 6 to 59 months in Bussi Islands in order to guide the formulation and integration of nutrition interventions by stakeholders into health service delivery.

The study found high prevalence rates of underweight (16.1%) and stunting (29.8%) among children aged 6 to 59 months. The above prevalence rates are all poor (medium) according to the WHO classification of the prevalence of malnutrition (16). The prevalence of stunting among children aged less than five years was similar to the national prevalence (29%), however, the prevalence of underweight was higher than the national prevalence of 11% (5). The above could be attributed to the study being conducted on an Island which is hard to reach and has people of low socioeconomic status.

On the contrary, prevalence rates of stunting and underweight in this study were far less than those from studies conducted in rural areas of Ethiopia and Kenya (17-19). This could have been due to the frequent draughts in those areas that affected food security and hence led to the high prevalence of stunting and underweight.

The study showed that utilisation of more than eighty litres of water by a household in a day, receiving of deworming tablets every six months by children, household food
insecurity, age of children 12 to 35 months, suffering from diarrhoea and measles were associated with stunting as having more than nine household members, age of children 24 to 35 months and suffering from diarrhoea were associated with underweight.

In the current study, utilisation of more than eighty litres of water in a day by a household was an independent predictor of stunting. Households which used more than eighty litres of water per day were less likely to have stunted children; this could be because they have enough water to use in maintaining hygiene of their children. Children in households which don’t have enough water to maintain their hygiene are susceptible to hygiene related diseases like frequent diarrhoea which predisposes them to stunting. The above findings concur with a study done in Ethiopia by Demissie and Worku (20) who demonstrated that there was a significant association between access to sufficient clean water with stunting and also reported that sufficient water prevents the spread of water-borne diseases that can negatively affect the health and nutrition of young children leading to stunting. Similarly, another study done in Nigeria reported that lack of sufficient amounts of safe water was a risk factor for stunting (21).

This study also revealed that taking deworming tablets every six months was an independent predictor and it was protective against stunting. Deworming children every six months protects them from intestinal worms which predisposes them to stunting. Food eaten by children with intestinal worm infestation is taken up by the worms leaving little for the children to utilise in their growth and as a result they are liable to becoming stunted. A similar study conducted by Yalew (22) in Ethiopia showed that deworming was protective against stunting in children aged less than five years. Wamani et al. (23), also carried out a study in Uganda and found out that failure to deworm children aged 12 months and older was positively associated with stunting in those children.

Household food insecurity was found to be an independent predictor of stunting with
households having food insecurity more likely to have children who were stunted. Due to prolonged periods of food insecurity, children in households which are food insecure eat low quantity and low quality food than what they are supposed to eat which predisposes them to stunting. Indeed, several literature has shown that household food insecurity is significantly associated with stunting (24-27).

In the current study Diarrhoea was an independent predictor of both stunting and underweight with children who had suffered from diarrhoea in the two weeks preceding the survey more likely to be stunted or underweight which is not a surprise as there is a reciprocal relationship with diarrhoea leading to malnutrition and malnutrition predisposing to diarrhoea. Diarrhoea leads to inflammation of the gut thereby affecting the ability of the gut to digest and absorb food; it also leads to loss of water, electrolytes and other nutrients; predisposes children to lactose and fat intolerances as well as fear of eating due to the pain after eating. All the above effects of diarrhoea reduce nutrient absorption and increase nutrient loss which can lead to underweight. The result of this study may suggest that children suffered from longer and repeated episodes of diarrhoea which predisposed them to stunting. The above results are consistent with other studies carried out in Ethiopia by Betebo et al. (26), Bantamen et al.(28) and Teshome et al. (18) which also showed that diarrhoea is an independent and positive predictor of stunting and underweight in children aged less than five years.

In this study, child age of 12 to 35 months and 24 to 35 months was an independent predictor of stunting and underweight respectively. Children who were aged 12 to 35 months and 24 to 35 months were more likely to be stunted and underweight respectively. The above maybe explained by the fact that by these ages most children have stopped breastfeeding and are only depending on family foods. Most of the family foods they eat are not hygienically prepared, served and stored, which predisposes them to diarrhoea
thereby leading to stunting and underweight. These ages are also very active moving around and eating anything they find in the neighbourhood which may predispose them to worm infestations eventually leading to stunting and underweight. The above findings are in agreement with several other studies done in Ethiopia which also reported that age of children is a risk factor of underweight and stunting with majority of them showing that chronic and acute malnutrition develops during the weaning period and then rises sharply thereafter (18-20, 26).

Having more than nine members in a household was an important predictor of underweight with those households more likely to have underweight children. When a household has many people to feed, it becomes hard to get enough food for everyone in the household which leaves children aged less than five years vulnerable to insufficient food intake because they depend on adults to provide them food. It becomes worse if most of the members in the household are adults and are unemployed. The above is consistent with a study by Yikii et al. (29) which revealed that households with fewer adult members were significantly food secure compared with those with more adults. Findings from this study are also consistent with another study carried out in Kenya by Adeladza (30) which reported that children from large households were more likely to be wasted due to the resources available in those households being inadequate in buffering children from the problems of maintaining large families such as competition for limited food. In contrast, another study carried out in Ethiopia by Bisrat Getaneh and Kulkarni (31) showed that having fewer members in a household was a positive predictor of underweight which could have been due to the fact that their study was done in an urban area where larger households had more people earning an income which improved their food security as compared to those households with fewer members.

**Study strengths and limitations**
As one of the strengths of this study, the sample size used was large enough and the variables studied were many which helped in getting a wider picture of the situation. This study also used key items adopted from the UNICEF conceptual framework on the causes of malnutrition(2).

The major limitation of this study is that it was cross sectional, therefore, it could not establish a cause and effect relationship between the dependent and independent variables. Recall bias might have affected responses to some of the questions that were asked as they depended on the respondents own memory. However, several measures like quality control checks were incorporated in the questionnaire to ensure accuracy of the data collected.

Further research should be conducted on the nutrition status of women in child bearing age and associated factors in the study area as well as other factors that were not included in the present study like antenatal care attendance.

Conclusions

Child stunting and underweight are public health problems in Bussi Islands in Uganda. This is shown by the high prevalence rates of stunting and underweight among children aged 6 to 59 months on the Island. Utilisation of more than eighty litres of water by a household in a day, receiving of deworming tablets every six months by children, household food insecurity, age of children 12 to 35 months, suffering from diarrhoea and measles were the determinants of stunting. Having more than nine household members, age of children 24 to 35 months and suffering from diarrhoea were the determinants of underweight.

Recommendations

The MOH and the district health authorities should integrate nutrition status assessment into the child days plus activities as well as other mass and school immunisation
campaigns as this will help to yield nutrition status surveillance information needed.

Nutrition status assessment, provision of deworming tablets, provision of family planning methods and health education of child caretakers on optimal IYCF practices should be incorporated into routine health facility activities by health workers in the study area.

Increased uptake of family planning methods will help in controlling the large family sizes. There is need for prompt diarrhoeal treatment and prevention through appropriate sanitation and availability of safe and sufficient water. This can be achieved when the local leaders lobby for more Boreholes to be constructed on the Island by the Ministry of Water.

Abbreviations

APR: Adjusted Prevalence Ratio; DALYs: Disability Adjusted Life in Years; FCS: Food Consumption Score; HC III: Health Centre III; HDDS: Household Dietary Diversity Score; HFIAS: Household Food Insecurity Access Scale; HH (s): Household (s); IYCF: Infant and Young Child Feeding; MOH: Ministry of Health; MUAC: Mid Upper Arm Circumference; ODK: Open Data Kit; SD: Standard Deviation; TBAs: Traditional Birth Attendants; UNICEF: United Nations Children's Fund; WASH: Water Sanitation and Hygiene; WAZ: Weight for Age Z-scores; WFH/LZ: Weight for Height/Length Z-scores; WHO: World Health Organisation.

Declarations

**Ethics approval and consent to participate**

This study was approved by Makerere University School of Public Health Higher Degrees Research and Ethics Committee (5th March 2019) and permission to carry out the study was then sought from the District Health Officer of Wakiso District (21st March 2019, Ref. No. 218/03/2019). Participation was voluntary and free from coercion. Written informed consent was obtained from all study respondents and all the information got was kept
confidential. Parental consent was obtained before taking anthropometric measurements of all children. All children who were identified to have malnutrition were referred to different health facilities depending on the severity of their conditions.

**Consent for publication**

Not Applicable

**Availability of data and materials**

All data generated or analysed during this study are included in this published article [and its supplementary information files].

**Competing interests**

All authors declare no conflicts of interest

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**Authors’ contributions**

NEJ: Conceived the idea of the study, designed the study, coordinated and assured quality of data collection, participated in data analysis and in writing of all drafts and the final manuscript. SM: Designed the study, participated in data collection and in writing of all drafts and the final manuscript. IJB: Designed the study, participated in data analysis and in writing of all drafts and the final manuscript. MRW: Designed the study, participated in data analysis and in writing of all drafts and the final manuscript. All authors read and approved the final manuscript.

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**Additional Files**

Additional file 1: Study dataset (XLS 931 kb)

Additional file 2: Completed STROBE Statement checklist (.docx 20.8 kb)

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Tables

Table 1: Socio-demographic and economic characteristics of the respondents
| Characteristic                        | Frequency | Percent |
|--------------------------------------|-----------|---------|
| **Sex of child caretaker**           |           |         |
| Female                               | 376       | 91.9    |
| Male                                 | 33        | 8.1     |
| **Age of child caretaker**           |           |         |
| ≤ 19                                 | 20        | 4.9     |
| 20 – 29                              | 207       | 50.6    |
| 30 – 39                              | 113       | 27.6    |
| 40 – 49                              | 36        | 8.8     |
| ≥ 50                                 | 33        | 8.1     |
| **Type of child caretaker**          |           |         |
| Biological mother                    | 320       | 78.2    |
| Father                               | 26        | 6.4     |
| Grand mother                         | 52        | 12.7    |
| Others                               | 11        | 2.7     |
| **Maternal parity**                  |           |         |
| Primiparous (1)                      | 66        | 20.6    |
| Multiparous (2 – 4)                  | 171       | 53.4    |
| Grand multiparous (≥5)               | 83        | 26.0    |
| **Breastfeeding and pregnancy state**|           |         |
| Breastfeeding and pregnant           | 1         | 0.3     |
| Breastfeeding but not pregnant       | 124       | 38.8    |
| Not breastfeeding but pregnant       | 35        | 10.9    |
| Not breastfeeding and not pregnant   | 160       | 50.0    |
| **Marital status**                   |           |         |
| Married                              | 315       | 77.0    |
| Divorced                             | 69        | 16.9    |
| Others                               | 25        | 6.1     |
| **Family size**                      |           |         |
| 2 – 5                                | 269       | 65.8    |
| 6 – 9                                | 128       | 31.3    |
| > 9                                  | 12        | 2.9     |
| **Child caretaker education**        |           |         |
| No formal education                  | 76        | 18.6    |
| Primary                              | 207       | 50.6    |
| Secondary                            | 114       | 27.9    |
| Tertiary certificate                 | 10        | 2.4     |
| Diploma and above                    | 2         | 0.5     |
| **Main source of income of HH**      |           |         |
| Fishing                              | 101       | 24.7    |
| Wage earner                          | 53        | 13.0    |
| Sale of agricultural produce         | 156       | 38.1    |
| Trade                                | 64        | 15.6    |
| Others                               | 35        | 8.6     |
| **Children < 5 years in HH**         |           |         |
| One                                  | 224       | 54.8    |
| Two                                  | 151       | 36.9    |
| > Two                                | 34        | 8.3     |
| **Lighting type**                    |           |         |
| Tadoba                                | 105       | 25.7    |
| Candles                              | 12        | 2.9     |
| Paraffin lamps                       | 14        | 3.4     |
| Rechargeable lamp                    | 46        | 11.3    |
| Solar                                | 232       | 56.7    |
** Only applies for child caretakers who were biological mothers of the study children
SD: Standard Deviation, Min: Minimum, Max: Maximum

Table 2: Child characteristics

| Characteristic                                | Frequency | Percentage |
|-----------------------------------------------|-----------|------------|
| **Child’s sex**                               |           |            |
| Boys                                          | 198       | 48.4       |
| Girls                                         | 211       | 51.6       |
| **Child’s age (months)**                      |           |            |
| 6 - 11                                        | 61        | 14.9       |
| 12 - 23                                       | 128       | 31.3       |
| 24 - 35                                       | 114       | 27.9       |
| 36 - 47                                       | 78        | 19.1       |
| 48 - 59                                       | 28        | 6.8        |
| **Place of delivery**                         |           |            |
| Home                                          | 107       | 26.2       |
| Health facility                               | 302       | 73.8       |
| **Person who conducted the delivery**         |           |            |
| Traditional Birth Attendant                   | 66        | 16.1       |
| Health worker                                 | 305       | 74.6       |
| Others                                        | 38        | 9.3        |
| **Birth type**                                |           |            |
| Single                                        | 403       | 98.5       |
| Twin                                          | 6         | 1.5        |
| **Birth order**                               |           |            |
| First born                                    | 112       | 27.4       |
| 2nd to 4th born                               | 205       | 50.1       |
| 5th born and above                            | 92        | 22.5       |
| **Child ever been breastfed**                 |           |            |
| Yes                                           | 396       | 96.8       |
| Don’t know                                    | 3         | 0.7        |
| No                                            | 10        | 2.5        |
| **Children <24 months breastfed the previous day** |       |            |
| Yes                                           | 68        | 36.0       |
| No                                            | 121       | 64.0       |
| **Child ever started on complementary feeding**|       |            |
| Yes                                           | 392       | 95.8       |
| No                                            | 17        | 4.2        |
| **Child fed on complementary foods the previous day** |       |            |
| Yes                                           | 386       | 98.5       |
| No                                            | 6         | 1.5        |
| **Method of feeding child**                   |           |            |
| Bottle                                        | 50        | 12.2       |
| Cup                                           | 310       | 75.8       |
| Spoon                                         | 12        | 2.9        |
| Hand                                          | 386       | 94.4       |
| **Frequency of feeding in a day**             |           |            |
| < 3 times                                     | 144       | 55.8       |
| 3 times                                       | 228       | 35.2       |
| > 3 times                                     | 37        | 9.0        |

SD: Standard Deviation, Min: Minimum, Max: Maximum
### Table 3: Health status characteristics of children aged 6 to 59 months in Bussi Islands

| Characteristic           | Frequency | Percentage |
|--------------------------|-----------|------------|
| Immunisation             | 355       | 86.8       |
| Diarrhoea                | 158       | 38.6       |
| Fever                    | 177       | 43.3       |
| Respiratory Disease      | 363       | 88.8       |
| Measles                  | 131       | 32.0       |
| Vitamin A                | 295       | 72.1       |
| Deworming                | 282       | 69.0       |

### Table 4: Household food security status characteristics
| Characteristic                                      | Frequency | Percent |
|----------------------------------------------------|-----------|---------|
| **HFIAS**                                          |           |         |
| Food insecure HHs (17 – 27)                       | 45        | 11.0    |
| Marginally food secure HHs (10 – 16)              | 123       | 30.1    |
| Food secure HHs (0 – 9)                           | 241       | 58.9    |
| **HDDS**                                           |           |         |
| Good (> 5.4)                                       | 184       | 45.0    |
| Poor (< 5.4)                                       | 225       | 55.0    |
| **FCS**                                            |           |         |
| Acceptable (> 35)                                  | 288       | 70.4    |
| Borderline (21.5 – 35)                             | 105       | 25.7    |
| Poor (< 21.5)                                      | 16        | 3.9     |
| **HH members earning an income**                   |           |         |
| One                                                | 263       | 64.3    |
| Two                                                | 135       | 33.0    |
| Three or more                                      | 11        | 2.7     |
| **HH’s source of food**                            |           |         |
| Purchase                                           | 292       | 71.4    |
| Own production                                     | 261       | 63.8    |
| Barter trade                                       | 86        | 21.0    |
| Borrow                                             | 2         | 0.5     |
| Gifts                                              | 17        | 4.2     |
| Food aid                                           | 8         | 2.0     |
| **Ownership of land**                              |           |         |
| Yes                                                | 272       | 66.5    |
| No                                                 | 137       | 33.5    |
| **Current crop growth**                            |           |         |
| Yes                                                | 269       | 65.8    |
| No                                                 | 140       | 32.2    |
| **Purpose of crops grown**                         |           |         |
| All for home use                                   | 127       | 47.2    |
| Both home use and sale                             | 136       | 50.6    |
| All for sale                                       | 6         | 2.2     |
| **Fishing carried out by HH member**               |           |         |
| Yes                                                | 120       | 29.3    |
| No                                                 | 289       | 70.7    |
| **Purpose of fish**                                |           |         |
| All for home use                                   | 5         | 4.2     |
| Both home use and sale                             | 114       | 95.0    |
| All for sale                                       | 1         | 0.8     |
| **Current food stock**                             |           |         |
| Yes                                                | 89        | 21.8    |
| No                                                 | 320       | 78.2    |
| **Ownership of livestock**                         |           |         |
| Yes                                                | 262       | 64.1    |
| No                                                 | 147       | 35.9    |
| **Purpose of livestock**                           |           |         |
| All for home use                                   | 40        | 15.3    |
| Both home use and sale                             | 143       | 54.6    |
| All for sale                                       | 79        | 30.1    |

SD: Standard Deviation, Min: Minimum, Max: Maximum
Table 5: Health system characteristics

| Characteristic                          | Frequency | Percent |
|----------------------------------------|-----------|---------|
| **Transport means to Bussi HC III**    |           |         |
| Foot                                   | 99        | 24.2    |
| Bicycle                                | 13        | 3.2     |
| Motor cycle vehicle                    | 294       | 71.9    |
| **HH member own transport means**      |           |         |
| Yes                                    | 124       | 30.3    |
| No                                     | 285       | 69.7    |
| **Type of transport means owned**      |           |         |
| Bicycle                                | 48        | 38.7    |
| Boat                                   | 15        | 12.1    |
| Motor cycle vehicle                    | 60        | 48.4    |
| Vehicle                                | 1         | 0.8     |
| **Cost of transport to Bussi HC III**  |           |         |
| < 5,000/=                              | 222       | 54.3    |
| 5,000/= - < 10,000/=                   | 85        | 20.8    |
| 10,000/= - < 15,000/=                  | 15        | 3.7     |
| ≥ 15,000/=                             | 87        | 21.2    |

Table 6: WASH characteristics

| Characteristic                          | Frequency | Percent |
|----------------------------------------|-----------|---------|
| **Water used in HH per day**           |           |         |
| < 40 litres                            | 19        | 4.7     |
| 40 – 80 litres                         | 304       | 74.3    |
| > 80 litres                            | 86        | 21.0    |
| **Source of drinking water**           |           |         |
| Borehole                               | 333       | 81.4    |
| Lake                                   | 60        | 14.7    |
| Rain water                             | 1         | 0.2     |
| Shallow well                           | 15        | 3.7     |
| **Drinking water treatment**           |           |         |
| Not treated                            | 92        | 22.5    |
| Boiling                                | 344       | 84.1    |
| Filtering                              | 18        | 4.4     |
| Chlorine tablets                       | 6         | 1.5     |
| **Wash hands before feeding child**    |           |         |
| Yes                                    | 102       | 24.9    |
| Sometimes                              | 300       | 73.4    |
| No                                     | 7         | 1.7     |
| **Waste disposal method**              |           |         |
| Burning                                | 69        | 16.9    |
| Common pit (Many HHs)                  | 88        | 21.5    |
| In pit (individual HH)                 | 66        | 16.1    |
| Open field disposal                    | 138       | 33.7    |
| Compositing                            | 48        | 11.7    |

Table 7: Prevalence of stunting and underweight

| Stunting | Underweight |
|----------|-------------|
|          | n | % (95% CI) | n | % (95% CI) |
| Girls    | 61 | 28.9 (23.2-35.4) | 32 | 15.2 (11.0-20.1) |
| Boys     | 61 | 30.8 (24.8-37.6) | 34 | 17.2 (12.6-23.1) |
| All      | 122| 29.8 (25.6-34.4) | 66 | 16.1 (12.9-20.0) |
The prevalence of oedema was 0.0%

| Characteristic                        | Stunting | Unadjusted PR (95% C.I) | p-value | Adjusted PR (95% C.I) |
|---------------------------------------|----------|-------------------------|---------|----------------------|
| **Maternal parity**                   |          |                        |         |                      |
| Primiparous                           | 22       | 44                      | 1.00    | 1.00                 |
| Multiparous                           | 53       | 118                     | 0.93 (0.62, 1.40) | 0.727 | 0.89 (0.61, 1.31) |
| Grand multiparous                     | 19       | 64                      | 0.69 (0.41, 1.16) | 0.159 | 0.63 (0.38, 1.04) |
| **Child's age (months)**              |          |                        |         |                      |
| 6 to 11                               | 13       | 48                      | 1.00    | 1.00                 |
| 12 to 23                              | 49       | 79                      | 1.80 (1.06, 3.05) | 0.031* | 2.28 (1.29, 4.03) |
| 24 to 35                              | 34       | 80                      | 1.40 (0.80, 2.45) | 0.239 | 1.97 (1.09, 3.56) |
| 36 to 47                              | 20       | 58                      | 1.20 (0.65, 2.22) | 0.555 | 1.33 (0.66, 2.66) |
| 48 to 59                              | 6        | 22                      | 1.01 (0.43, 2.37) | 0.990 | 0.61 (0.17, 2.20) |
| **HFIAS**                             |          |                        |         |                      |
| Food secure HHs                       | 59       | 182                     | 1.00    | 1.00                 |
| Food insecure HHs                     | 63       | 105                     | 1.53 (1.14, 2.06) | 0.005* | 1.67 (1.15, 2.43) |
| **HDDS**                              |          |                        |         |                      |
| Good (> 5.4)                          | 46       | 138                     | 1.00    | 1.00                 |
| Poor (< 5.4)                          | 76       | 149                     | 1.35 (0.99, 1.84) | 0.057 | 1.24 (0.87, 1.76) |
| **FCS**                               |          |                        |         |                      |
| Acceptable                            | 80       | 208                     | 1.00    | 1.00                 |
| Poor and borderline                   | 42       | 79                      | 1.25 (0.92, 1.70) | 0.156 | 0.94 (0.65, 1.36) |
| **Cost of transport to Bussi HC III** |          |                        |         |                      |
| < 5,000                               | 58       | 164                     | 1.00    | 1.00                 |
| 5,000 to < 10,000                     | 24       | 61                      | 1.08 (0.72, 1.62) | 0.707 | 0.79 (0.49, 1.27) |
| 10,000 to < 15,000                    | 6        | 9                       | 1.53 (0.79, 2.96) | 0.205 | 1.03 (0.43, 2.46) |
| > 15,000                              | 34       | 53                      | 1.50 (1.06, 2.11) | 0.022* | 0.98 (0.65, 1.48) |
| **Water used in a home**              |          |                        |         |                      |
| < 40 Litres                           | 10       | 9                       | 1.00    | 1.00                 |
| 40 to 80 Litres                       | 93       | 211                     | 0.58 (0.37, 0.92) | 0.021* | 0.68 (0.41, 1.13) |
| > 80 Litres                           | 19       | 67                      | 0.42 (0.23, 0.75) | 0.004* | 0.48 (0.24, 0.95) |
| **Diarrhoea in past 2 weeks**         |          |                        |         |                      |
| No                                    | 58       | 193                     | 1.00    | 1.00                 |
| Yes                                   | 64       | 94                      | 1.75 (1.31, 2.35) | < 0.001* | 1.79 (1.28, 2.50) |
| **Measles in past 6 months**          |          |                        |         |                      |
| No                                    | 90       | 188                     | 1.00    | 1.00                 |
| Yes                                   | 32       | 99                      | 0.75 (0.53, 1.07) | 0.111 | 0.62 (0.42, 0.92) |
| **Deworming in past 6 months**        |          |                        |         |                      |
| No                                    | 54       | 73                      | 1.00    | 1.00                 |
| Yes                                   | 68       | 214                     | 0.57 (0.42, 0.76) | < 0.001* | 0.58 (0.42, 0.81) |

* Significant association at p-value < 0.05

** Maternal parity only applies for child caretakers who were biological mothers of the study children

Table 9: Determinants of underweight among children aged 6 to 59 months in Bussi Islands
| Characteristic                          | Underweight | Unadjusted PR (95% C.I) | p-value | Adjusted PR (95% C.I) |
|----------------------------------------|-------------|-------------------------|---------|----------------------|
| **Child’s age (months)**               |             |                         |         |                      |
| 6 to 11                                | Yes (n): 6  | No (n): 55              | 1.00    | 1.00                 |
|                                        | 12 to 23    | 21                      | 1.67 (0.71, 3.92) | 0.241 | 1.49 (0.66, 3.37)    |
|                                        | 24 to 35    | 24                      | 2.14 (0.92, 4.96) | 0.076 | 2.30 (1.13, 5.33)    |
|                                        | 36 to 47    | 13                      | 1.69 (0.68, 4.20) | 0.255 | 2.04 (0.85, 4.89)    |
|                                        | 48 to 59    | 2                       | 0.73 (0.16, 3.38) | 0.684 | 1.01 (0.24, 4.35)    |
| **Water used in a home**               |             |                         |         |                      |
| < 40 Litres                            | 5           | 14                      | 1.00    | 1.00                 |
| 40 to 80 Litres                        | 52          | 252                     | 0.65 (0.29, 1.44) | 0.287 | 0.74 (0.33, 1.64)    |
| > 80 Litres                            | 9           | 77                      | 0.40 (0.15, 1.05) | 0.064 | 0.42 (0.16, 1.10)    |
| **Caretaker’s marital status**         |             |                         |         |                      |
| Divorced                               | 15          | 54                      | 1.00    | 1.00                 |
| Married                                | 46          | 269                     | 0.67 (0.40, 1.13) | 0.135 | 0.83 (0.49, 1.41)    |
| Others                                 | 5           | 20                      | 0.92 (0.37, 2.27) | 0.857 | 1.10 (0.43, 2.82)    |
| **Diarrhoea in past 2 weeks**          |             |                         |         |                      |
| No                                     | 27          | 224                     | 1.00    | 1.00                 |
| Yes                                    | 39          | 119                     | 2.29 (1.46, 3.60) | <0.001* | 2.06 (1.30, 3.27)    |
| **Own food growth**                    |             |                         |         |                      |
| Yes                                    | 30          | 118                     | 1.00    | 1.00                 |
| No                                     | 36          | 225                     | 1.47 (0.95, 2.28) | 0.087 | 0.84 (0.45, 1.58)    |
| **Livestock kept**                     |             |                         |         |                      |
| No                                     | 31          | 116                     | 1.00    | 1.00                 |
| Yes                                    | 35          | 227                     | 0.63 (0.41, 0.98) | 0.042* | 0.75 (0.44, 1.28)    |
| **Waste disposal**                     |             |                         |         |                      |
| Burning                                | 14          | 55                      | 1.00    | 1.00                 |
| Community pit                          | 21          | 67                      | 1.18 (0.65, 2.14) | 0.596 | 0.91 (0.48, 1.72)    |
| Composting                             | 10          | 38                      | 1.03 (0.50, 2.12) | 0.943 | 1.32 (0.60, 2.91)    |
| HH pit                                 | 10          | 56                      | 0.75 (0.36, 1.56) | 0.439 | 0.79 (0.37, 1.70)    |
| Open field disposal                    | 11          | 127                     | 0.39 (0.19, 0.82) | 0.013* | 1.27 (0.58, 2.77)    |
| **No. of people in a home**            |             |                         |         |                      |
| Two to five                            | 42          | 227                     | 1.00    | 1.00                 |
| Six to nine                            | 20          | 108                     | 1.00 (0.61, 1.63) | 0.998 | 1.33 (0.81, 2.18)    |
| > Nine                                 | 4           | 8                       | 2.13 (0.91, 4.99) | 0.080 | 3.18 (1.10, 10.16)   |
| **Type of birth**                      |             |                         |         |                      |
| Single                                 | 63          | 340                     | 1.00    | 1.00                 |
| Twin                                   | 3           | 3                       | 3.20 (1.39, 7.35) | 0.006* | 1.86 (0.43, 8.00)    |
| **Borrowed food**                      |             |                         |         |                      |
| No                                     | 65          | 342                     | 1.00    | 1.00                 |
| Yes                                    | 1           | 1                       | 3.13 (0.77, 12.76) | 0.111 | 0.88 (0.05, 17.18)   |
| **Food aid**                           |             |                         |         |                      |
| No                                     | 63          | 338                     | 1.00    | 1.00                 |
| Yes                                    | 3           | 5                       | 2.39 (0.95, 6.01) | 0.065 | 1.53 (0.28, 8.43)    |
| **Filtering of drinking water**        |             |                         |         |                      |
| No                                     | 61          | 330                     | 1.00    | 1.00                 |
| Yes                                    | 5           | 13                      | 1.78 (0.82, 3.89) | 0.148 | 1.48 (0.65, 3.39)    |

* Significant association at p-value < 0.05
Supplementary Files

This is a list of supplementary files associated with the primary manuscript. Click to download.

Completed STROBE Statement checklist.docx
Study dataset.xls