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MALNUTRITION AMIDST PLENTY: AN ASSESSMENT OF FACTORS RESPONSIBLE FOR PERSISTENT HIGH LEVELS OF CHILDHOOD STUNTING IN FOOD SECURE WESTERN UGANDA

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ABSTRACT

In spite of favourable natural and human resource capacity, malnutrition remains an important health and welfare problem in Uganda especially among children below 5 years. Western Uganda has persistently registered highest levels of childhood malnutrition despite being referred to as "*the food basket*" of the country. This study sought to establish the causes of persistent child undernutrition to guide design of effective nutritional policies and interventions. This was a cross-sectional study that used both quantitative and qualitative methods. Multistage random sampling and stratified sampling were used to select study areas and households with children 6–59 months, respectively. Stunting levels were determined using anthropometric measurements of height-for-age using the US National Center for Health Statistics (NCHS) Reference Standards, which were approved for use in developing countries by the World Health Organization (WHO). The main causes of malnutrition were determined by logistic regression analysis. Almost half (46%) of children below 5 years were stunted, which is comparable to national prevalence of 47.8% for Western Uganda and this is unacceptably high. The major causes of stunting at ($p \leq 0.05$) were improper health and sanitation, poor child feeding practices, poor access to appropriate knowledge for health and nutrition, poor socio-economic variables of access to food, type of employment, distance to main roads and markets, housing facility, income flow regime, gender disparities and access to fuel for cooking. Overall, there is low intake of animal protein and generally constrained access to adequate amount of food required for normal growth and development. At multivariate level, the main risk factors included; lack of information on child health feeding, socio-economic capacity of household, poor hygiene practices, and preparation of special foods for children. Results suggest that more emphasis needs to be put on community nutrition and health education with a focus on diet, hygiene, sanitation, social-economic and livelihood programs, improvement of health care services and diversification of interventions especially into poverty alleviation programs with a nutrition focus.

Key words: Stunting, young children, nutrition, Uganda

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INTRODUCTION

Nutritional well-being is fundamental to attainment of the full social, economic, mental and physical potential of individuals, communities and populations[1]. In Uganda, despite the favorable natural and human resource capacity, malnutrition remains one of the most important health and welfare problems among vulnerable groups, particularly infants and young children. Uganda has one of the highest levels of childhood stunting in sub-Saharan Africa. The 1988/89 Uganda Demographic and Health Survey (UDHS) [2] revealed that almost half of the children under five years of age (45%) were chronically malnourished (stunted). Subsequent national demographic and health surveys over the last two decades found the situation not appreciably improved as stunting levels among under-five children stagnated between 33-39% [3-6].

Stunting levels are almost 20 times higher than what would be expected in a normal healthy population [7]. Prevalence of micronutrient malnutrition in Uganda is also reported to be high among children, and women of reproductive age [5].

Although all regions of Uganda have registered unacceptably high levels of childhood malnutrition over the years, the distribution has not been even. Western region has persistently registered the highest levels of childhood malnutrition especially stunting. Ironically, this is the region with adequate food production and is sometimes referred to as "*the food basket*" of the country [8].

The consequences of prolonged nutritional deprivation in children are grave resulting in growth retardation, decreased resistance to disease and infections and ultimately, ill health and death. In Uganda, infant mortality rates (IMR) and childhood mortality rates (CMR) are high, estimated at 76 and 137 respectively per 1,000 live births [5]. Malnutrition undermines the child's ability to fight infections and diseases and hence the child succumbs to common childhood diseases. It has been estimated that between 35-40% of under-five deaths in Uganda are attributable to malnutrition[7].
While the description of the malnutrition problem is clear, specific analysis of the causes is scanty. Besides, the demographic and health survey data does not cater for the analysis of causes of malnutrition and yet there are many, complex and multi-factorial. There is need, therefore, to clearly build a holistic picture of the factors responsible for these high levels of childhood malnutrition so as to guide the design of effective policies and nutrition interventions. Thus, this study was conducted to examine the factors causing the high levels of childhood malnutrition in western Uganda.

METHODOLOGY

A survey was carried out to establish malnutrition mapping in western Uganda and specifically in Bushenyi district, collect information on nutritional status of children and establish the possible causative factors.

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Study design
The study design was cross-sectional using both quantitative and qualitative methods of data collection. The ultimate sampling unit for respondents was a household. A household was defined as a group of family members living and eating together for at least 3 months.

Sampling design

Study subjects: The primary study subjects were women and caregivers of household members and their children aged between 6-59 months.

The study area
The study was conducted in Igara and Buhweju Counties, Bushenyi District in western Uganda.

Inclusion /exclusion criteria
All households in selected villages with children 6-59 months of age were enumerated with the help of local community leaders. Only one child was selected from each household as an index child for anthropometry. In cases where there was more than one child in a household within the required age bracket of 6-59 months, the oldest child was preferably selected.

Sampling techniques
Bushenyi District was purposively selected for this study because it clearly exhibits both characteristics needed for the study; viz. high levels of chronic malnutrition [9] against a background of high levels of agricultural output [10]. Thus, this area is a good case study to explain why high levels of general economic growth and even high output of food in an area at the macro level may not necessarily lead to a good nutritional status at the micro-level.

Multi-stage sampling was used to select study areas and in each selected county, 2 sub-counties were randomly selected (Karungu for Buhweju county and Kyeizooba for Igara county).

In each subcounty, two parishes were also selected: Katara and Kitega from Karungu while Kararo and Rutooma were from Kyeizooba Sub County. From each parish, 10 villages were randomly selected as shown below in Fig. 1.

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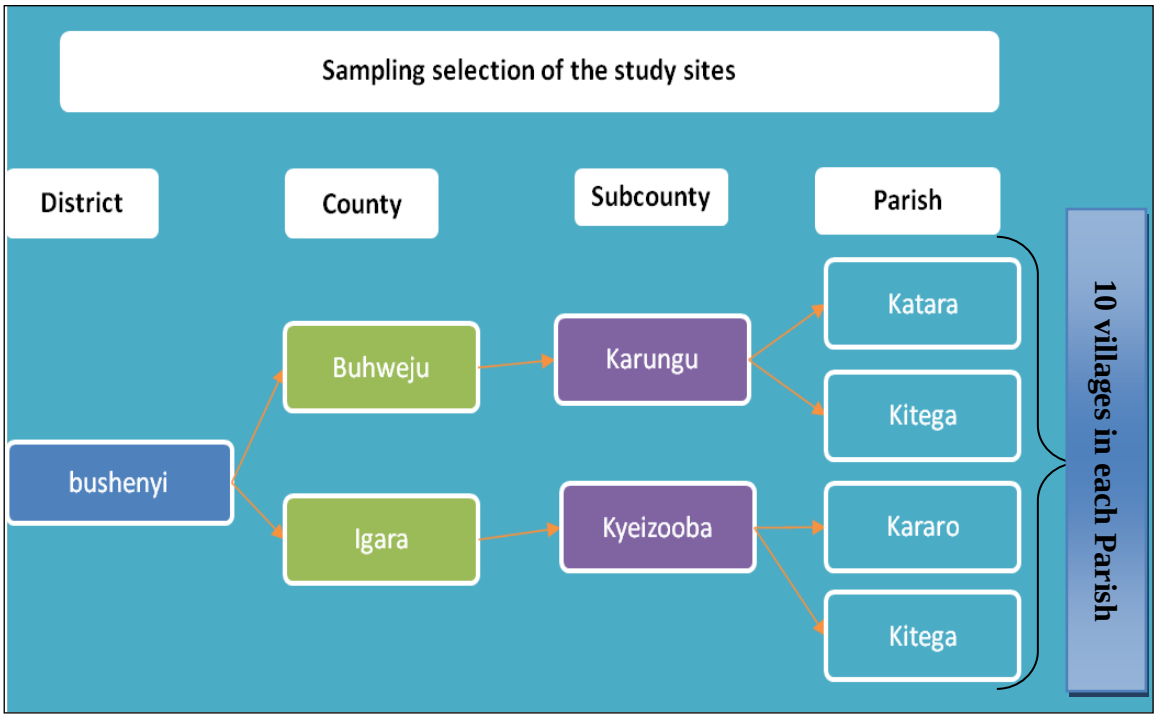

Figure 1: Sampling selection of the study sites

Sampling size calculation

In total, 403 households were sampled in all the 4 parishes. The formula for calculating sample size was:

$$N=\frac{(1.96^{2})(0.5)(0.5)}{0.05^{2}} = 384$$

A correction factor of 5% was applied to maintain the chosen precision that could arise; this catered for any other errors hence subjecting the total sample to 5% more and thus 403 [11].

Data collection

Data was collected using a semi-structured questionnaire administered to respondents. In total, 391 households (97% of total sample) were visited and each household had a child aged 6-59 months. Focus Group discussions with key district and sub-county leaders were also carried out.

Quantitative data

Social, economic, demographic, cultural and environmental data: Household income by source, expenditure patterns on food and non-food items, complementary feeding practices, child morbidity, agricultural output and price of agricultural produce were some of the quantitative data collected. Other variables included: household size, access/utilization of health services, education level and age of the mother and family members, care variables, cultural norms and household social status. Data was also collected on house living conditions for instance access to toilet,

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safe water, and shelter, as well as control and ownership of resources by gender, food habits, and cultural values.

Data on Nutritional status and feeding practices of children <5 years: Weight and height of children were taken using standard procedures as recommended by WHO [12]. The age of the child was obtained from the child's health card where available and/or from the parents or guardians. These anthropometric measurements were used to calculate stunting (height-for-age). Stunting was interpreted using the US National Center for Health Statistics (NCHS) Reference Standards which was approved for use in developing countries by the World Health Organization.

Qualitative data collection

Three Focus Group Discussions (FGDs were conducted with the first being at the district level attended by 7 participants: 1 National Agricultural Advisory Services (NAADs) Coordinator, 2 members of the health department, 2 members from the community department and 2 members from the planning department. The other two FGDs were done at the sub- county level in; Karungu and Kyeizooba sub-counties. At Karungu sub-county, the FGD composition was 10 women leaders from the 2 parishes as participants while in Kyeizooba 10 participants comprising 1 sub-county chief, 3 parish chiefs and 3 agriculture and extension worker agents and 3 health officers.

Data analysis

Quantitative data (main survey)

Information in the household questionnaire was analyzed using SPSS (Statistical Package for Social Scientists) Version-13 and Z-scores of height-for-age (H/A) were calculated based on the National Center for Health Statistics (NCHS) International growth reference using Epi-Info 2000 software. Descriptive statistics such as measures of central tendency and percentages were used on categorical variables. Households were ranked into two categories based on the presence of a malnourished and normal/healthy child in the household (<-2 z-scores). The main causes of malnutrition were identified using cross tabulations and logistics regression. The independent variables were the categories of demographic and socio-economic factors confirmed after the FGDs Exploratory Data Analysis (EDA). The main dependent variable was the final outcome of nutritional status. Measuring scales such as wealth ranking were determined using a participatory approach with the community members. A single wealth ranking criterion was developed based on the indicators that were commonly mentioned across the study area.

Qualitative data was analyzed by creating theme and observer impression. Data was examined, interpreted via forming an impression and reporting the impression in a structured and sometimes (quasi-) quantitative form.

The logistic regression model used

Logistic regression was used to establish the relationship between stunting and multiple categorical variables. A dichotomous dependent variable was used with a

value of 1 assigned to the presence of a factor (malnutrition) or YES response and value of 0 assigned to the absence of a factor or NO response [13] as indicated in Table 1.

Ethical clearance

Ethical clearance for the study was given by the Uganda National Council of Science and Technology. The mothers of the children gave verbal informed consent to participate in study after objectives and methods of the study were explained to them. All elements were written and read to the participants. Oral consents have been proven to work in such circumstances[14].

RESULTS

Characteristics of the Sampled Population

Table 2 shows that almost half of the study population (48.4%) does not have access to protected water sources. Seventy six percent (76%) of the respondents said that they boiled water before drinking it.

Toilet facilities and waste disposal methods are indicators of sanitation in an area. From the study, as indicated in Table 2, 96% reported that they used traditional pit latrines while only 4% used other methods. However, the impact is greatest if sanitation improvement happened concurrently with improvement in water safety.

The so-called “safe water” places may not necessarily be safe. As already indicated, provided water is available, the real impact may depend on the ability to have safe water handling practices such as boiling at household level.

According to NEMA[15] and confirmed by FGDs , firewood is the main source of fuel (98%) used for cooking food in Bushenyi District. The majority of the households (62.2%) in the District had their own source of fuel. Constraints in accessing fuel can contribute to malnutrition and according to respondents, the impacts of fuel shortage included eating poor quality food (that is either half cooked and/ or easy to cook food), drinking un-boiled water and environmental degradation, among others.

Road and market network

The road and market network was gauged according to the distance from the nearest road and market. This was in turn an indicator of area remoteness. Generally, Bushenyi has a relatively poor road network. Only 13% of the respondents reported that they were less than 2km in respect to the main road and about 17% were more than 8km (Table 2). The main road (tarmac road) was defined as one which could be utilized throughout the year. The impact of poor roads was reflected in areas far from the health facilities. Areas which were far from the nearest health units had higher rates of malnutrition. Therefore, availability of health units may directly impact on attendance of antenatal care and the related outcomes of access to information and safe motherhood.

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Prevalence of Childhood Malnutrition in Bushenyi District

The prevalence of malnutrition in the study areas among the under-5 children as shown in Table 3, was high with stunting levels of 46% (as <-2 Z-scores height-for age, NCHS cut-offs) which was much closer to the Western region prevalence of 47.8% [2, 5] as indicated in the UDHS. The stunting rates were even higher in Buhweju County (55.6%) compared to 36.3% in Igara County. Stunting in the district was even higher than national average survey at 39% [2, 5].

Dietary Factors

Stunting is also often associated with long-term dietary inadequacy [16]. This section analyses food situation and food consumption regime.

The food situation

In Uganda, Maize, Beans, Banana (Food), Cassava and Sweet Potatoes are the crops grown by most of the agricultural households - one million households for each of the two seasons. Of these five major crops, maize carries over 1.5 million households growing the crop in each season[17]. In Bushenyi, the main socio-economic activity is cultivation of traditional cash crops like coffee, tea, and cotton, and food crops like plantain (locally known as matooke), beans, finger millet, sweet potatoes, sorghum, cassava, *Solanum* potatoes, ground nuts, maize, soybeans, cabbages and other vegetables. Some communities carry out fishing - especially those surrounding Lake Edward and Kazinga Channel. Bushenyi has a high milk output and dairy farming is practiced at household level mainly for sale to urban centres. The district produces more than 32 million litre of milk/year [18] from mainly small- scale producers.

General household food consumption regime

The general food consumption regime is shown in Table 4.

Number of meals and intake frequency of selected foods (food frequency)

The number of meals eaten in a day along with the type of foods are some of the indicators of food availability and household food security [19,20] Most of the respondents pointed out that adults had only two meals (69.5%) in a day and children three meals (48.3%)**.** Most of the respondents had no preferences in food serving (67%). Depending on the nature of preferences, this can affect intra-household food distribution either positively or negatively.

The frequency of animal protein intake along with number of meals taken in a day has been used as an index of food security in some policy studies [20]. The higher the number of meals consumed in a day and frequency of animal protein intake, the better the index. Since this is a major milk producing area in the country, in this study, milk was selected to represent household animal protein intake. Generally, the first complementary foods were milk and millet porridge (32% and 29%, respectively). Other foods that were mentioned include matooke (cooked banana), maize porridge, meats, potatoes, soybeans, eggs, beans, dodo (*Amaranth leaves*), and sweet potatoes.

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In the study, only 48.6% had children less than 2 years and were asked about their recent methods of feeding their young children. The most common method used to feed the children are the cup (45%) and hands (35%) for both liquids and semi-liquids, respectively. Since these two methods account for over 80% of the respondents' responses, one can use them as a basis for gauging child feeding practices. Bottle feeding was practiced by only 8.5%.

Socio-economic level and income flow information

Data was collected on wealth ranking, income flow, expenditure patterns and housing facility as a proxy for socio-economic status and income level. Wealth ranking criteria had been previously determined using a participatory approach with the community members. A single wealth ranking criteria was developed based on the indicators that were commonly mentioned across the two counties. Housing, land and food availability were the most consistent criteria for wealth ranking in the population. Inclusion of the food indicator in the wealth ranking by the community leaders is a great opportunity for food and nutrition security-focused poverty alleviation programs.

Housing facilities are related to healthy living conditions and occurrence of diseases, which is an immediate cause of malnutrition. Using wealth indices developed during the FGDs, it was found that 60% of the sampled households were poor compared to 11% rich (Table 5). However, unless similar indices are applied, these results on wealth rankings of Bushenyi District cannot be generalized to the whole country. Wealth ranking is an indicator of poverty, which is an underlying determinant of all welfare indicators including nutrition out-comes. According to the findings, 68.8% were getting some income at least every 1-3 months and this has positive influence on nutrition status. Income that comes in bulk once or two times in a year will more likely be channeled to the purchase of durables and investments that may not necessarily improve nutrition of the household. Moreover, such incomes are in most cases controlled by men as opposed to women [20] **.** Different authors [21-23] have concluded that income in the hands of men is likely to be used on other purposes, which the child may not benefits directly from, while that in the hands of women is more available for household food and nutrition improvement. Hence, economic empowerment of women has one of the greatest contributions to nutrition and food security for family members.

Causes of Malnutrition in Bushenyi District

The main causes of malnutrition in the district were identified using the Logistic Regression model of the binary form. The main dependent variable was the level of stunting in under-five children. Stunting was selected owing to its high proportion in the population (46%) in the district (Table 3) and western Uganda at large[5]. Moreover, stunting is a serious form of malnutrition that has a long-term effect on socio-economic development.

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Model specification at bivariate level

During the FGDs, the researchers identified the categories of underlying factors that were potentially capable of causing malnutrition in the district. Categories identified included dietary, economic, social-demographic and environmental variables. These variables were first analyzed at bi-variate level to detect any indicative consistent trends in the cause-effect relationship.

Stunting

Variables that were found to have some reasonable indicative and consistent trends to cause stunting included health and sanitation issues included: child feeding practices and access to appropriate knowledge; socio-economic variables of economic access, gender, demographic; and environmental variables. These variables are consistent with the well-known UNICEF conceptual framework for the underlying causes of child under-nutrition in developing countries namely: food security, healthy environment, mother and child care and those identified by FANTA-2[13]. Trends of specific variables are presented in Table 7.

As can be seen in Table 6, stunted children were more (49.5%) in homes that used water from unprotected sources compared to those who fetched from protected ones (42.7%). This can be explained by the fact that un-protected water sources expose families to diseases which are the immediate causes of malnutrition. Moreover, those who took water without boiling had more malnourished children (62.2%) compared to those who boiled it to make it safer (42.8%). Households with pit latrines had a lower percentage of stunted children (46.6%) compared to those with none (78.6%).

Access to clean water, presence of toilet, waste disposal methods and occurrence of diseases [24], are health and sanitation issues that can have an immediate impact on nutritional status[25]. Presence of toilet facility is likely to have a high impact on nutritional status. These health and sanitation variables impact on nutrition through their relationship to disease occurrence. Results in Table 6 also indicate that occurrence of illness in a child more frequently in a month leads to higher levels of stunting (58.7%) as compared to those households where the illness occurs once or not at all in a month (45.8%). Occurrence of diseases is an immediate cause of malnutrition while access to clean water and sanitation are underlying determinants of disease occurrence. In particular, access to safe water has been used as a proxy for good health conditions in a community. Therefore, these results support the well-tested hypotheses in other studies[23, 26, 27].

People who were relatively wealthy had lower prevalence of stunting (40.5%) compared to those who were poor (53.5%) (Table 6). However, there was relatively small difference between those who were rich and at the margin (of becoming rich or poor), indicating that, other factors apart from wealth, were more important in improving nutritional status. These results seem to agree with those of Smith and Haddad [23], where it was shown that once a country reached *a per-capita* GDP of

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US $ 4700, further increases in GDP no longer had a significant contribution to the reduction of childhood malnutrition.

Income flow in the year had a significant positive impact on nutritional status at bivariate level. Those households whose income flow was assured within 1 – 3 months had a lower rate of stunting (39.7%) compared to those who had unpredictable income (83.3%). This supports the already known fact that income which flows more frequently is more likely to be spent on health enhancing expenditure and welfare in general[28].

Multivariate analysis of causes of malnutrition in western Uganda using Logistic regression

The binomial (binary) logistic regression is a form of regression used to examine the relationship between the independent variables and stunting (dependant variable). This model is considered an appropriate method of analysis of this data because both independent and dependent variables are categorical in nature and the dependent variable is also discrete in nature. The analysis was based on the significance level of p=0.05.

As indicated in Table 7, the variables that were used to run the logistic regression model were the information on child-care, the age when food is introduced to the children, occurrence of child illness, wealthy ranking and existence of safe drinking water. Preference in serving food, if household prepares special foods for children, if anything is added to make food nutritious and if children are given cereal porridge were also all included in the model.

As shown in Table 7, four variables were found to have a considerable impact at 5% level of significance that is: information on childcare, wealth ranking, safe drinking water in the household, and if special foods were prepared for children. At 10% level of significance, importance of cereal porridge and age when other foods are introduced (for 6+ months) were significant.

Outcome of the binary logistic regression (stunting as dependent variable)

Information on child- care

At multivariate level, information on child-care was significant in influencing childhood stunting. Taking the No (for those who had not got information on child-care) as a reference category, a positive relationship at B= 0.72, p=0.03, OD=2.06 existed with stunting where those who had never received this information were 2 times more likely to have stunted children than those who received (Table 7). Other factors constant, access to information on child-care improves the efficiency of transforming available household resources into child nutrition investments. As well, access to information may be related to other variables such as availability of health facilities, good road network, radio and household wealth level[28-30].

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As already pointed out, the impact of poorer infrastructure was related to nutrition trends such as: Buhweju County, which is more remote and with poor infrastructure especially health facilities and road network as indicated in Table 7.

Wealth category

The wealth ranking was found to influence the level of stunting in Bushenyi District. At multivariate level, taking the poor as the reference category, it was revealed that the rich were less likely to have stunted children (at 10% level of significance) B= -1.11, p=0.08, OD= 0.33. The moderately rich (at margin), were also less likely to have stunted children: B= -1.89, p=0.00, OD = 0.15 compared to the poor (Table 7). Household wealth is one of the basic determinants of malnutrition, in particular stunting which takes long to manifest[31]. It can easily translate into underlying nutrition determinants such as access to information and affordability of health care[26].

Safe drinking water

Pre-preparation of drinking water for instance by boiling to make it safe, is associated with hygiene and health seeking character. At multivariate level, results indicated that those who boil water for drinking were less likely to have stunted children compared to those who do not (Table 7). Access to safe water has been used as a proxy for good health conditions in a community[23]. Therefore, these results are in agreement with expected trends.

Special food preparation

Infants and children have special nutritional needs because of their relatively rapid growth rates and higher activity. In Table 7, those families that prepared special foods for children were less likely to have stunted children as compared to those who did not prepare special foods: B= -1.03, P= 0.02, OD= 0.36.

DISCUSSION

The main causes of malnutrition shown by the results are multifaceted in nature and this supports the well-known view that a multi-sectoral approach is needed to solve the problem of malnutrition in rural communities[32]. The main informants at district and sub-county level also recommended intervention strategies that cover the whole food chain: from food production to consumption and utilization. However, one cannot have nutrition focus unless there is awareness from policy level to grass-roots level. This is especially important if the development activities are initiated as a result of demand from the grass-roots level.

From the logistic regression results, one can deduce that community nutrition and health education activities for the population should be emphasized in poverty alleviation programs with a nutrition focus. The available programs in the districts, such as agriculture modernization, reproductive health, primary health care programs and environmental protection can be modified to suit this objective. In particular, reproductive health programs, which already have a high coverage but poor

acceptability should be re-evaluated and re-designed to make them more acceptable, and inclusive of a strong nutrition component.

It should be noted that environmental degradation is an aspect of sustainable household food security; thus, constraints on fuel access can have negative impact on food and nutrition security and should be put on the development agenda of the country.

Well-designed advocacy/nutrition sensitization programs have a high chance of success in the district, hence, a nation-wide and holistic advocacy/nutrition sensitization program could be part of the intervention to improve nutrition in Uganda.

Apart from community level nutrition awareness programs, most of the needed interventions to improve food and nutrition security are more of socio-economic in nature and focus mainly on poverty alleviation actions that are simply aimed at the problem of malnutrition. As already indicated, it can be argued that this is part of sustainable development with a human face. This implies that a sustainable nutrition intervention program can be developed by creating a policy dialogue on the issue through appropriate advocacy. Once policy dialogue is successful, then resources can be continuously budgeted for at all levels. Nutrition related programs which are more acceptable and/or with a high coverage, can be used as an entry point. Agricultural intervention programs can have an in-built nutritional focus within the market-oriented approach.

The impact of distance to the nearest roads cannot be overemphasized since it will in turn affect access to markets, prices of products and access to health services and information.

Thus, the results on distance to the markets follow a similar trend**.** Distance to the main road can have wide implications on welfare indicators of the community. From the literature, availability of health services is an underlying determinant of under nutrition and is directly related to the occurrence of diseases [33,34]

Poor households cannot easily access food, have inadequate access to care and health services on a sustainable basis [26]. As indicated, intake of animal products is associated with better food security. Therefore, it is possible that extreme poverty is one of the main causes of under-nutrition in Bushenyi District. Income that flows at steadier and shorter intervals is more likely to be diverted to welfare enhancing consumption expenditures as opposed to that which is seasonal or unpredictable [35].

Furthermore, the type of housing has been used along with other assets as an indicator of wealth and poverty level in Uganda and other developing countries [36]. Therefore, while income improvement is a necessary condition for sustainable nutrition improvement, it may not be sufficient in ensuring rapid nutritional outcomes in the short-to medium-term. Qualitative results indicate that health and nutritional

expenditures are down on the household priority ranking in Bushenyi District. This implies that household income may not necessarily be used for health and nutrition expenditures. A comparison of the rich households and those at the margin (of crossing to be rich or poor) does not indicate any significant difference in the nutrition situation of their children. The poor, perhaps because they are highly deprived of all means of livelihood, are the most malnourished. However, as results indicate, even if households are at "the margin", it may be possible to have an appreciable improvement in their nutritional status and welfare in general.

The role of women controlled income in ensuring food and nutrition security is well known and has also been indicated in this study. Therefore, creative enterprise selection with a gender approach can be one way of improving nutritional status in the community. Establishment of small-scale industries that are linked to the agricultural sector and with a gender approach can move the nutrition agenda forward.

As already pointed out, creative nutrition awareness and health education campaigns along with reproductive health programs, should be relentlessly pursued for the masses to increase the impact of poverty alleviation programs in the area. Moreover, such an approach, if well designed can also be used to promote consumption and subsequent market demand of some products. As indicated by the great gap in nutritional status between 2 counties, infrastructure such as roads, health facilities, electricity and water supply have a great cross cutting impact on their welfare. These are obviously general development issues that need not be specifically emphasized under any study.

It is also important to note that for better nutrition, it is imperative that vulnerable groups like children and pregnant mothers are given priority during meal planning and food serving.

CONCLUSION

Under-nutrition levels in Bushenyi district as shown by high stunting levels (46%) are still unacceptably high. At the same time, there is generally low intake of animal protein and generally constrained access to enough food requirements.

From the data, variables that had positive trend for stunting at bi-variate level were those of health and sanitation category, child feeding practices and access to appropriate knowledge; socio-economic variables of access, demographic and environmental factors. Further analysis using logistic regression model, indicated that the main causes of stunting were poverty (wealth ranking), lack of information on child care, poor weaning practices and compromised access to proper hygiene, sanitation and more specifically access to safe drinking.

The data indicate that the causes of malnutrition in Bushenyi District in general coincide with the UNICEF model; however, more emphasis needs to be on

community nutrition, health education and family planning services in poverty alleviation programs with a nutrition focus.

It is hoped that this study will stimulate interest and lead to a more extensive national study. A more detailed study should be undertaken guided by the variables which were significant at bivariate level in Bushenyi district to map out the main causes of malnutrition at national level. The findings may be useful in guiding the design of sustainable food and nutrition interventions in the country.

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Table 1: Logistics model

The model is presented as follows:

$\mathbf{P_i} = \mathbf{1/1+e^{-z}}$ ……..…….....…1

Where,

$\mathbf{Z} = a_0 + a_i x_i$…….....2

Pi = Probability of an event happening (under nutrition),

e = the base of natural logarithms approximately 2.718.

From equation it is clear that Z is the linear combination of explanatory variables including social, economic and demographic factors (x_i) identified. $\mathbf{a_0,\ldots\ldots a_n}$ are the coefficients to be identified from the data and can be given by the modified equation below.

$$\mathbf{Pi}\ (0,1) = a_0 + a_1x_1 + a_2x_2 + \ldots\ldots\ldots\ldots..x_n + \mu \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots.3$$

Where **μ** is the random error term

The "**a**" parameters are estimated using the maximum like hood method.

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Table 2: Percentage distribution of water source, drinking water safety, toilet & sanitation, transport and fuel used for food preparation in Bushenyi District

Variables	*N*	*%*
Source of drinking water		
Protected sources	178	48.4
Un protected sources	190	51.6
Boiling of drinking water for safety		
Yes	285	76.0
No	90	24.0
Type of toilet facility		
Traditional pit	352	96.2
None	14	3.8
Sources of fuel (by ownership)		
Own source	189	62.2
Does not have own source	115	37.8
Distance to nearest road		
0-2km	51	13.1
2-4km	146	37.4
4-6km	91	23.3
6-8km	36	9.2
More than 8 km	66	16.9
Distance to nearest market		
0-2km	51	13.4
2-4km	139	36.4
4-6km	90	23.6
6-8km	36	9.4
More than 8 km	66	17.3
Distance to the nearest health unit		
0-2km	84	25.1
2-4km	81	24.2
4-6km	78	23.3
6-8km	41	12.2
More than 8 km	51	15.2

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Table 3: Prevalence of Stunting among children 6-59 months in Bushenyi District based on NCHS Reference

Locality		Stunting rates (< -2 Z-Scores)	Normal (≥ -2 Z-Scores)
	N	%	
Buhweju County	198	55.6	44.4
Igara County	193	36.3	63.7
Overall prevalence	**391**	**46**	**54**

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Table 4: Percentage distribution of dietary factors

Variables	N	Percent
Meals eaten in a day by adults		
1 meal	33	8.6
2 meals	267	69.5
3 meals	79	20.6
4 meals	5	1.3
Meals eaten in a day by children		
1 meal	13	3.4
2 meals	127	33.3
3 meals	184	48.3
4 meals	46	12.1
>4 meals	11	2.9
Preference in serving food		
Yes	107	32.7
No	220	67.3
Food frequency (milk)		
Daily	92	35.0
4-6 days per week	20	7.6
1-3 days per week	49	18.6
Once in 2 weeks	23	8.7
Once a month	26	9.9
Rare	36	13.7
Never	17	6.5
First complementary foods		
Meats	3	0.8
Milk	120	31.6
Millet porridge	110	28.9
Beans	4	1.1
Matooke (banana for cooking)	31	8.2
Eggs	2	0.5
Sweet potatoes	9	2.4
Kalo (millet bread)	23	6.1
Dodo (amaranths)	2	0.5
Soya	6	1.6
Yellow bananas	40	10.5
Maize porridge	2	0.5
Solanum potatoes	3	0.8
Maize porridge	25	6.6
Method of feeding		
Cup	86	45.3
Spoon	16	8.4
Hand	66	34.7
Bottle feeding	15	7.9
Chewing by mother	7	3.7

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Table 5: Socio-economic levels and income flow information in Bushenyi District

Variables	N	%
Wealthy ranking		
Rich	37	11
At the margin	97	28.8
Poor	203	60.2
Income flow in the year		
Every 1-3months	179	68.8
Twice year	15	5.8
Not predictable	66	25.4
Type of housing		
Permanent	62	16.5
Semi-permanent	314	83.5

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Table 6: Frequency distribution of independent variables against Stunting

Variables	*N*	*Stunted <-2 z-score)*	*Normal (> = -2 z score)*
Source of Drinking water *P = 0.19*			
Protected sources (wells and public tap)	178	42.7	57.3
Un protected sources (wells, spring, rain)	190	49.5	50.5
Total	**368**	**46.2**	**53.8**
Boiling of water to improve safety p=0.01			
Yes	285	42.8	57.2
No	90	62.2	37.8
Total	**375**	**47.5**	**52.5**
Type of toilet facility p=0.02			
Traditional pit	352	46.6	53.4
None	14	78.6	21.4
Total	**366**	**47.8**	**52.2**
Waste disposal p=0.02			
Dumping and others	124	56.5	43.5
Burning	13	53.8	46.2
Mulching	158	44.3	55.7
Composite pit	93	35.5	64.5
Total	**388**	**46.4**	**53.6**
Age of the mother *P= 0.04*			
≤ 19	12	75	25
20 – 24	86	51	49
25 – 29	104	34.6	65.4
30 – 34	73	42.5	57.5
≥ 35	87	30.8	69.2
Total	**362**	**43.9**	**56.1**
Occurrence of the child illness P = 0.28			
0 – 1 times	214	45.8	54.2
2 – 3 times	109	46.8	53.2
Several times	46	58.7	41.3
Total	**369**	**47.7**	**52.3**
Preference in food serving p= 0.17			
Yes	107	37.4	62.6
No	220	45.5	54.5
Total	**327**	**42.8**	**57.2**
Milk intake in household P=0.18			
Less than 120 liters	124	38.7	61.3
120-240 liters	52	52	48
320-440 liters	48	31.2	68.8
More than 441 liters	28	35.7	64.3
Total	**252**	**39.7**	**60.3**
Supplementary feeding P=0.00			
Yes	58	31	69
No	299	52.5	47.5
Total	**357**	**49.0**	**51.0**
Wealthy ranking p = 0.08			
Rich	37	40.5	59.5

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At the margin	97	41.2	58.8
Poor	203	53.7	46.3
Total	**337**	**48.7**	**51.3**
Income flow in the year p = 0.00			
Every 1- 3 months	179	39.7	60.3
Twice a year	15	60	40
Not predictable	66	83.3	16.7
Total	**260**	**51.9**	**48.1**

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Table 7: Relationship between stunting and independent variables

Model summary: Cox & Snell $R^2 = 0.330$, Nagelkerke $R^2 = 0.442$

Variables	B	Df	*P- Value*	OR
Information on child care*				
Yes	**0.00**		**1.00**	
No**	0.72	1	0.03	2.06
Age other foods are introduced		***2***	***0.13***	
Less than 4 months**	**0.00**		**1.00**	
4-6 months	-0.34	1	0.46	0.71
6+ months	-0.79	1	0.05	0.45
Occurrence of child illness		***2***	***0.26***	
0-1 times	0.19	1	0.55	1.22
2-3 times	-0.75	1	0.18	0.47
3+ times**	**0.00**		**1.00**	
Wealthy ranking*		***2***	***.00***	
Rich	-1.11	1	0.08	0.33
At margin	-1.89	1	0.00	0.15
Poor **	**0.00**		**1.00**	
Safe drinking water preparation *				
Yes	**-1.02**	**1**	**0.01**	**0.36**
No**	**0.00**		**1.00**	
Preference in serving food				
Yes**	**0.00**		**1.00**	
No	**-0.37**	**1**	**0.27**	**0.69**
Special food prepared for children*				
Yes	**-1.02**	**1**	**0.02**	**0.36**
No**	**0.00**		**1.00**	
Anything added to make it nutritious				
Yes	**-0.44**	**1**	**0.41**	**0.65**
No**	**0.00**		**1.00**	
If children take Cereal porridge				
Yes	**1.01**	**1**	**0.07**	**2.74**
No**	**0.00**		**1.00**	
Constant	***1.04***	***1***	***0.01***	***2.83***

Source: Survey data

*** Reference category. **** Those were significant in the logistic model.*

***B**=Logistic Co-Efficient, Odds Ratio (OR)=**Exp(B)**, **DF**=Degree of Freedom, **P** Value-level of Significance*

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