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Imparting Nutrition Knowledge to School Children and Communities: The Role of Orange Fleshed Sweet Potato in Nutrition

Domina Esther Nkuba Mbela
Tanzania Food and Nutrition Center (TFNC)
Department of Nutrition Education and Training

Nnally Luitfrid Peter
Tanzania Food and Nutrition Center (TFNC)
Department of Nutrition Education and Training

Victoria Kariathi
Tanzania Food and Nutrition Center (TFNC)
Department of Nutrition Education and Training

Mariam Mtunguja
Tanzania Agricultural Research Institute (TARI): Ilonga

Eliasaph Mwana
Tanzania Food and Nutrition Center (TFNC)
Department of Nutrition Education and Training

Medina Wandella
Tanzania Food and Nutrition Center (TFNC)
Department of Nutrition Education and Training

ABSTRACT

Consumption of orange-fleshed sweet potato is essential in combating malnutrition. To date, researchers have made many efforts to introduce bio-fortified foods to increase nutrient adequacy. This study conducted baseline and end-line surveys to 480 students and 48 teachers in the three districts of Tanzania, namely Mkuranga, Bukoba, and Missenyi and were trained on nutrition education. The knowledge on orange-fleshed sweet potato (OFSP) nutrition value increased from 0.40% to 74.21% for students and from 5.30% to 97.72% for teachers. Both students and teachers showed to score high dietary diversity. Teachers and farmers/women of reproductive age practiced boiling OFSP with peels which is the appropriate method for preventing nutrient loss. These results show that students and teachers gained knowledge of the nutrition benefits of OFSP. The study found that more than half (60.80%) of students and 25.00% of teachers in their households still cook potatoes after peeling; the practice that can lead to the loss of some nutrients, especially water-soluble vitamins. There was an increase in OFSP consumption by teachers (100%), students (99.2%), and farmers/women of reproductive age

(76.3%). The majority of family members preferred sweet potato consumption at the end line survey by 62%. The study also showed an increase in student's school attendance from 85.06% (2015) to 91.56% (2018). This study suggests more effort is needed to increase the adoption and utilization of OFSP through a developed partnership with agro-processors for viable processed products.

Keywords**:** Orange fleshed sweet potato, School children, teachers, Vitamin A, Dietary Diversity

INTRODUCTION

Roots and tubers are part of the diet for the majority of the global population, with a world average per capita consumption of 19.4 kg/year (2013–2015) and projecting to achieve 21.0 kg/year by 2025 (OCED-FAO, 2016). In 2018, Tanzania recorded the largest producer of sweet potatoes in Africa with a total production of 3 345,170 metric tons, followed by Nigeria (3,178,270), Ethiopia (2,701,599), Uganda (1,863,000), and Rwanda (1,080,780) [1]. There have been tremendous efforts of introducing nutrient-rich crop varieties such as orange-fleshed sweet potatoes in various farming communities to increase the contribution of sweet potatoes to healthy diets. Orange fleshed sweet potato (OFSP) is essential in combating malnutrition, including vitamin A deficiency. OFSP is a source of dietary fiber, complex carbohydrates, proteins, vitamins A, C, and B, iron, calcium as well as the making of industrial starch [2]. Leaves are consumed as vegetables in some communities [3]. School children and pregnant women are vulnerable to malnutrition, especially vitamin A deficiency. Researchers have made many efforts to introduce bio-fortified foods, including orange-fleshed sweet potato, into the communities during the past decade. Biofortification is a feasible and cost-effective means of delivering micronutrients to populations with limited access to diverse diets and other micronutrient interventions [4]. Vitamin A is an essential nutrient though needed in small amounts by the human body. It plays a vital role in the normal functioning of the visual system, growth and development, and maintenance of epithelial cellular integrity, immune function, and reproduction [5]. Apart from preventing vitamin A deficiency, carotenoids rich foods protect human bodies against chronic diseases including cancers, cardiovascular disease, diabetes, cataracts, some inflammatory diseases, and age-related muscular degeneration due to their antioxidant properties [6, 7, 8]. Vitamin A is available as preformed retinol from animal sources and provitamin A carotenoids (pVACs) from plant sources. In Tanzania, vitamin A deficiency remains a public health concern due to monotonous, cereal-based diets that lack diversity.

Dietary diversity is one strategy to address nutrient deficiencies by increasing nutrient adequacy[5]. Evidence from the study on Orange Fleshed Sweet Potatoes (OFSP) consumption for improved nutrition in Tanzania shows that diets of a large percentage of households are deficient in vitamin A [9]. Therefore, a study was conducted to assess the knowledge and practices of primary school children and teachers in their respective communities. The study objectives were: i) To assess knowledge attitude and nutritional practices (KAP) of teachers and students on nutrition ii) Identify local cooking practices of sweet potato and vegetables based foods iii); To assess acceptability of OFSP by the communities; iv) to promote the consumption of orange-fleshed sweet potato (OFSP) to school children and their respective communities v), and vi) To determine dietary diversity for students and teachers.

METHODS AND MATERIALS

Study Area

The study was conducted in the three districts of Mkuranga in Pwani region, Bukoba, and Missenyi in Kagera region of Tanzania Mainland.

A baseline (the year 2016) and end-line (the year 2018) surveys were conducted in 24 primary schools; 480 students and 48 teachers were assessed on consumption patterns, knowledge, attitude, nutritional practices, and dietary diversity.

Nutrition education assessment

Based on the nutritional gaps identified during baseline, teachers were trained (both male and female) in nutrition to improve their nutritional knowledge and delivery of educational materials and recipe preparation. After that, teachers trained students during nutrition clubs in their respective schools. Monitoring was done quarterly to monitor students' training and sweet potato production. Dissemination of nutrition and gender-sensitive messages were done using flyers, radios, article publications, fact sheets, and TV programs.

Data analysis

Both qualitative and quantitative methods were employed in data collection using the prepared survey instruments. Data was keyed into SPSS software version 20 where quality check, cleaning, coding, and creating additional ready for the final analysis were done. Data descriptive analysis included cross-tabulations of various variables, frequencies, mode, means, proportions, and tests of significance were generated. After that, baseline and end-line data were merged, and final inferential analysis was done whereby the logit model was used to examine the predictors of consumption of OFSP among students at baseline and end-line surveys.

Ethical Clearance and Consenting

The community and individuals were informed about the study. Written consent to participate in the study was obtained from the students and teachers. Permission to conduct the study was obtained from regional, district, and ward authorities.

Demographic information

Demographic characteristics for both students and teachers were obtained. Demographic characteristics collected for students were age, sex, and education level. The information on age, gender, head of household, marital status, and education levels were collected for teachers.

RESULTS AND DISCUSSION

Demographic characteristics

Students from male-headed households were 69.4%, and the rest were from female-headed households. About 58.8% of students were female, and 41.2% were male. Their age ranged from 10-18 years, whereby most students had 13 (30.8%) and 14 (30.4%) years. Students were from class 4 (2.3%), 5(12.3%), 6 (33.5%) and 7 (51.9%). Teachers from male-headed households were 77.1% and from female-headed households were 22.9% (n=11). Male teachers were 60.4% (n=29) and female teachers were 39.6% (n=19). The teacher's age range was from 25-60 years, and 10.4% were 33 years old. About 81.2% of teachers were married monogamous, 10.4% were single, 4.2% were separated, and 4.2% were married polygamous.

Among polygamous marriages, one household was headed by a female who was the breadwinner of her family without depending on her husband. All the respondents (teachers) have attained a college education.

Knowledge attitude and practices (KAP) on nutrition

Nutrition education

From 2016 to 2018, the study showed an improvement in awareness of nutrition education to be taught at primary school from 30% during the baseline survey to 98.5% at the end-line survey. The increase in nutrition knowledge in this study was high compared to Grant and colleagues in Tanzania, where after their study intervention, the increase in nutrition knowledge to caregivers was 23% [10]. Because nutrition education is vital in this era, there is a need for the Ministry of education through the Tanzania Institute of Education to introduce nutrition subjects instead of being part of other subjects. Considering nutrition as a stand-alone subject can draw attention to the young generation to acquire nutrition knowledge and break the malnutrition cycle in the generation. Eighty-five percent of students attended nutrition clubs; in 2016, the baseline results showed that only 11% of all schools attended nutrition clubs. In other schools like Kilamba, Kibuyuni, Lupodo, and Kise, messages on nutrition education and nutritional benefits of orange-fleshed sweet potato were delivered to the whole school during pared time. In schools with nutrition clubs, students were delivering nutrition messages during the parade; this could be why non-member was able to mention the health benefits of OFSP.

Table 1: Teacher's Knowledge on nutrition education being part of the curriculum

Criteria	2016 results (%)	2018 results (%)
	Yes	Yes
Knowing school curriculum covers aspect of nutrition	10.6	100
Knowing level at which level nutrition education is covered	75	100
Knowing the subject where nutrition education is taught	13	100
Knowing subtopic that covers nutrition education	43	100
Participation in nutrition club/extra curriculum activities	57	100

Unlike the 2016 baseline results, in 2018, the results revealed that teachers were aware that the school curriculum covers nutrition, the levels in which nutrition education is covered, the subject with nutrition education, and subtopics that covered nutrition education. All of them were participating in nutrition club/extra curriculum activities (Table 1). This indicates that the project had positive results in its activity implementation.

Students who claimed to know health benefits of OFSP were 89.2%, and 88.8% were able to mention the nutritional benefits. In contrast, only 10.8% of the students didn't know the health benefits of OFSP. About 11.2% of the students failed to mention the health benefits. A baseline study showed that only 22% and 31% of students and teachers respectively claimed to know health benefits, and among them, only 3% and 14% respectively were able to mention the health benefits. Unlike the previous study baseline study, all the interviewed teachers

mentioned the health benefits and recipes of OFSP, and 97.92% mentioned nutrients found in OFSP. Figure 1 shows that students and teachers have gained knowledge on the nutrition value and health benefits of OFSP. All teachers (100%) and 89.2% of students become aware of the health benefits of OFSP.

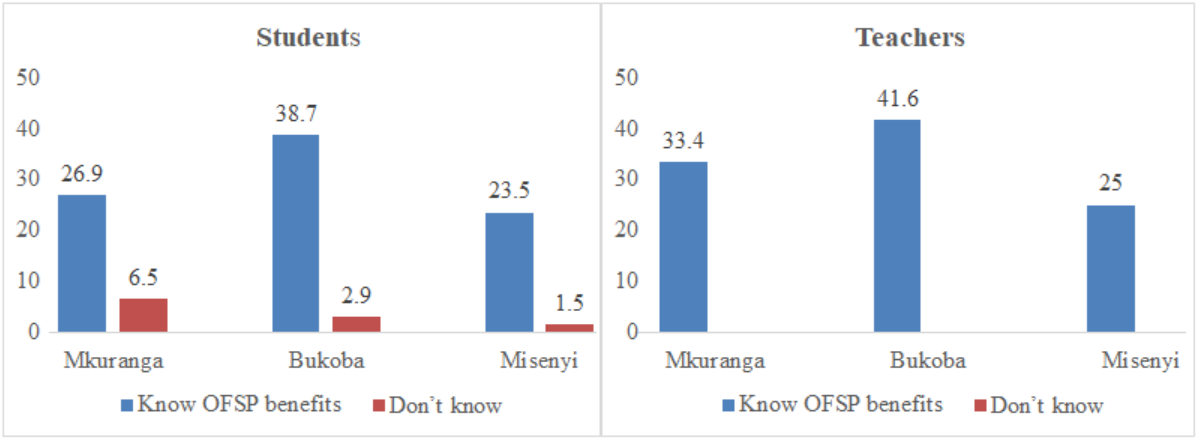

Figure 1: Knowledge on OFSP benefits

The results show that 75.21% of students and 97.72% of teachers mentioned nutrients found in OFSP (Fig. 2). The 2016 baseline study showed that almost all students (99.6%) and teachers (94.7%) didn't know what nutrients are in OFSP. Thus, the knowledge of OFSP nutrients contents has increased from 0.40% to 74.21% for students and from 5.30% to 97.72% for teachers. This implies that the community has gained knowledge on the nutritional value and health benefits of OFSP; this might lead to the increased consumption of OFSP at the household level, as suggested by Shiundu and colleagues' study. In their study, they found that nutrition knowledge level revealed a positive effect on the choice of OFSP bread; a unit increase in the level of nutrition knowledge increased the probability that a consumer will choose OFSP bread by 5%. They concluded that nutrition knowledge is important in promoting consumption of OFSP bread, and therefore strategy for promoting consumption of vitamin A-rich bio-fortified foods should be designed to incorporate appropriate nutrition educational programs [11].

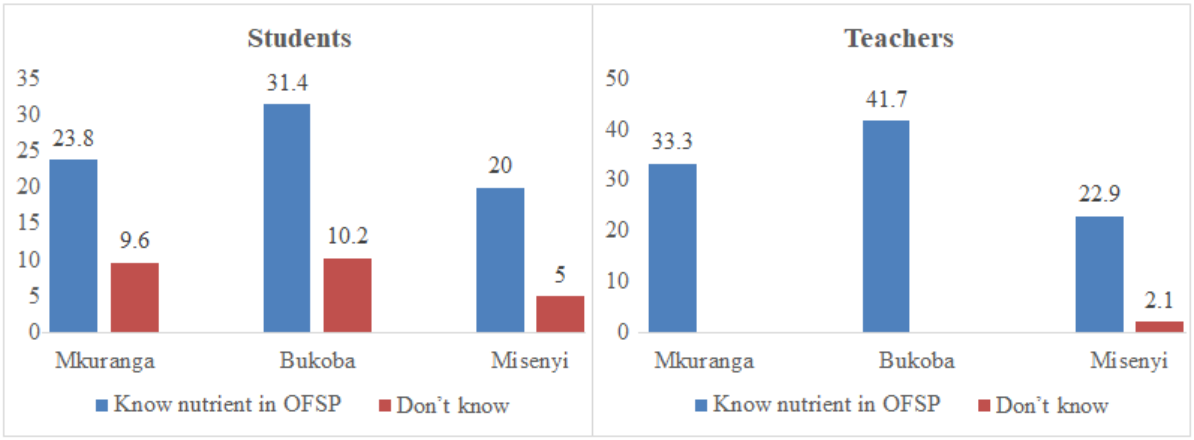

Figure 2: Knowledge of students and teachers on nutrients found in OFSP

Respondents' knowledge and attitudes on key nutritional practices

Ninety-seven percent of the interviewed students' claimed to know the food groups; however, among the 97%, only 94% were able to mention the groupings of the foods; however, among the 97%, only 94% were able to correctly mention the food groups. However, student's syllabus classifies n food groups based on food nutrients which creates difficulties in making practical applications in planning the meals. The project trained students on the correct food groups basing on the food items and not nutrients. Table 2 below explains the difference between food groups and food nutrients. Teaching students/people food groups in terms of food nutrients does not help an individual understand well which food he/she should cultivate/buy for food and nutrient diversity for improved increased nutrient intake. All interviewed teachers were able to mention food groups and their functions. However, they had to teach their student the food groups as per curriculum requirement basing food nutrient contents. There is a need to review student's curriculum to incorporate appropriate information of the required food groups to remove confusion between what is taught in class and the current classification of food groups.

Table 2: Food groups and their nutrients

Food group type	Food nutrient
Cereals, green bananas, roots, and tubers	Carbohydrates
Foods of animal origin and plant origin (legumes)	Protein
Fruits	Vitamin and minerals
Vegetables	Vitamin and minerals
Sugar, honey, fats, and oils	Fat and oil

Local cooking practices of sweet potato and vegetables based foods

About 86.46% of the students mentioned preparing vegetables for their households by sorting, washing, cutting, and cooking. All teachers (100%) prepare vegetables in their households by washing, cutting, and cooking (Fig 3). Washing vegetables before cutting is a good practice for the prevention of nutrient loss. Excessive nutrient loss through vegetable preparation (cutting, washing, and cooking vegetables) at the household level by students has been reduced to 13.54% from 18% of the 2016 baseline survey. The practice of washing vegetables after cutting reducing size into small particles leads to the loss of some nutrients by depleting the nutrients with washing water, especially water-soluble vitamins like vitamin B and C. It is recommended not to cut or, if necessary, cut vegetables into large pieces before washing to avoid destruction and loss of some nutrients, respectively. Furthermore, the teachers (100%) do use cooking oil when preparing vegetables.

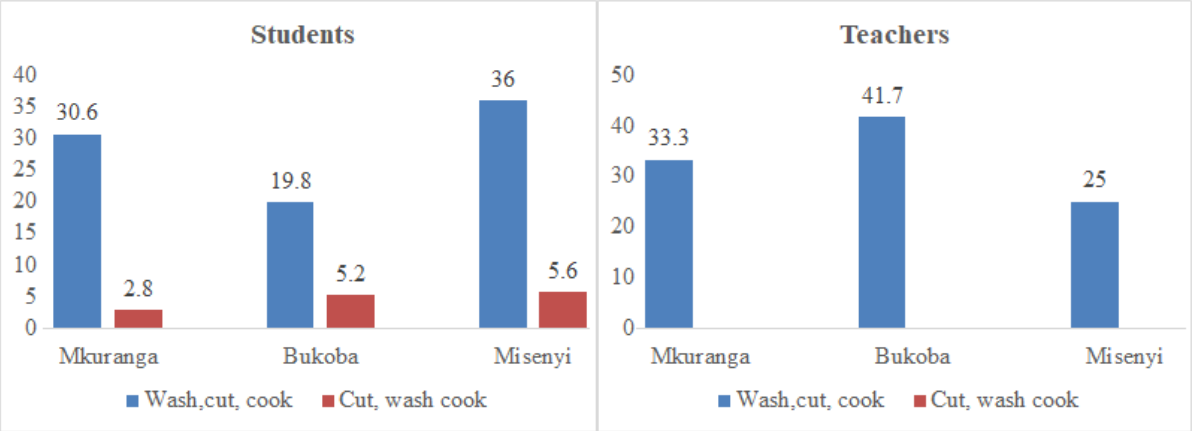

Figure 3: Household vegetable preparation practice for students and teachers

Peeling sweet potatoes can lead to the loss of some nutrients, especially water-soluble vitamins like vitamin B and C. More than half (60.80%) of the students' and 25.00% of teachers' households still practice un-recommended boiling practices of sweet potato after peeling. Of the 25.00% teachers, 14.50% were from the Mkuranga district (Fig. 4). Only 39.2% of students' households boil sweet potato with peels. This is a good practice because it prevents nutrient loss from sweet potatoes; this fact is reported by Olagunju, A. I., *et al.,* [12] study where the culinary practices resulted in unavoidable leaching of water-soluble compounds that changed the entire phytochemical profile and nutrient contents. The low percentage of students practicing recommended cooking methods at students' households might comprise the students who are not responsible for cooking, especially boys.. Instead, mothers and girls in Tanzania are the ones responsible for cooking in the household. In the current study, nutrition education to mothers was provided through village assembly; this might not have reached many mothers because not all mothers attended village meetings. The study recommends that healthy cooking methods should be passed through both parents/mothers and students intensively since not all cooking methods retain the nutritional value of OFSP [13]. Almost all teachers (97.91%) cooked vegetables with oil. Only a few teachers failed to manage to mention foods from a plant source that provides vitamin A source the rest (97.9%) mentioned. Both students and teachers did not mention any taboos that hinder vegetable and sweet potato consumption; this finding reveals that taboos do not hinder vegetable and sweet potato consumption in the study community.

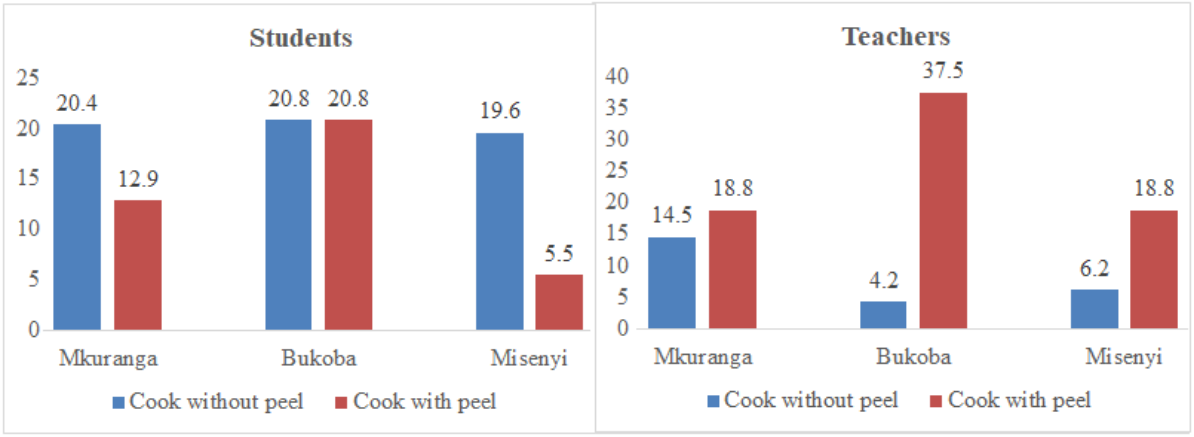

Figure 4: Sweet potato (SP) cooking practices

Consumption, nutritional value, and benefits of OFSP

Generally, OFSP consumption has been increasing in the study areas. Sweet potatoes play an immense role in the human diet and are considered the second staple food in developed and underdeveloped countries [14].

The acceptability of OFSP

The study showed that almost all students have seen (99.8%) and consumed (99.2%) orange-fleshed sweet potato (OFSP). The end line study showed that only one (0.20%) and four (0.83%) respondents had neither seen neither nor eaten OFSP respectively, while baseline result in (2016) showed that 42% of the students in the three districts by that time had not seen OFSP and 51.7% not tested OFSP. Among the 0.83% of the students not tested OFSP, 0.63% were female. The end-line study revealed that all teachers did consume OFSP, while the baseline study in 2016 showed that 31.0% of teachers by that time had not tasted OFSP. These results showed there is an increase in OFSP consumption by the community, confirming that OFSP has been promoted and adopted in the community effectively. Hence, there was a possibility that the intervention might have decreased the risk of nutrient deficiency, particularly and vitamin A deficiency as stated by Gurmu *et al* [15] that dietary diversification using orange-fleshed sweet potato has the potential to combat vitamin A deficiency due to its high beta-carotene content and provitamin A content". Among the 480 students, only 6 (1.25%) of the students preferred white-fleshed sweet potato (WFSP), while 98.75% of the interviewed students prefer OFSP to WFSP. The Criteria used in ranking sweet potatoes were sweetness, nutrient density, taste, and color. Furthermore, the results show that 98.75% of the interviewed students prefer OFSP to WFSP, only 1.25% preferred WFSP. About 41.46% of the students (41.46%) liked the consumption of OFSP due to its sweetness, 22.08% due to its nutrient composition, followed by taste (15.42%) (Table 1). The baseline study in 2016 showed that only 40% of students ranked OFSP as number one for consumption preference. Unlike their students, and 95.8% of the teachers prefer OFSFP to WFSP

Table 3 Attributes for OFSP and WFSP preferences (n=480) in Mkuranga, Missenyi and Bukoba districts, 2018, Tanzania: Students

	OFSP %								**WFSP%**			
	Colour	**Taste**	**Sweetness**	**Nutrients**	**Colour and taste**	**Taste and sweetness**	**Colour, taste and sweetness**	**Taste and nutrients**	**Taste**	**Sweetness**	**Nutrients**	**Total**
Male	2.08	8.13	15.00	8.54	2.50	1.88	1.46	1.25	0.00	0.21	0.21	41.25
Female	1.88	7.29	26.46	13.54	3.33	2.08	0.63	2.71	0.21	0.63	0.00	58.75
Total	**3.96**	**15.42**	**41.46**	**22.08**	**5.83**	**3.96**	**2.08**	**3.96**	**0.21**	**0.83**	**0.21**	**100.00**

Table 3 shows that 97.92% of the interviewed teachers prefer OFSP to WFSP, while only 2.08% of the interviewed teachers preferred WFSP. Taste attribute in the 2016 baseline survey scored

41%, but in the current study, taste attribute scored 31.25%, followed by nutrients (16.67%) and color and taste (16.67%) for OFSP preference by primary school teachers (Table 4). This showed that teachers had gained knowledge on nutrition education because now they could choose food based on its nutrient content, which was not revealed in the baseline study. In the previous study nutrient, content attributes were not considered.

Table 4 Attributes for OFSP and WFSP preferences (n=48) in Mkuranga, Missenyi and Bukoba districts, 2018, Tanzania: Teachers

OFSP%								WFSP%		
	Colour	Taste	Sweetness	Nutrients	Colour and taste	Taste and sweetness	Colour , taste and sweetness	Sweetness	Colour and taste	Total
Female	0.00	25.00	10.42	6.25	12.50	0.00	4.17	2.08	0.00	60.42
Male	10.42	6.25	0.00	10.42	4.17	2.08	4.17	0.00	2.08	39.58
Total	10.42	31.25	10.42	16.67	16.67	2.08	8.33	2.08	2.08	100.00

A baseline study indicated that children and their mothers preferred to eat OFSP than the rest of the family members. Unlike before the interventions, sweet potato consumption at the end line survey was preferred by all members of the family (children, mother, and father) by 62%, followed by school children (15.6%) (Table 5).

Table 5: OFSP consumption at Students household in Mkuranga, Missenyi and Bukoba districts, 2018, Tanzania (n=480)

Category of people	Number of respondents (n)	Percent (%)
Children under five	61	12.7
School children	75	15.6
Mother	25	5.2
Father	14	2.9
No sweet potato at home	7	1.5
Children and mother	2	0.4
All children, mother, farther	295	61.5
School children and father	1	0.2
Total	480	100

Food frequency and dietary diversity

Food diversity is crucial for increased nutrient intake for an individual. Our bodies need nutrients from various types of food. Eating diverse foods per day can have a positive impact on the nutrition status of an individual. A study conducted on Chinese Children, Aged 3–17 years found that inadequate micronutrient intake was significantly associated with poor dietary diversity and food variety [16]. A descriptive analysis on items consumed 24 hours before the commencement of the study revealed that all students (100%) consumed cereals, followed by sweets [sugar/honey/ sweetened soda or sugary foods such as chocolates, sweets] (89.6%), legumes, nuts and seeds (82.9%), and other vegetables like cassava leaves, cabbage,

indigenous vegetables (82.5%) (Table 6). This result did not differ much from the 2016 baseline survey results, which revealed that most students (92%) consumed cereals, sweets [sugar/honey/ sweetened soda or sugary foods such as chocolates, sweets, or candies] (90%), spices/condiments/beverages (90%), legumes (83%), non-dark green vegetables (83%) and oil and fats (78%). Cereals (62.1%), spices/condiments/beverages (58.8%), sweets (51.0%), legumes (40.8%), and oil/fats (40.4%), are mostly consumed at seven times per week by students.

Table 6. Individual of foods consumed in the past 24 hrs before the study Food and frequency for students (N=480)

Food group	**Consumption in 24hrs %**	**Frequency per week The highest frequency**	**%**
Cereals	100.0	7	62.1
Sweets	89.6	7	51.0
legumes, nuts and seeds	82.9	7	40.8
other vegetables	82.5	7	35.2
oil and fats	78.1	7	40.4
white tubers and roots	69.6	3	26.5
vitamin A rich fruits	62.5	2	22.7
dark green leafy vegetables	60.8	3	24.4
Fish	51.7	0	31.7
other fruits	42.1	0	31.7
vitamin A-rich vegetables and other tubers	41.9	3	28.3
flesh meat	31.0	0	34.2
Eggs	29.2	1	38.8
milk and milk products	29.2	0	44.2
organ meets rich iron	14.4	0	63.1
spices, condiments, and beverages	9.6	7	58.8

The results revealed that cereals (100%), other vegetables (100%), sweets (95.8%), and spices/condiments/beverages (89.6%) are consumed seven times per week. The most consumed foods per week by teachers at more than 80% includes cereals, other vegetables (like cassava leaves, cabbage, indigenous vegetables), sweets, and spices/condiments/beverages (Table 7). Fifty percent of teachers ate outside the home the day before the survey.

Table 7: Individual foods consumed in the past 24 hrs before the study Food and frequency for Teachers (n=48)

Food group	Consumption in 24hrs %	Frequency per week The highest frequency	%
Cereals	100	7	89.6
other vegetables	100	7	100
sweets	95.8	7	85.4
spices, condiments, and beverages	89.6	7	83.3
legumes, nuts and seeds	85.4		41.7
oil and fats	83.3	7	70.8
vitamin A-rich vegetables and other tubers	77.1	7	45.8
fish	68.8	2	27.1
dark green leafy vegetables	62.5	7	25
white tubers and roots	60.4	2	22.9
vitamin A-rich fruits	54.2	7	18.8
other fruits	50	0	27.1
flesh meat	47.9	2	22.9
milk and milk products	33.3	0	29.2
eggs	29.2	0	43.8
organ meets rich iron	18.8	0	37.5

The results showed that legumes, particularly beans, are consumed by the majority in the communities; therefore, introducing iron and zinc biofortified beans will positively improve micronutrient deficiencies in this community. Tanzania Demographic and Health Survey and Malaria Indicator Survey (TDHS-MIS) 2015-16 [17] showed that anemia prevalence in children aged 6-59months is at 58%, and 45% of women of reproductive age (15-49 years) are anemic. Therefore there is a need to make sure these people consume nutrient-rich foods such as OFSP, iron, and zinc beans for combating micronutrient deficiencies and improve nutrition status.

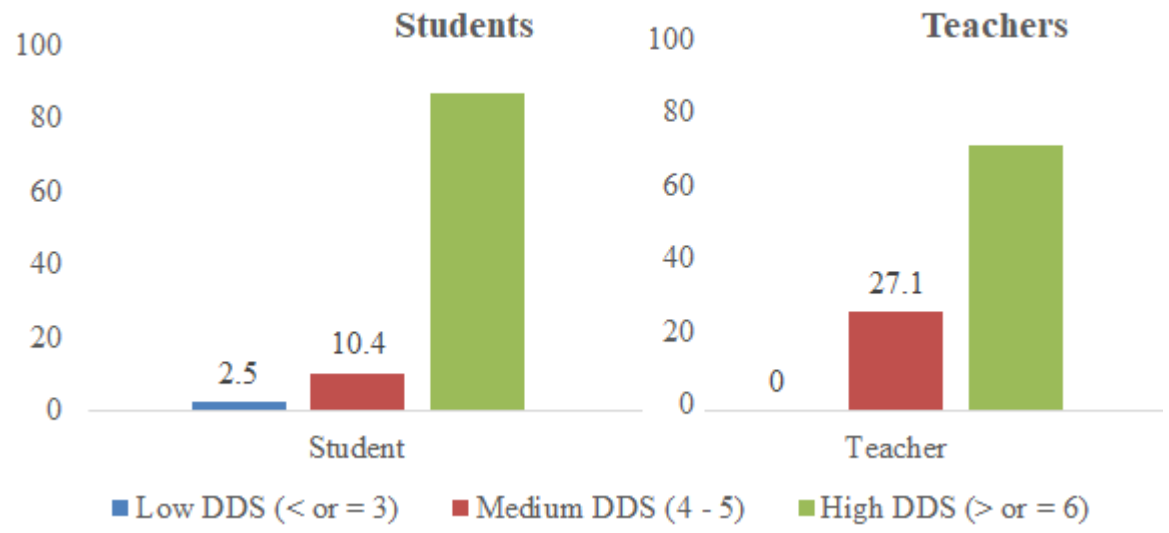

Figure 5 individual dietary diversity score

Unlike the 2016 baseline study, both students (87.08%) and teachers (72.90%) showed to improve their dietary diversity score (DDS). Teachers had no low dietary diversity score; only students score low DDS at 2.50% (Fig. 5). High dietary diversity usually results in diets of higher absolute levels of energy and nutrients [18].

School attendance

Figure 6 shows that students' school attendance in the three districts of Mkuranga, Bukoba, and Missenyi has increased from 2015 (85.06%) to the year 2018 (91.56%).

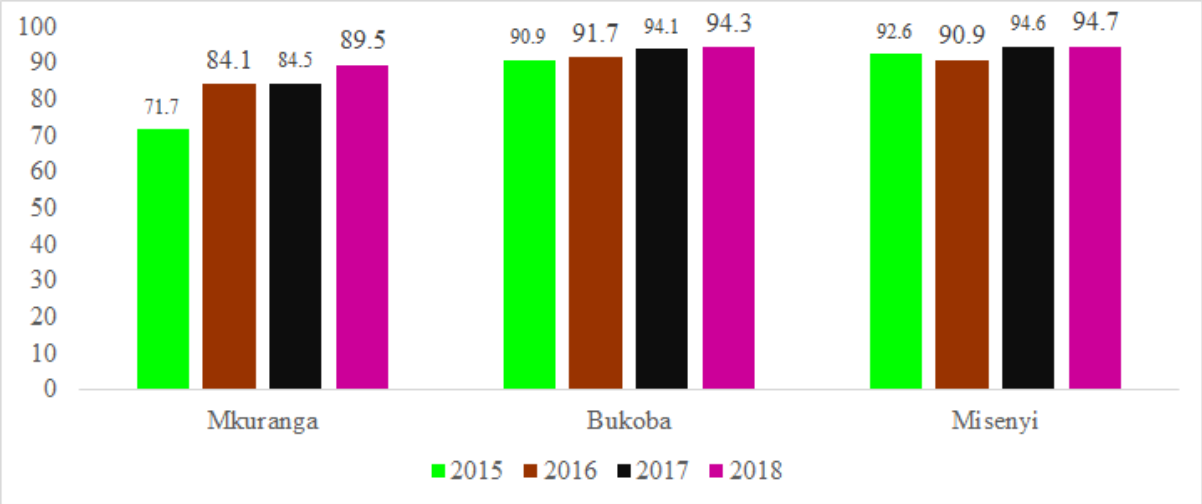

Figure 6: Average School attendance from 2015-2018

Factors Associated with consumption of OFSP

The results of logit analysis indicate that consumption of orange-fleshed sweet potatoes was found to be related to whether the respondent has ever seen orange-fleshed sweet potatoes or not; and whether she ate dark green leafy vegetables or otherwise (Table 8). We found no evidence of any relationship between consumption of orange-fleshed sweet potatoes with other variables, namely District, Sex, receiving nutrition education, being a member of nutrition club, having knowledge of food groups, ability to mention food groups, having knowledge of benefits of Orange Fleshed Sweet Potatoes, Consumption of vitamin A-rich vegetables, and consumption of vitamin A-rich fruits (Table 8).

The regression coefficient (β) for respondents who have seen orange-fleshed sweet potatoes was positive, implying that children who have seen orange-fleshed sweet potatoes had a higher likelihood of consuming those potatoes than their opposite counterparts (Table 8). The results show that the Odd (Exp - β) of children who have seen orange-fleshed sweet potatoes to consume those potatoes was 160 times higher than their opposite counterparts. This difference was statistically significant at a 95% level of confidence (p <0.01).

The 95% confidence interval reveals that the Odds of children who have seen orange-fleshed sweet potatoes to consume orange-fleshed sweet potatoes in the survey districts was between 710 to 360, meaning that at population levels, the likelihood of those children to consume orange-fleshed sweet potatoes was between 710 to 360 higher than that of their colleagues

who have never seen orange-fleshed sweet potatoes when all other factors are the same (Table 8).

Table 8: Predictors of consumption of OFSP among students at baseline and endline (n=480)

Variable	β	S.E.	Wald	*df*	*Sig.*	Exp(β)	95% C.I.for EXP(β) Lower	Upper
Mkuranga	-0.5	0.5	0.9	1	0.339	0.6	0.2	1.7
Bukoba	0.6	0.4	2.1	1	0.147	1.9	0.8	4.5
Male	0.2	0.3	0.2	1	0.623	1.2	0.6	2.3
8 – 10 years	-0.7	2.2	0.1	1	0.744	0.5	0.0	3.8[E1]
11 – 13 years	-0.6	2.2	0.1	1	0.791	0.6	0.0	4.1[E1]
14 – 16 years	-0.3	2.2	0.0	1	0.899	0.7	0.0	56.676
Received nutrition education	0.1	0.4	0.1	1	0.716	1.1	0.5	2.495
Member of Nutrition Club	0.2	0.5	0.1	1	0.785	1.2	0.4	3.481
Knowledge of food groups	-0.1	0.6	0.0	1	0.875	0.9	0.3	3.038
Mentioned food groups	0.4	0.4	0.8	1	0.346	1.5	0.6	3.426
Seen OFSP	5.1	0.4	1.5[E2]	1	0.000***	1.6[E2]	7.1[E1]	3.6[E2]
Mentioned benefit of OFSP	1.2	1.4	0.7	1	0.398	3.2	0.2	4.6[E1]
Ate Vit. A rich veggies	-0.3	0.3	0.9	1	0.336	0.7	0.3	1.4
Ate Dark green leafy Veggies	-0.8	0.4	4.7	1	0.030***	0.4	0.2	0.9
Ate Vit. A rich fruits	0.3	0.4	0.7	1	0.406	1.3	0.6	2.7
Constant	**-2.6**	**2.3**	**1.3**	**1**	**0.247**	**0.1**		

Reference category: *District* = Misenyi; *Sex* = Female; *Age* = 17 – 18 years; *Nutrition education* = Did not receive; *Nutrition club membership* = Non member; *Knows food groups* = Do not know; *Mentioned food groups* = Unable to mention; *Ever seen Orange Fleshed Sweet Potatoes* = Never seen; *Knowledge of benefits of Orange Fleshed Sweet Potatoes* = No knowledge; *Ate Vitamin A rich vegetables* = Did not eat; *Ate Dark Green Leafy Vegetables* = *Did not eat; Ate Vitamin A rich fruits* = Did not eat

On the contrary, the regression coefficient (β) for respondents who ate dark green leafy veggies was negative, implying that children who ate dark green leafy vegetables had a lower likelihood of consuming those orange fleshed sweet potatoes than their opposite counterparts (Table 8). The results showed that the odds of children who have eaten dark green leafy vegetables to consume OFSP was 0.4 times lower than that of their opposite counterparts. This difference was statistically significant at a 95% level of confidence (p <0.05). The 95% confidence interval reveals that the odds of children who eat dark green leafy vegetables and orange-fleshed sweet potatoes were between 0.2 to 0.9, meaning that at population levels, the likelihood of those children to consume orange-fleshed potatoes was between 0.2 to 0.9 lower than that of their colleagues who have not eaten dark green leafy vegetables when all other factors are the same (Table 8).

Communities nutrition education

The study conducted 38 group discussions; 13 groups comprised farmers, and 25 groups had women of reproductive age from the Reproductive and Child Health (RCH) center. The topics learned by the FGD members were the health benefits of OFSP, OFSP utilization, and malnutrition. Seventy-one percent of the groups participated in nutrition activities at the village level, that is, nutrition day which involved cooking and tasting OFSP recipes. Farmers received nutrition education during village assemblies and from district nutritionists. Women of

reproductive age from RCH received nutrition education from nurses. Children (73.7%) liked to consume OFSP at home. Reasons for children's likness of consuming OFSP were color(50%) and sweetness(50%). Among the 38 groups, 89.5% mentioned food nutrients found in food groups and their function. Good vegetable preparation practice can preserve nutrient loss during preparation. Farmers and women at RCH center about 94.7% prepared vegetables by washing, cutting, and cooking. This is good practice because it preserves nutrient loss, especially vitamin C and B. However, 5.3% of them still prepared vegetables by cutting, washing, and cooking; this led to water-soluble vitamin loss. Another good practice done by both groups is using cooking oil while preparing vegetables. This practice helps absorb fat-soluble vitamins like vitamin A, D, E, and K. Boiling sweet potato with peels is a good practice that preserves water-soluble vitamins [19]. Farmers and women of reproductive age 50% of them did cook sweet potato without peeling. The remaining percent still boiled sweet potato after peeling. Among farmers and women at RCH, 92.1% mentioned food plant sources that provide vitamin A. Both farmers and women at RCH mentioned cooking oil as an ingredient necessary in cooking vegetables and OFSP for absorption of vitamin A. Ninety-two percent of them consumed sweet potato leaves. No taboo was mentioned to be associated with sweet potato and vegetable consumption. Consumption of orange-fleshed sweet potato (OFSP) has increased in society; of the 38 conducted FGD, 86.8% prefer OFSP to white-fleshed sweet potato (WFSP). Thus WFSP was ranked second to OFSP. Colour, taste, sweetness, and nutrient content were the reasons for the consumption of OFSP. Of the 13.2% who ranked WFSP as number one, the reasons included more nutrients (5.3%) and color and taste (7.9%). These reasons show that the respondents are ignorant of the nutrition value of OFSP. There is a need for the community to have continuous nutrition education to help them adopt nutritional quality foods. The results showed that 76.3% of the group discussion confirmed that all family members like to consume OFSP, and 23.7% of them claimed that children are the one who likes to consume OFSP. Nutritional value and benefits of food are significant to be known; 97.4% of farmers and women at RCH know the nutritional value of OFSP, and 84.2% of them know the nutrition benefits of OFSP. Both farmers and women (100%) at RCH were able to mention OFSP recipes.

CONCLUSION AND RECOMMENDATIONS

There was an improvement in the awareness of basic nutrition education and the nutritional value and benefits of OFSP to pupils, teachers, farmers, and women of reproductive age. Consumption preference of OFSP has changed from mothers and children only to other family members (children, mother, and father). The increased awareness of the health benefits of OFSP led to the increased consumption of OFSP at the household level. Knowledge of nutrition education was improved; moreover, intensive nutrition education training in the community is needed. Training pupils only have a less immediate impact because parents/farmers are responsible for food purchase, preparation, and cooking at households. Therefore parents/farmers should also obtain thorough training like the one given to pupils to enhance awareness and increased consumption with food diversity for better nutritional status. The same model should be applied to other districts (which were not covered by the project) to increase coverage and trickledown effect and help eradicate malnutrition. Also, more effort is needed to increase the adoption and utilization of OFSP through a developed partnership with agro-processors to develop viable processed products. Moreover, effort should be geared to increase the availability of OFSP throughout the year by developing and adopt processing technologies to increase shelf life through the processing of dried chips and purees.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interest.

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