Journal of Agriculture and Food Research 5 (2021) 100171

Contents lists available at ScienceDirect

Journal of Agriculture and Food Research

journal homepage: www.sciencedirect.com/journal/journal-of-agriculture-and-food-research

Dietary diversity among households living in Kilombero district, in Morogoro region, South-Eastern Tanzania

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ARTICLE INFO

Keywords:
Dietary diversity
Households
Principal component analysis
Social economic status
Undernutrition

ABSTRACT

Background: Adequate nutrition is essential for good health and active life. However, diets in most low and middle-income households lack diversity, especially in settings where people eat predominantly starchy foods. In this study, we assessed the associations between socio-economic status and household dietary diversity in families living in South-eastern Tanzania.

Method: A cross-sectional questionnaire was administered to 925 parents of school children in four wards in South-eastern Tanzania, as part of a trial; assessing the effects of physical activity and micronutrient supplementation on overall growth, health and well-being of school children. The dietary intake was assessed by 24-h dietary recall and dietary diversity score (DDS) was calculated. Socio-economic status was derived from a weighted score using principal component analysis (PCA). Multinomial logistic regression was used to investigate the association between dietary diversity and socio-economic status. This baseline data assessment was completed in July and August 2019.

Results: Cereals, oils and fats were the most consumed food groups, legumes were the most common source of protein and fish was the most common animal protein. More than three quarters of the households had medium dietary diversity (MDD). Higher household education and large farm size were the only factors significantly associated with having high dietary diversity.

Conclusion: A majority of the households in South-eastern Tanzania have medium dietary diversity, comprised of cereal, fats and oils and proteins. Having high dietary diversity was associated with higher education and large farm sizes. Improving community members' knowledge and awareness of nutritional benefits could improve the dietary diversity at household level.

1. Background

Malnutrition remains a major challenge for global development, disproportionately affecting low- and middle-income countries [1,2]. In 2019, nearly 1.9 billion adults were overweight and 462 million were underweight [3]. Likewise, more than 144 million children under five years were stunted, 47 million were wasted and 38.3 million were overweight [3]. However, differences across regions persist, with low and middle-income countries experiencing the highest burden of undernutrition [4], and lack of access to a diversified diet is a major contributor to this burden [5]. In Africa, approximately 45% of deaths among children under 5 years are linked to undernutrition.

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https://doi.org/10.1016/j.jafr.2021.100171
Received 19 February 2021; Received in revised form 8 June 2021; Accepted 8 June 2021
Available online 11 June 2021

Simultaneously, the prevalence of childhood overweight and obesity in 2010 was 8.5% in Africa, and it was expected to increase to 12.7% in 2020 [6]. The effects of COVID-19 have also added a toll on the household nutrition across the world [7]. In order to contain the spread of the virus, national lockdowns characterized by restricted movement and social distance have been the order of the day in many countries. Besides of its benefits of slowing down the spreading of the virus, it has potential down sides such as increased stress, reduced physical activity, limited availability and access to diverse nutritious foods and health services [8,9]. Evidence across Africa, India and the Middle East have indicated a negative impact of COVID-19 on the overall eating habits [10,11], which can in turn have a negative impact on the overall health and wellbeing. The United Nations' Sustainable Development Goals (SDGs) number one target is to eliminate hunger, achieve food security and improve nutrition by 2030 [12].

Tanzania is one of the sub-Saharan African (SSA) countries facing both undernutrition and obesity problems, where limited dietary diversity is a major challenge [13,14]. The burden of undernutrition is greater in rural settings where households depend on seasonal crop yields, and with poor post-harvest storage facilities. In Tanzania, stunting affects 34% of children aged younger than five years, while 5% are wasted and 14% underweight [15]. Most household diets are predominantly based on starchy foods with little or no animal products, fruits and vegetables [13–15].

Dietary diversity is defined by a variety of foods within and across food groups in the diet [16]. A diverse diet helps to ensure adequate intake of essential nutrients that can promote good physical health and mental development [17]. Dietary diversity is positively linked with pillars of food security, i.e. availability, access and utilization [13,14]. Likewise, a non-diversified diet can have negative effects on individual's health and development, by reducing physical capability, weakening immunity and increasing disease susceptibility. Cognitive development, reproductive health and social capacities may also be impaired [20].

Households are food secure when they have access throughout the year to adequate quantities and a variety of safe foods that their members require for active and healthy life [21]. The ability of resources in household can predict household dietary diversity [22]. Factors like household income, size, gender and educational level have also been found to be associated with dietary diversity [23]. Understanding factors associated with dietary diversity is a significant step in improving healthy eating habits in households in low and middle-income settings. This study assessed the association between household dietary diversity and socio-economic status (SES) in households living in South-eastern Tanzania.

2. Methods

2.1. Study area

Data presented in the present article are a part of the larger KaziAfya project, a cluster randomised, placebo-controlled trial using a 2 × 2 factorial design to assess the effect of physical activity and multi-micronutrient supplementation on overall growth, health and well-being of school children in Ifakara town south-eastern Tanzania [24]. The clinical trial is being conducted in four randomly selected primary school within Ifakara town. The four schools were randomly selected from a pool of 33 schools in Ifakara town, and they came from four different wards including: Katindiuka, Kibaoni, Kining'ina and Mlabani (Fig. 1). In each school, children from grades one through four were recruited to participate in the study. A detailed description of the study's procedures is provided in the published protocol [24]. In this study, parents who provided informed consent for their children were invited to complete a survey that assessed household dietary intake, relative to the household living conditions. The majority of the parents are

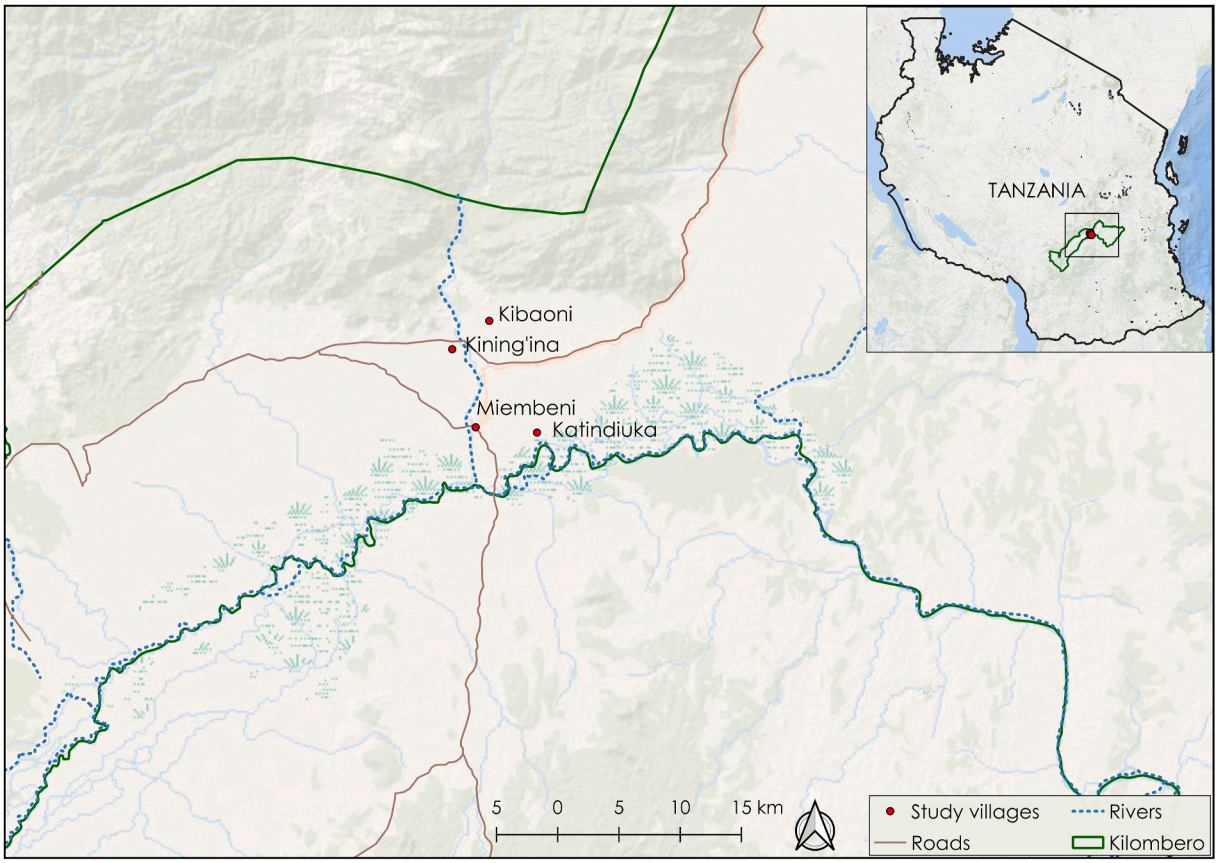

Fig. 1. Map of the Ifakara wards where the study was conducted. Map prepared by Najat Kahamba.

primarily subsistence rice farmers, but many also conduct small-scale retail business, fishing and animal husbandry as minor revenue sources [25]. Other crops grown in the area include maize, legumes and bananas as food crops. Cassava, sweet potatoes, cowpeas and vegetables are also grown, but in a smaller-scale.

2.2. Study design and data collection procedure

During the baseline data assessment, a cross-sectional questionnaire was administered to parents of children attending the primary schools participating in the KaziAfya study [24]. The questionnaire gathered information on demographic and socio-economic characteristics of the parents such as marital status, mother/caregiver education, occupation of the respondent, number of people living in the household, size of cultivated land etc. The household dietary diversity was collected through a 24-h dietary recall adapted from United Nations' Food and Agriculture Organization FAO [26]. It was adapted to reflect food names and items that were common in Tanzania and the study site. The research team members administered the survey Kiswahili, Tanzanian national language using KobotoolboxTM software [27] on electronic tablets. The questionnaire was administered during a period of two months between July and August 2019. Each day, a maximum of 50 consenting parents or guardians were interviewed. Parents and caregiver were invited to respond on behalf of all family members. For the 24-h dietary recall, parents and guardians were first asked to list all foods including drinks and snacks that were consumed through the 24 h preceding the survey at home and away from home. Parents and caregiver were then probed for likely forgotten foods and then asked to give a detailed description of foods and beverages consumed, including ingredients for mixed dishes.

2.3. Data management and statistical analyses

Data analysis was done using open source statistical software R, version 3.3.2 [28]. Basic descriptive parameters were reported as frequencies, percentages and means. Multinomial logistic regression was used to analyse the factors influencing household dietary diversity for rural and peri-urban villages. DDS was used as dependent variable distinguishing between the following categories: low dietary diversity (LDD), middle dietary diversity (MDD) and high dietary diversity (HDD). Independent variables were household size, education, occupation, cultivated land and SES.

The DDS categories were calculated as follows: the food items consumed over 24-h were classified into one of the 12 different food groups (i.e., cereals, oils and fats, legumes, vegetables, fish, fruit, meat, milk and milk product) that are used for the assessment of individual or household dietary diversity [26]. One point was awarded to each food group consumed and zero score was given to a household that did not consume a specific food group. The points were then summed to generate a DDS for each household. LDD was defined as DDS $\leq$3, MDD as DSS between 4 and 6, and HDD as DSS $\geq$7, hence food secured [26].

SES was derived from a weighted score using principal component analysis (PCA) and categorized into three wealth categories including: poorest, poor and least poor. Variable selected for the PCA are described in Table 1. The PCA was done following the Filmer and Pritchet approach, in which dummy dichotomous variables were created from categorical variables [29]. For example, a variable with three categories was recoded into three dichotomous dummy variables. Eigenvalues were generated from the transformed variables using the factor functions. Factors with $\geq$2 eigenvalue (two factors only from the data) were included in the generating of scores used to create the SES quintiles by applying a linear PCA. Varimax rotation was applied to ensure that the first factor contains as much of the variation as possible after applying the PCA function with selected two factors. Scores were generated using the first principal component/factor only were used to generate weights for each of variables included and the three SES quintiles (Table 1).

Table 1
Variables included into principal component analysis.

Variables	Examples
Durable assets	Radio, mobile phone, fan, television, iron, refrigerator, and television
Domestic animals	Chickens, dogs, cows, ducks and goats
Means of transportation	Bicycle, motorcycle and car
Light source	Candle, electricity, battery/soar panel and kerosene lamps
House structure	Wall, roof and floor
Water sources	Drug up well, tap water and pump water
Sanitary facilities	Flush toilet (inside), flush toilet (outside), pit latrine and no toilet (bushes)

2.4. Ethical considerations

Permission to conduct this study was obtained from Kilombero district and Ifakara town authorities, as well as from respective community leaders. Ethical approval for the study was obtained from Ifakara Health Institute Institutional Review Board (Ref. # IHI/IRB/No 39-2018) and from the Medical Research Coordinating Committee (MRCC) at the National Institutes of Medical Research (Ref: NIMR/HQ/R.8a/Vol. IX/3137). Ethical approval was also obtained from Ethical Commission of Northwest/Central Switzerland with a certificate Req-2018-00608 and registered at http://www.isrctn.com/ISRCTN29534081. Meeting with household representatives were held, aims and procedure of the study were explained and written informed consent forms were obtained. Permission to publish the results of this study was obtained from National Institute for Medical Research (NIMR/HQ/P.12VOL XXXII/46).

3. Results and discussion

3.1. Demographic characteristics of the households

A total of 925 household representatives responded to the survey. More than three quarters (76%, n=699) were females. This could be due to already observed scenario where care of children is a role mostly performed by the women. The caregivers were generally young with an average age of 37 years, ranging from 18 to 77 years. The average household size was 3 people (ranging from 3 to 5 people per household), and the average household income reported was 129,385 Tanzanian shillings (TZS), equivalent of 58.8 USD per month. A majority of the respondents had primary school education, and reported farming as

Table 2
Demographic characteristics of households (N=925).

Variable	Category	(%) n
Respondent's gender	Male	24.43% (226)
	Female	75.57% (699)
Age of the respondents	12–25 years	11.68% (108)
	26–50 years	77.51% (717)
	$\geq$51 years	10.81% (100)
Marital status	Not married	22.05% (204)
	Married	64.75% (599)
	Divorced/separated	8.86% (82)
	Widowed/widower	4.32% (40)
Educational status	No formal education	7.67% (71)
	Primary education	81.62% (755)
	Secondary education	10.70% (99)
Main income generating	Farming	83.67% (774)
	Entrepreneurship	15.13% (140)
	Non-employed	0.97% (9)
	Health officer	0.23% (2)
Household members	1–2	1.83% (17)
	3–5	57.51% (532)
	>6	40.65% (376)
Social-economic class	Poorest	31.46% (291)
	Poor	35.03% (324)
	Least poor	33.51% (310)

their main income generating activity (Table 2).

3.2. Household food consumption and dietary diversity

Information about household food consumption diversity is summarized in Table 3. Generally, cereals, fats and oils and spices, condiments and beverages were the most frequently consumed food groups. The most popular cereals reported were rice, ugali (maize-meal) and fried bananas, and the most consumed oils and fats were sunflower oils (89%, n=823) and palm oil (12%, n=116).

The high consumption of cereals, particularly rice is also consistent with the main income generating activity in the study site (rice farming), which makes rice a readily available food item [30,31]. These findings are generally in agreement with other studies carried out in Sub-Sahara Africa and the Middle East which reported a relatively high consumption of cereals compared to other food groups [27–29]. Also, oils and fats were highly consumed when compared to other food groups. Oils and fats were added to relishes green leafy and other vegetables [27]. Legumes, fish and vegetables were consumed by about 50% of the households. Sweet/beverages consumption in terms of sugar and honey was (13%, n=120) (Table 3).

Nearly half of the households consumed vegetables (dark leafy and other vegetables), especially indigenous vegetables were found to be major part of diet and usually accompanying a main meal made from maize flour locally called 'ugali' or rice. The high vegetable consumption has also been observed in other studies and survey carried out in Zambia and Western Kenya [30]. These vegetables can be easily accessed from the backyard gardens and farms. This study showed that only a fifth of the households consumed fruit. The low consumption of fruit may have resulted from the seasonal availability of the fruits. Since a majority of the households had low SES, this may have made it difficult to purchase fruit, particularly when they are off-season. Enabling the households on fruits and vegetables with improved skills, knowledge and nutrition education on their importance may likely improve their consumption. A study conducted in Tanzania in 2012 showed that almost all Tanzanians (>95%) consumed insufficient fruits and vegetables [31]. Similar findings have been reported in Malawi, Zambia, Mozambique and Botswana [32].

Although 54% of the respondents possessed at least one type of domestic animal, there was infrequent consumption of animal products such as meat, eggs and milk among the household representatives (Table 3). However, a study by Sarris et al., 2006. showed that in Tanzania, majority of households keep animals mainly for income generation rather than for consumption [33]. In this study, there was a relatively high consumption of fish, likely because fishing is one of the major income-generating activities in the Kilombero valley, where the Kilombero River is the main source of the fish for local residents. Legumes, fish and vegetables were consumed by about 50% of the households. Sweet/beverages consumption in terms of sugar and honey was 13% (n=120) (Table 3).

Legumes were the most preferred source of protein in the study area. This is likely linked to their low cost compared to meat, hence more affordable to the local residents. Also, legumes are served as relish in the food menu; a similar study in Morogoro region indicated similar findings [34]. The low consumption of sweets reported in this study also has been observed in other investigations that indicated lower consumption of sweetened food products in poorer compared to more affluent communities. Information on household DDS is provided in Fig. 2. Overall, almost 80% (n=733) of the households were classified as MDD, whereas 10% (n=95) and 10% (n=97) were categorized as LDD and HDD respectively.

Consuming inadequately diversified diet may lead to undernutrition and predispose people to opportunistic infections and severe illness [32]. Findings from this study indicated that a majority of the households had MDD, which was similar to a study carried out by Hadijah et al. in Central and Southern Tanzania, also indicating MDD among a majority household members [33]. These findings make sense as the communities generally have low SES, and thus cannot afford to have HDD, but they produce a variety of their own food to afford MDD.

3.3. Determinants of household food diversity

Factors associated with having MDD and HDD are described on Table 4. When MDD was used as a reference, the only household factors associated with HDD were education and farm size (Table 4). Comparing LDD and HDD, household members with secondary education and above were more than 6 times as likely to have HDD compared to household representatives with no formal education (OR = 6.60, p = 0.02). These findings make sense as improvement in education often leads to better opportunities for employment which would invariably increase household dietary diversity [34]. These findings are comparable with previous studies conducted in Bangladesh and Vietnam [35,36], indicating that maternal education was associated with both maternal and child dietary diversity. Additionally, it has been found that educated women would

Table 3
Consumption of various food groups among households.

Food groups	Example of food reported	% (n)
Cereals	Rice, maize-meals, millet, sorghum, banana, wheat etc	99.7% (913)
Oils and fats	Palm oil, sunflower oil, ghee etc	98.9% (915)
Spices, condiments and beverages	Tea, coffee, water, carbonated soft drink etc	69.7% (645)
Legumes, nuts and seeds	Bean, chickpea, cowpea, Bambara groundnut, soybean, pigeon pea, groundnuts, cashew nut, pumpkin seeds sunflower seeds etc	55.4% (512)
Vegetables	Spinach, amaranths, chines, carrot, okra, pumpkin fruit, tomato, onion, cabbage, cucumber, eggplant etc	49.3% (456)
Fish	Stew fish, dry fish and small fish	49.0% (453)
Fruit	Mango, oranges, papaya, pear, pineapple, watermelon, banana, avocado, jackfruits, lemon etc	21.4% (198)
White tubers and roots	Potatoes, sweet potato, yams and cassava	14.6% (135)
Sweets	Sugar cane, honey	13.0% (120)
Meat	Beef, goat, mutton, pork, chicken, duck, liver, kidney etc	10.3% (95)
Milk and milk product	Milk (cow, goat)	2.6% (24)
Eggs	Eggs from chicken or duck	0.9% (8)

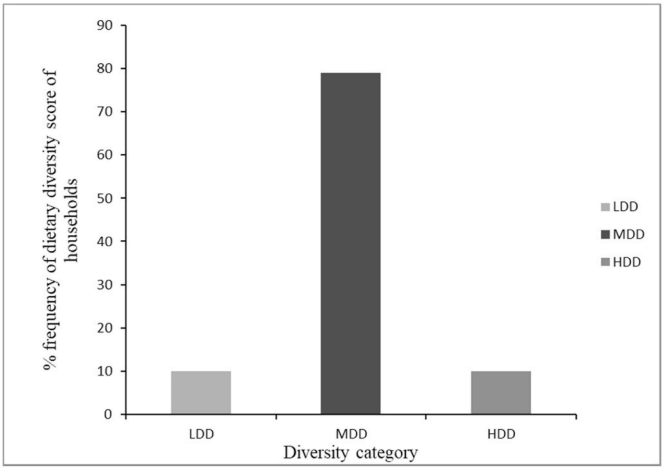

Fig. 2. Distribution of household dietary diversity score in the study area: LDD ≥3 food groups, MDD 4-6 food groups and HDD ≥7 food groups.

Table 4
Household factors affecting dietary diversity score among households in south-eastern Tanzania.

Category	Variable	LDD as a reference				MDD as a reference			
		MDD		HDD		LDD		HDD	
		OR [95% C.I.]	P-value	OR [95% C.I.]	P-value	OR [95% C.I.]	P-value	OR [95% C.I.]	P-value
Education	Non-formal	Ref		Ref		Ref		Ref	
	Primary	0.70 [0.29–1.67]	0.42	1.26 [0.34–4.67]	0.72	1.42 [0.59–3.39]	0.43	1.80 [0.64–5.11]	0.26
	Secondary and above	1.41 [0.41–4.87]	0.58	6.60 [1.34–32.52]	**0.02**	0.71 [0.20–2.42]	0.58	4.66 [1.52–14.26]	**<0.005**
SES	Least poor	Ref		Ref		Ref		Ref	
	Poor	0.97 [0.58–1.62]	0.90	0.81 [0.41–1.60]	0.55	1.03 [0.61–1.73]	0.90	0.84 [0.51–1.39]	0.49
	Poorest	0.99 [0.58–1.70]	0.99	0.75 [0.37–1.53]	0.43	1.00 [0.59–1.70]	0.99	0.75 [0.44–1.28]	0.29
Household size	1-2 person/s	Ref		Ref		Ref		Ref	
	3-5 persons	0.50 [0.06–3.90	0.51	0.47 [0.04–5.37]	0.55	1.98 [0.25–15.34]	0.51	0.94 [0.21–4.24]	0.94
	≥6 persons	0.61 [0.07–4.83]	0.64	0.55 [0.04–6.40]	0.64	1.62 [0.21–12.72]	0.64	0.90 [0.19–4.13]	0.89
Farm size	1–2 acres	Ref		Ref		Ref		Ref	
	3–5 acres	1.14 [0.56–2.30]	0.72	1.24 [0.53–2.93]	0.61	0.88 [0.43–1.77]	0.72	1.09 [0.62–1.92]	0.76
	≥6 acres	0.66 [0.24–1.81]	0.42	1.44 [0.45–4.57]	0.54	1.50 [0.55–4.08]	0.42	2.16 [1.00–4.65]	**0.04**

Notes: LDD = Low dietary diversity. MDD = Medium dietary diversity. HDD = High dietary diversity. SES = Socio-economic status.

have better skills and information for planning purposes as well as for implementing strategies that can adequately meet the nutritional needs of their family [34]. As it was with educational level, households with more than 6 acres of farm land were more than twice as likely to have HDD compared to households with 1–2 acres of farm land (OR = 2.16, p = 0.04, Table 4). These findings seem fitting and are in line with previous studies investigating factors determining food security at a household level which have shown that there is strong association between owning large farm land, food availability and dietary diversity [37].

Comparing MDD and HDD, education was the only factor that resulted in the difference in dietary intake; households with secondary education and above were nearly 5 times as likely to have HDD (OR = 4.66, p < 0.005) compared to households with no formal education. No significant differences were observed in other factors. Socio-economic status was not found to significantly influence the household dietary diversity, which was inconsistent with other similar studies [38,39]. The statistically non-significant difference in our study could be primarily due to the fact that nearly all respondents of our survey were poor, just in varying levels (Table 2). The lack of diversity could also be explained by competing priorities within families, in which family income could be directed to education and health care [40]. Other studies have indicated that high health care needs impact the HDD by reducing money to be budgeted for food [41,42].

This study was not without limitations. Firstly, we note that although DDS provides a suitable proxy for food security (availability, access and utilization), it does not measure the amount of the food items, hence, it does not reliably predict whether consumed food met the required dietary intake. Secondly, food security in the Kilombero district is known to vary across seasons with months between July and November having high food security and those between December and June having low food security. Given that the questionnaire was administered between July and August, immediately after rice harvesting season, it is likely that this may have influenced the household DDS. A study conducted in Burkina Faso has shown significantly higher intakes of micronutrients during post-harvest season compared to the lean season [43,44]. Other studies have also indicated dietary diversity to be higher at the time of harvest, decreasing with time and being lowest during the planting season [9,30,31]. Additionally, due to the short study duration, it was not possible to assess the seasonal variation of dietary diversity among the participants. However, this is a cross-sectional study that provides a snapshot of dietary diversity in the time of high food availability in the Kilombero valley.

4. Conclusion

In developing countries such as Tanzania, food and nutrition insecurities remain a major public health problem, mainly in rural and peri-urban areas. Findings from this study have shown that the majority of the households had MDD during the harvesting season. Households predominantly depended on cereals and vegetables to meet their energy and nutrient requirements. Fish was the most animal protein consumed by the households. Secondary education was found to be a key determinant that is positively associated with households' diet diversity. Because most of the households depend on agriculture, there is a need to increase awareness on improving the production of fruits and vegetables in order to diversify the households' diets, which may lead to more healthy lives of the household members. Also, there is a need to advocate on fishing activities as the source of proteins and income. Home economics and nutrition related courses should be taught at all levels of education to create awareness on good food consumption habits as well as health benefits of diversified diets.

Author contributions

EGM was involved in study, design, data collection, entry and analysis, interpretation of the results and writing the manuscript. JKS HN and WMP were involved in PCA analysis, revision of the manuscript and data collection. MFF, JB, KZL, CL, JU, FOO and MG were involved in study design, supervision and critical revision of the manuscript revision.

Availability of data and material

All data for this study will be available upon request.

Funding

The study is funded by the Fondation Bertarelli (Basel, Switzerland, project number 6071 'Physical activity and multi-micronutrient supplementation'), covering research expenses, staff salaries, study equipment and laboratories analyses. In-kind contributions are provided by all involved parties. The multi-micronutrient supplementation and the placebo products which will be used in the intervention trial are sponsored by DSM Nutritional Products Ltd. (Basel, Switzerland). The KaziAfya teaching material is based on (or an extension of) the development of the KaziKidz teaching material, an initiative financially and technically supported by the Novartis Foundation since 2017. The

KaziAfya study is part of the activities carried out under the umbrella of the UNESCO Chair on Physical Activity and Health in Educational Settings at the University of Basel (Basel, Switzerland).

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

We express our sincere gratitude to all study participants; students, teachers, community leaders and community members for their time and contribution to this study. We are grateful to Ms. Noelia Pama, Shani Mbaruku, Mwansiti Ngonyani, Nuru Nchimbi, Asma Kasanga, Godian Selemani, Bertha Mwandyala and Tumpe Mwandalya for their help in conducting the surveys. We are also grateful to Ms. Najat Kahamba for developing a map for the study area.

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