

Dietary diversity and Anthropometric status of students at universities in Dodoma and Morogoro Regions, Tanzania

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Abstract

Background: Young adulthood is a transitional period that provides an opportunity to influence immediate and future eating behavior and good nutritional status. As diets evolve during young adulthood due to changes in circumstances and the introduction of new influences, young adults are a significant population group that influences future eating behaviours and prevents the development of NCDs. There is scanty information on the relationship between dietary diversity and the nutritional status of university students in Tanzania. This study aimed to find the synergy between university students' anthropometric status and dietary diversity in Morogoro and Dodoma regions of Tanzania.

Methods: This cross-sectional study involved 247 University students in Morogoro and Dodoma regions (130 from Mzumbe University and 117 from Saint John's University) respectively. The two Universities were purposively selected from each region. Data on Dietary diversity was collected using food groups from DDS to obtain the dietary score of each student. Anthropometric measures such as weight, height and waist circumference were done to obtain the anthropometric status of the University students.

Results: The descriptive cross-sectional study involved 247 University students. In comparative chi-square analysis, the association was found among different socio-demographic characteristics of the University students. The p-value < 0.05 was used to determine the association among the variables.

Conclusion: In conclusion, university students are a vulnerable group in developing obesity/overweight due to the transitional stage. Being overweight and obese was associated with being female, increased age and being married. High dietary diversity was also linked with abdominal obesity. Factors that can help describe and understand the anthropometric status of university students have also been identified. These include years of study, religion, and university location. Therefore, efforts to adopt good lifestyle behaviours should be sensitized amongst this sub-population to reduce the risk of developing chronic diseases in the long run.

Keywords: dietary diversity, anthropometric status, university students

Introduction

Nearly a third of the world's population is affected by the incidence of overweight and obesity, which has doubled since 1980 whereby it is becoming more of a public health concern, especially among university students in developing nations (Quiliche

Castañeda *et al.*, 2021). According to (2018), university represents a fundamental transition into adulthood whereby concerns about lifestyle changes, such as selecting poor-quality diets, have potential implications for body weight and long-term health.

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The overall nutritional status of an individual can be assessed by anthropometry, biochemical tests and evaluation of dietary intake which establishes normal status or risk of malnutrition (Pimentel *et al.*, 2019). The fundamental elements of anthropometry are height, weight, body circumference (waist, hip, and head), and skinfold thickness (Kayode & Oshineye, 2022). Malnutrition is characterized by the simultaneous presence of undernutrition, overweight, and obesity linked to diet within populations (Bhati *et al.*, 2022).

The Food and Agriculture organization defines dietary diversity as a measure of the number of individual foods or food groups consumed in a given period of time (Ansari *et al.*, 2020). Food diversity has long been recognized as a key element of high-quality diet, based on the principle that no single food can provide the right amount of nutrients necessary to maintain optimal health (Verger *et al.*, 2021).

Unhealthy dietary habits are common among university students and are associated with increased incidence of lifestyle and chronic illnesses. Studies have reported poor dietary practices among university students for example Tok *et al.*, (2018) reported consumption of less than 3 meals per day among (33.3%) of university students. Globally, the literature suggests that during the transitional period from secondary level to graduate level, students often engage in unhealthy dietary habits and poor nutritional intake (Kabir *et al.*, 2018). For this reason, University years are also a potential period of intervention.

The central cause of overweight and obesity is imbalance between energy consumed and calories expended, and reports show a global increase in intake of energy dense-foods that are high in fat (Munyogwa & Mtumwa, 2018). The World Health Organization has linked overweight and obesity to more death worldwide

whereby more people are obese in parts of sub-Saharan Africa (WHO, 2020).

Tanzania is one of the sub-Saharan African (SSA) countries facing both undernutrition and obesity problems, where limited dietary diversity is a major challenge (Minja *et al.*, 2021). The recent national nutrition survey reported that the prevalence of overweight or obesity among adult females has nearly tripled from 11.3% in 1991 to 31.7% in 2018 (TNNS, 2018). They are characterized by abnormal eating behaviors, a preoccupation with food and an obsession with weight and body shape.

Studies in Tanzania have shown the association of obesity and dietary diversity in other populations such as women, children, and pastoralist societies. Although there is extensive literature on the association between dietary diversity and anthropometric status of university students in developed countries, there appears to be a scarcity of research on university students in Tanzania.

Due to the rapid global nutrition shift and growing number of people who are directly affected by the double burden of malnutrition and their exposure to various forms of malnutrition throughout their lives (Wells *et al.*, 2020) it is important to know what factors are associated with these risks. The need to focus on this subpopulation is due to the healthy risky behaviors that start in young people.

Considering the scant information this study aims to understand the synergy between dietary diversity and anthropometric status in university students in Tanzanian regions that have contrasting characteristics.

Findings from this study will therefore be important to public health experts in Tanzania and help to work towards the Sustainable Development Goal-3 (SDG-3), which aims to ensure healthy lives and promote wellbeing for all at all ages (United Nations, 2015).

Methodology

Study design.

The study used a cross sectional research design, which is appropriate for descriptive research and was chosen because of the nature of the investigation, which included collecting and analyzing data from a sample of a large population at a specific point in time.

Description of the study area

The study was conducted in universities located in Morogoro and Dodoma Regions. Morogoro region is in the eastern zone of Tanzania. With 29 wards and 260 square miles of land, Morogoro Municipality, one of Morogoro Region's nine districts, serves as the region's capital which represents 0.74% of the region's total land area. (Pori *et al.*, 2022). The recently estimated population of Morogoro urban is approximate to 440109 with the growth rate of 3.85%. In the case of Morogoro Municipal, linear and nucleated settlements have been the dominant form of urban development, with a few cases of scattered settlements, and population growth go hand in hand with urban

Description of the study population

The cross-sectional study included full-time registered students who gave consent in the selected universities in Morogoro and Dodoma region which were Mzumbe University and Saint Johns' University respectively. Students who were on diet or weight management programs, those pregnant and those having physical limitations were excluded from the study.

Sample size and sampling procedure.

Students were randomly selected into the sample to ensure fairness, males and females were given an equal opportunity to be included in the sample.

Morogoro and Dodoma regions were purposively selected due to differences in climatic conditions, food systems, agro-ecological zones, and having a large population of university students.

Purposive sampling was also used to select one public university in Morogoro and one

expansion and human development, which may take numerous forms. (Sumari *et al.*, 2020). Morogoro experiences bimodal rainfall seasons. Heavy rain seasons are locally called Masika dominating late March to early May and the light rain seasons are locally called Vuli normally between November to December (Pori *et al.*, 2022).

Dodoma is the region found in the central part of Tanzania mainland. With 41,311 km², it has seven districts: Dodoma urban, Chamwino, Bahi, Kondoa, Kongwa, Mpwapwa, and Chemba. It is the 12th largest area in Tanzania. Movement of people to the region as it became the host of the capital city has resulted in increasing population growth, within the Dodoma region, including its metropolitan environment, having 3,085,625 people in 2022 (NBS, 2022). Dodoma is one of the semi-arid regions with annual rainfall that ranges from 550 to 660 millimetres and a lengthy dry season. The region receives between 550 and 3690 mm of rainfall annually (World Bank, 2022). There is just one rainy season there, which is a crucial climate component for agricultural activity.

private University in the Dodoma region (Mzumbe university and Saint John's university respectively).

The total number of university students who participated in the study was determined by using the formula by Kothari (2004) which is used to calculate sample size.

$$n = \frac{z^2 p (1 - p)}{d^2}$$

whereby.

n = desired sample size

z = standard normal deviation, set at 1.96 corresponding to 95 % confidence interval

P = proportion in the intended population estimated to have a particular characteristic (0.192) among university students. Prevalence of obesity in community studies in urban Tanzania revealed obesity rate to be 19.2% (Pallangyo *et al.*, 2020).

q = (1-p) proportion of the population who are estimated to not have the characteristics (0.192) d = degree of accuracy desired (0.05) therefore

$$n = (1.96)^2 \times 0.192 (1-0.192) / 0.05^2$$

$$n = 238$$

Allowance for attrition/non-response, which is 10% will be added,

Therefore 10% of 238=23.8

$$23.8 + 238 = 262$$

The sample size is approximately 262 students. A total of 247 university students participated in this study. 130 students from Mzumbe University participated in the study 117 students from Saint John's participated in the study.

Data Collection

Pre-testing was carried out in one university in Morogoro region (Sokoine University of Agriculture) and another University in Dodoma (University of Dodoma) region after the completion of formal training of research assistants. Data was then collected by the help of research assistants at Mzumbe and Saint John's University in Morogoro and Dodoma regions respectively.

Information on socio-demographics

Age of university students, gender, degree type, year of study, marital status, religion, living arrangements, chronic disease situation, smoking status, primary source of nutritional information, total hours spent for sleeping, scholarship status were collected using pretested questionnaire with structured questions which was administered to the students by trained research assistants in the selected Universities in Morogoro and Dodoma regions (Mzumbe and Saint John's respectively).

Anthropometry Measurements

Weight, height, and waist circumference were measured to determine the anthropometric status of the students.

Weight was measured using a standard weighing scale (digital electronic SECA scale;(Model 8811021659, Germany) that was kept on a firm horizontal surface. The participant was measured without shoes and with light clothing by ensuring the removal of heavy-worn clothing such as coats and scarfs as well as personal items such as wallets,

phones, and watches. Weight was then recorded to the nearest 0.1kg. The scale reading was always allowed to return to zero before the subject was asked to stand on it. Height was measured using a stadiometer (Model No PE-AIM-101-USA) and recorded to the nearest 0.1 cm. Participants were requested to stand upright without shoes on with their back kept against the wall and heels put together in a V-shape while looking forward.

The body mass index (BMI) was calculated by dividing weight (in kilograms) over their height (in meters square). Nutritional status was classified according to the WHO classification of Body mass index. Students were classified as underweight, normal, overweight and obese if they have a Body mass index of below **18.5 (underweight)**, **18.5-24.9 (normal weight)**, **25.0-29.9 (overweight)** and **≥30.0 above (obese)** (Weir and Jan 2022).

The waist circumference (WC) was measured using a non-stretchable tape on the upper lateral border of the right ilium in the midaxillary line at the navel level without skin compression to the nearest 0.1 cm. The waist circumference was used to identify individuals with possible health risks based upon threshold values of **≥ 82 cm for women** and **≥ 91 cm for men** identified from adults in Sub Saharan Africa population (Tladi *et al.*, 2020).

Dietary Consumption.

Participants were required to recall food groups, number of meals per day during the past 7-days prior to survey. They were also asked on how they accessed their diets during different mealtimes.

Dietary Diversity

Individual dietary diversity was collected by using a dietary diversity score questionnaire. Participants were asked on whether or not certain food groups were consumed during the past 7-days prior to survey to assess their variety in diets on the food groups consumed. (Kolliesuah *et al.*, (2023) reported the 7-day reference period presents a better

understanding on nutrient adequacy which is a proxy measure of nutritional status.

The individual dietary diversity was adapted from United Nations' Food and Agriculture Organization (FAO, 2010) and modified to include foods present in Tanzanian setting.

To calculate the Dietary diversity score (DDS), reported food items were categorized into 16 food groups which are (i) cereals (ii) Vitamin A-rich vegetables and tubers (iii) Other roots and tubers (iv) Green leafy vegetables (v) Vitamin A-rich fruits (vi) Other vegetables and fruits (vii) Legumes (viii) Nuts and oil seeds (ix) Animal milk and milk products (x) Eggs (xi) Organ meats (xii) flesh meats (xiii) fish, sardines and other sea foods (xiv) Oil, fat, ghee and butter used for cooking (xv) Sugars, honey, sugary products, sweetened sodas (xvi) spices, condiments, beverages.

Consumption of each food group was transformed into binary variables (1=yes, 0=No) to indicate whether food items from a particular group was eaten or not. Total score was the sum scores of the sixteen food groups and the maximum score was 16.

The sixteen (16) food groups were then aggregated into nine (9) food groups adapted from (FAO,2010). Individual dietary diversity was determined by aggregating the sixteen (16) food groups into nine (9) food groups present in the Women's dietary diversity questionnaire. Women's dietary diversity questionnaire can be used to assess dietary diversity at individual level on individuals in other age/sex groups (FAO,2010). The food groups aggregated include (i) Starch staples (ii) Dark green leafy vegetables (iii) Other vitamin A rich fruits and vegetables (iv) Other fruits and Vegetables (v) Organ meats (vi) Meat and Fish (vii) Eggs (viii) Legumes, nuts and seeds (ix) Milk and Milk products. Cut off values were established by determining the distribution of the dietary diversity scores by measures of central tendencies (mean and median) of the participants. The points were then summed to generate a DDS for each participant. A dietary diversity scored <7 was regarded as

inadequate dietary diversity and ≥ 7 was regarded as adequate dietary diversity.

Dietary habits

Participants were required to recall the number of meals consumed per day i.e. Breakfast Lunch and dinner and how often they consumed these meals during the past 7-days prior to the survey. They were also asked if they skipped meals (yes/no) and reasons for meal skipping.

Dietary access during various mealtimes

Participants were asked on how they access their diets throughout their day. The questionnaire included four options adapted for university settings (i) Purchasing cooked meals at university canteens (ii) Purchasing food out of university (iii) Self-cooking (iv) Group cooking.

Data Analysis

The data was entered, cleaned and analyzed using Statistical Package for Social Sciences (SPSSTM) version 26 software. Descriptive statistical measures such as percentage and frequencies of variables were computed to summarize the data. Chi square (X^2) test at 5% level of significance was used to examine the relationship between dependent variables (Anthropometric status) and other independent variables such as socio-demographic factors.

Ethical Considerations

The study was approved by the National Institute for Medical Research (NIMR/HQ/R.8a/Vol.IX/4363) and Sokoine University of Agriculture (SUA/MHN/D/2019/0009). Permission to conduct the study was also sought from respective universities from the administration offices through the dean of students. Students were informed about the study and consent forms were given for signing. Confidentiality of the information was ensured where all participants were identified by numbers.

Results

Socio-demographic characteristics of University Students

The socio-demographic characteristics of the University students are presented in Table 2.1. A total of 247 university students participated in this study whereby about half 131(53%) were males and 116 (47%) were females. More than half females at Mzumbe University participated in the study 70 (53.8%) when compared to Saint John's 46 (39.3%). More than half of the males at Saint John's University participated in the study 71 (60.7%)

when compared to Mzumbe University 60 (46.2%).

More than half of the participants 155 (62.8%) were between 20-24 years old. About half 137 (55%) of the participants in this study were on their second year of university. Most of the study participants were single 230 (93.1%). Majority 201 (81.4%) of the university students were Christians. There was a significant difference in gender, years of study, religion and place of residence between the University students in Mzumbe and Saint John's University.

Table 2.1: Demographic characteristics of study population (n=247)

Characteristics	Overall	Mzumbe University	St.John's University	P-Value
Sex				0.022*
Female	116 (47%)	70 (53.8%)	46 (39.3%)	
Male	131(53%)	60 (46.2%)	71 (60.7%)	
Age				0.221
20-24 Years	155 (62.8%)	85 (65.4%)	70 (59.8%)	
≥25 Years	92 (37.2%)	45 (34.6%)	47 (40.2%)	
Study Year				0.045*
Second Year	137 (55.5%)	65 (50%)	72 (61.5%)	
>Second Year	110 (44.5%)	65 (50%)	45 (38.5%)	
Marital Status				0.301
Single	230 (93.1%)	119 (91.5%)	111 (94.9%)	
Married	17 (6.9%)	11 (8.5%)	6 (5.1%)	
Religion				0.001*
Christian	201 (81.4%)	96 (73.8%)	105 (89.7%)	
Muslim	46 (18.6%)	34 (26.2%)	12 (10.3%)	
Presence of Chronic diseases				0.858
Yes	9 (3.6%)	5 (3.8%)	4 (3.4%)	
No	238 (96.4%)	125 (96.2%)	113 (96.6%)	
Sleeping hours				0.373
<8 hours	124 (50.2%)	69 (53.1%)	55 (47%)	
≥ 8 hours	123 (49.8%)	61 (46.9%)	62 (53%)	
Place of residence				0.000*
Off campus	192 (77.7%)	85 (65.4%)	107 (91.5%)	
In campus	55 (22.3%)	45 (34.6%)	10 (8.5%)	
Smoking status				0.079
Non-smoker	240 (97.2%)	124 (95.4%)	116 (99.1%)	
Smoker	7 (2.8%)	6 (4.6%)	1 (0.9%)	
Primary source of nutritional Information				0.893
Offline	83 (33.6%)	43 (33.1%)	40 (34.2%)	
Online	164 (66.4%)	87 (66.9%)	77 (65.8%)	
Scholarship status				0.006
No	124 (50.2%)	76 (58.5%)	48 (41%)	
Yes	123 (49.8%)	54 (41.5%)	69 (59%)	
Type of scholarship				0.087
Partial	25 (20.3%)	9 (16.7%)	16 (23.2%)	
Full	98 (79.7%)	45 (83.3%)	53 (76.8%)	

*Significant at P< 0.05

Food access during various meal times

Majority 100 (79.9%) of the participants eat breakfast and purchase them at University Canteens. The proportion of students that purchase breakfast at university canteens in Mzumbe university is slightly higher 65 (50%) than Saint Johns' University 35 (29.9%). More than half 89 (72%) of the university students purchase their lunch out of the University premises. The proportion of students that purchase lunch out of the university premises

in Mzumbe university is slightly higher 48 (37%) than Saint John's University 41 (35%). A large proportion 91 (76%) of participants in this study cook their dinner. More than half 70 (59.8%) of Saint Johns' students cook their dinner compared to Mzumbe university students 21 (16.2%). There was a significant difference in ways of accessing food during all the mealtimes.

Dietary habits of University Students

The dietary habits of the University Students are as shown in Table 2.3. Majority 167 (67.6%) of the study participants ate two meals per day. The proportion of students who ate two meals per day was slightly higher 88 (67.7%) in Mzumbe university when compared to Saint John's University 79 (67.5%). Skipping of

meals due to being busy with studies was common 144 (58.3%) and was significantly higher in Mzumbe University 87 (66.9%) than Saint John's University 57 (48.7%). There was a significant difference in reasons for meal skipping in Mzumbe and Saint Johns' university.

Table 2.3 Dietary habits of University Students

VARIABLES	OVERALL	MZUMBE UNIVERSITY	ST JOHNS' UNIVERSITY	P-VALUE
Number of meals per day				
One meal	17 (6.9)	9(6.9)	8(6.8)	0.999
Two meals	167 (67.6)	88(67.7)	79(67.5)	
Three meals	63 (25.5)	33(25.4)	30(25.7)	
Meal Skipping				
No	63 (25.5)	33(25.4)	30(25.6)	0.963
Yes	184 (74.5)	97(74.6)	87(74.4)	
Reasons for meal skipping				
Busy with studies	144 (58.3)	87(66.9)	57(48.7)	0.001*
Financial constraints	20 (8.1)	4(3.1)	16(13.7)	
Less priority	12 (4.9)	3(2.3)	9(7.7)	
Not applicable	71 (28.7)	36(27.7)	35(29.9)	
Often take breakfast				
No	176 (71.3)	94(72.3)	82(70.1)	0.779
Yes	71 (28.7)	36(27.7)	35(29.9)	
Often take Lunch				
No	66 (26.7)	41(31.5)	25(21.4)	0.071
Yes	181(73.3)	89(68.5)	92(78.6)	
Often take dinner				
No	37(15)	24(18.5)	13(11.1)	0.106
Yes	210 (85)	106(81.5)	104(88.9)	

*Significant at P<0.05

Association between Dietary diversity score and Anthropometric status

The association between dietary diversity score and Anthropometric status of university students are as shown in Table 2.4. The proportion of Mzumbe university students in consuming a diverse diet was

slightly higher 79 (60.8%) than students in Saint John's University 75 (64.1%). The study revealed that more than half 119 (59.2%) of the Christian students had a diversified diet. There was a significant difference in Religion and waist circumferences in the dietary diversity of the university students.

Table 2.4 Association between Dietary Diversity Score and Anthropometric status

VARIABLES	Less than 7 food groups	At least 7 food groups	P-Value
Name of university	https://dx.doi.org/10.4314/thrb.v25i2.14		
Mzumbe University	51 (39.2)	79 (60.8)	
St. John's University	42 (35.9)	75 (64.1)	0.602
Sex of respondents			
Female	39 (33.6)	77 (66.4)	0.219
Male	54 (41.2)	77 (58.8)	
Age categories			
20 to 24 years old	58(37.4)	97 (62.6)	0.922
≥25 years old	35(38)	57 (62)	
Marital status of respondents			
Single	88 (38.3)	142 (61.7)	0.467
Married	5 (29.4)	12 (70.6)	
Religion			
Muslim	11 (23.9)	35 (76.1)	0.033*
Christian	82 (40.8)	119 (59.2)	
Place of residence			
Off-campus	74 (38.5)	118 (61.5)	0.59
Within students' residence	19 (34.5)	36 (65.5)	
Scholarship Status			
No	43 (34.7)	81(65.3)	0.333
Yes	50 (40.7)	73 (59.3)	
Scholarship Type			
Partial	54 (36.2)	95 (63.8)	0.573
Full	39 (39.8)	59 (60.2)	
Anthropometric profile			
Underweight (BMI < 18.5)	9 (50)	9 (50)	
Normal weight (18.5≤BMI<25)	65 (40.4)	96 (59.6)	
Overweight (25≤BMI<30)	15 (27.8)	39 (72.2)	
Obesity (BMI ≥ 30)	4 (28.6)	10 (71.4)	0.22
WAIST CIRCUMFERENCE			
Risk of morbidity (≥91 cm male ≥82cm female)	7 (21.9)	25 (78.1)	
None risk of morbidity (Normal fat distribution)	86 (40)	129 (60)	0.048*
Suffering from of chronic disease			
No	91(38.2)	147 (61.8)	
Yes	2 (22.2)	7 (77.8)	0.33
Total number of hours spent for sleeping per night			
Less than 8 hours	49 (39.8)	74 (60.2)	
8 hours and above	44(35.5)	80 (64.5)	0.48
Currently smoking status			
Non-smoker	89 (37.1)	151(62.9)	
Ex-smoker/smoker	89 (37.1)	151(62.9)	0.28
Source of nutrition information			
Offline (family, friends and others)	32(38.6)	51(61.4)	
Online (TV, internet, news)	61(37.2)	103 (62.8)	0.835

Anthropometric status of university students

Body mass index (BMI) and Waist circumference (WC) were used to assess the anthropometric status of the University students. Body mass index was used to identify general obesity while waist circumference was used to identify central obesity.

Waist Circumference

The waist circumference of study respondents is as shown in Tables 2.5. The study revealed that a larger proportion (95.4%) of male participants not in a risk of morbidity when compared to female participants 90 (77.6%). There was a significant difference on Sex, Age and Marital status.

Table 2.5 Socio- demographic characteristics and Waist Circumference

VARIABLES	Risk of morbidity (≥91 cm male ≥82cm female)	None risk of morbidity (Normal fat distribution)	P-VALUE
Name of university			
Mzumbe	18(13.8)	112(86.2)	0.707
St. John's	14 (12)	103(88)	
Sex			
Female	26 (22.4)	90 (77.6)	0.000*
Male	6(4.6)	125 (95.4)	
Age categories			
20 to 24 years old	11 (7.1)	144 (92.9)	0.001*
≥25 years old	21 (22.8)	71 (77.2)	
Years study			
Second year	18 (13.1)	119 (86.9)	0.924
>Second year	14 (12.7)	96 (87.3)	
Marital status			
Single	22 (9.6)	108 (90.4)	0.000*
Married	10 (58.8)	7 (41.2)	
Religion			
Muslim	7 (15.2)	39 (84.8)	0.613
Christian	25 (12.4)	176 (87.6)	
Place of residence			
Off campus	23 (12)	169 (88)	0.393
Within students' residence	9 (16.4)	46 (83.6)	
Presence of Chronic disease			
No	32 (13.4)	206 (86.6)	0.238
Yes	0	9 (100)	
Hours spent for sleeping			
Less than 8hours	18 (14.6)	105 (85.4)	0.434
More than 8hours	14 (11.3)	110 (88.7)	
Smoking status			
Non-smoker	31 (12.9)	109 (87.1)	0.915

Smoker	1 (14.3)	6 (85.7)	
Source of nutrition information			
Offline (family, friends and others)	15 (18.1)	68 (81.9)	0.088
Online (TV, internet, news)	17 (10.4)	147 (89.6)	
Scholarship status			
No	19 (15.3)	105 (84.7)	0.266
Yes	13 (10.6)	110 (89.4)	
Type of scholarship			
Partial	21 (14.1)	128 (85.9)	0.511
Full	11 (11.2)	87 (88.8)	

*Significant at P<0.05

Body Mass Index

The Body mass index of study respondents is as shown in Tables 2.6. This study shows that Saint Johns' University students had a slightly higher proportion 33 (28.2%) of overweight when compared to Mzumbe University students 21 (16.2%). The study revealed that the proportion of overweight and obesity 37 (31.9%) ;12 (10.3%) respectively in female university students was slightly higher when compared to male university students 17 (13%) for overweight and 2 (1.5%) for obesity.

Overweight in students from third year and above was slightly higher 31 (28.2%) when compared to students in the second year 23 (16.8%). This study also showed that Students who were enrolled in their second year had higher proportion 11 (8%) of obesity than students in higher years of enrolment 3 (2.7%). There was a significant difference on university type Sex, Age, year of study and marital status.

Table 2.6 Socio- demographic characteristics and Body Mass Index (BMI)

VARIABLES	Underweight (BMI < 18.5)	Normal weight (18.5 ≤ BMI < 25)	Overweight (25 ≤ BMI < 30)	Obesity (BMI ≥ 30)	P-VALUE
Name of university					
Mzumbe	13 (10)	86 (66.2)	21 (16.2)	10 (7.7)	0.031*
St. John's	5 (4.3)	75 (64.1)	33 (28.2)	4 (3.4)	
Sex					
Female	4 (3.4)	63 (54.3)	37 (31.9)	12 (10.3)	0.000*
Male	14 (10.7)	98 (74.8)	17 (13)	2 (1.5)	
Age categories					
20 to 24 years old	15 (9.7)	106 (68.4)	30 (19.4)	4 (2.6)	0.007
≥25 years old	3 (3.3)	55 (59.8)	24 (26.1)	10 (10.9)	
Years study					
Second year	8 (5.8)	95 (69.3)	23 (16.8)	11 (8)	0.039*
>Second year	10 (9.1)	66 (60.0)	31 (28.2)	3 (2.7)	
Marital status					
Single	17 (7.4)	156 (67.8)	47 (20.4)	10 (4.3)	0.001*
Married	1 (5.9)	5 (29.4)	7 (41.2)	4 (23.5)	
Religion					

Muslim	3 (6.5)	28 (60.9)	11(23.9)	4(8.7)	0.746
Christian	15 (7.5)	133(66.2)	43 (21.4)	10 (5)	
Placeof residence					
Off campus	14 (7.3)	123(64.1)	46(24)	9 (4.7)	0.339
Withinstudents' residence	4 (7.3)	38 (69.1)	8 (14.5)	5 (9.1)	
Presenceof chronic diseases					
No	17 (7.1)	154(64.7)	53(22.3)	14 5.9	0.697
Yes	1 (11.1)	7 (77.8)	1 (11.1)	0	
Total number of hours spent for sleeping per night					
Less than 8hours	11 (8.9)	81(65.9)	23 (18.7)	8 (6.5)	0.501
More than 8hours	7 (5.6)	80 (64.5)	31(25)	6 (4.8)	
Smoking status					
Non-smoker	16 (6.7)	158(65.8)	52 (21.7)	14 (5.8)	0.134
Smoker	2 (28.6)	3 (42.9)	2(28.6)		
Source of nutrition information					
Offline (family, friends and others)	7 (8.4)	56 (67.5)	16 (19.3)	4 (4.8)	0.833
Online (TV, internet, news)	11 (6.7)	105 (64)	38(23.2)	10(6.1)	
Scholarship status					
No	5 (4)	82(66.1)	29 (23.4)	8 (6.5)	0.242
Yes	13(10.6)	79 (64.2)	25 (20.3)	6 (4.9)	
Typeof Scholarship					
Partial	7 (4.7)	95 (63.8)	38 (25.5)	9(6)	0.115
Full	11 (11.2)	66 (67.3)	16 (16.3)	5 (5.1)	

*Significant at P <0.05

Discussions

Dietary diversity and anthropometric status of university students.

This study reports the association between dietary diversity scores and characteristics of university students as well as their Anthropometric status. Generally, high levels of dietary diversity are frequently linked to better nutritional status, whereas low levels are strongly thought to contribute to inadequate nutrient intake.

In this study the religion of the university students was associated significantly with dietary diversity scores. Whereby Muslim students had a high dietary diversity (76.1%) when compared to Christian

students. This means that the intake of a diverse diet may be attributed with religion in university students. The possible explanation could be the difference in the agro-ecological zones. However, this could perhaps be due to the fact that majority of respondents in this study were Christians. According to a study conducted in Ethiopia the odds of having inadequate dietary diversity were 70% lower among Muslim adolescents when compared to Christians due to difference in residence (Gonete *et al.*, 2020). Furthermore, a study done in Tanzania suggested that dietary diversity can also be attributed by agriculture, agrobiodiversity, landscape

heteroginty personality and family traditions (Powell *et al.*, 2017).

The findings of the current study showed that there was a significant difference between waist circumference and dietary diversity. According to this study high dietary diversity is linked with increased risk of central obesity in university students due to excessive consumption of selected food groups which are mostly-energy dense. Respondents that had low dietary diversity

Anthropometric status of university students.

Central Obesity among University students.

The study reported that risk of morbidity was associated with sex of the respondents. The finding shows that female university students were at a higher risk of developing central obesity compared to their male counterparts. The possible explanation for this could be due to high dietary diversity in the female students; selection of meals compared to their male counterparts. These findings are in line with the study done by (Mogeni & Ouma, 2022) who reported females embraced greater dietary diversity in their eating habits compared to males.

The possible variations in the obesity prevalence could be justified by the use of different cutoff values for waist circumference (Tekalegn *et al.*, 2022).

Moreover, the findings of this study corroborate with (Molla *et al.*, 2020) the odds of being centrally obese was 9.62 times higher among female study participants compared to their counterparts. Furthermore, Maila *et al.*, (2021) reported a study done in Verulam, South Africa that indicated 68.4% of women and 25% of men were at risk of central obesity.

The study also found that age was associated with risk of abdominal obesity, whereby participants aged twenty-five and above (≥ 25 years of age) were at a higher risk of morbidity compared to participants aged between 20-24 years. The possible

Overweight and Obesity among University students.

were at a low risk of developing central obesity. This study corroborates with similar study done in the southwest of China which showed adults with medium and high Dietary diversity score were at higher risk of central obesity (Zhang *et al.*, 2017). However, using waist circumference, a study of pastoralists in Tanzania revealed no connection between dietary diversification and central obesity for both male and female (Khamis *et al.*, 2021).

reasons are higher dietary diversity of individuals aged 20-24 when compared to individuals of ≥ 25 years of age. The findings of this study are in line with Molla *et al.*, (2020) that found an increase in age was statistically associated with central obesity. Tekalegn *et al.*, (2022) also revealed that the odds of central obesity tend to increase as age increases. Similarly, a study by (Munyogwa *et al.*, 2021) in Dodoma City reported respondents with an increased age were associated with development of abdominal obesity.

Furthermore, in this study married people were reported to have a risk of morbidity compared to Single people. This could be due to the difference in dietary diversity where married people have a higher dietary diversity which is believed to be linked with higher intake of energy dense foods. However, this could perhaps be due to the fact that majority of respondents in this study were single. The findings of this study go in line with a study done by (Ntimana & Choma, 2023) whereby Bivariate correlation analysis showed that married participants correlated positively and significantly with central obesity. Similarly, a study Bakir *et al.*, (2017) reported that the mean Body mass indexes and other anthropometric measurements such as Waist circumference were significantly higher in married women. Furthermore, Cisse *et al.*, (2021) reported that main predictors of abdominal obesity were associated with being married.

The findings showed that students in Saint John's University were overweight when

compared to Students in Mzumbe University. The possible reason for this could be due to difference of agro-ecological zones, since Saint John's is located in Dodoma a semi-arid area and Mzumbe University is located in Morogoro characterized by bi-modal rainfall patterns. The increase in urbanization in Dodoma could also justify the prevalence of overweight in the region. (Munyogwa & Mtumwa, 2018) reported prevalence of overweight to be higher in urban areas in Tanzania and other countries worldwide. A study revealed that Overweight and obesity are common in private schools and urban settings (Mosha *et al.*, 2021).

It is important to take into consideration difference in agro-ecological zones since they differ in climate soil as well as economic activities, all this can have influence in the overall nutritional status of an individual. A study reported that household dietary diversity differed from different regions in rural and urban Tanzania, regions such as Morogoro contributes to high diversity due to food availability while regions like Dodoma import most foods due to experiencing one season rainfall per annum (Borrego, 2021). Bailey *et al.*, (2022) reported that students in the Midwest had higher BMIs compared to students in the Northeast.

This study reports that female University students were more likely to be Overweight and Obese when compared to their male counterparts. This could be influenced with the differences between the dietary diversity among the genders. Because females often have less lean mass and more fat mass, biological factors may account for the gender differences in overweight or obesity.

Dietary diversity has been reported to positively affect obesity through higher energy intake. A study reported that the probability of overweight/obesity was increased as tertiles of dietary diversity score increased (Golpour-Hamedani *et al.*, 2020). In contrast to these findings Tok *et al.*, (2018) reported the prevalence of overweight/obesity was similar among male

and female students with a difference of only 0.3%.

In our study students that were ≥ 25 years of age were more susceptible to Overweight and obesity when compared to students that were 20-24 years of age. It was noted that individuals that were ≥ 25 years of age had a lower dietary diversity which can affect the overall nutritional status due to lack of diversified foods that complement each other. The study is in line with Al-Ghamdi *et al.*, (2018) who reported that there was a linear positive association (trend) of increasing BMI with older age groups. In the same context a study done in Tanzania reported that older women (35-49 vs 15-24 years) of a reproductive age where at a higher risk to develop obesity/overweight (Mosha *et al.*, 2021). Quiliche Castañeda *et al.*, (2021) reported that being older than 27 years old significantly predicted overweight/obesity ($OR_B = 2.07; 95\% CI = 1.19-3.6$).

The current study reported that years of studies was associated with Overweight and Obesity. Whereby Students that were in their 3rd year and above were associated with Overweight when compared to second year students. The possible explanation for this could be the difference in dietary diversity and selection of food among the second-year students and students that are in their 3rd year and above. These findings are in line with Ahmed *et al.*, (2015) who reported a significant association between students of their first year of study and second year of study. In contrast Bailey *et al.*, (2022) reported that being a second-year student had higher BMI_s compared to four-year students.

In our study we also found that Married people were Overweight when compared to single people. This study revealed that married individuals had a high dietary diversity when compared to single individuals which could lead to the consumption of high energy foods and affect the overall nutritional status. However, we noted that majority of the study participants were single this could also be a possible explanation. These findings are similar with

(Liu *et al.*, (2021) who reported that married individuals were at a higher risk of being overweight/obese than never-married individuals. In the same context being married was a significant predictor of

overweight/obesity whereby it was suggested that companionship after marriage may encourage an individual to avoid obesity or even contribute towards it (Al-Ghamdi *et al.*, 2018).

Conclusions and Recommendations

The study concludes that University students are at a risk of general obesity and central obesity which could be a baseline for developing chronic illnesses in the long run. The study also shows that University students have different access to meals in and out of the University campus and tend to skip meals due to being busy with studies. This study suggests that female university students, Increased age and Married individuals are at a higher risk of developing central and general obesity. The study also implicates that high dietary diversity is linked with central obesity. This study builds insight on dietary diversity and anthropometric status on university students. It shows that Body mass index in itself is not sufficient to evaluate the overall nutritional status. Dietary diversity can be associated with factors like Religion and waist circumference which is an indicator of abdominal obesity. Factors that can help describe and understand the Anthropometric status of university students have also been identified these include; gender, year of study, marital status, age, location of university.

Reference

- Ahmed, E. A., Ahmed, A. A., Huque, M. S., Abdulhameed, A., Khan, I., & Muttappallymyalil, J. (2015). Obesity Among University Students: A cross-Sectional Study in Ajman, UAE. *Gulf Medical Journal*, 4(S2), 14–23. www.gulfmedicaljournal.com
- Al-Ghamdi, S., Shubair, M. M., Aldiab, A., Al-Zahrani, J. M., Aldossari, K. K., Househ, M., Nooruddin, S., Razzak, H. A., & El-Metwally, A. (2018). Prevalence of overweight and obesity based on the body mass index; A cross-sectional study in Alkharj, Saudi Arabia. *Lipids in Health and Disease*, 17(1). <https://doi.org/10.1186/s12944-018-0778-5>
- Ansari, G., Jain, S., & Bhatia, N. (2020). Association

Recommendation

Due to the risks that University students face due to their newly adapted independency, there is a need for sustained health and nutrition education initiatives to help them adjust to lifestyle changes that affects their overall health. There should be educational initiatives promoting healthier diets, lifestyles, and weight control which may have a positive impact on university student's health.

Competing Interests

The authors declare that they have no competing interests

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- of Maternal Dietary Diversity and Nutritional Status with Child's Dietary Diversity and Nutritional Status (2-5 years) in India. *World Nutrition*, 11(1), 110–128. <https://doi.org/10.26596/wn.2020111110-128>
- Bailey, C. P., Elmi, A. F., Hoban, M. T., Kukich, C., & Napolitano, M. A. (2022). Associations between college/university campus characteristics and student body mass index. *Environmental Health and Preventive Medicine*, 27, 1–7. <https://doi.org/10.1265/ehpm.21-00352>
- Bhati, D., Tripathy, A., Mishra, P. S., & Srivastava, S. (2022). Contribution of socio-economic and demographic factors to the trend of adequate dietary diversity intake among

- children (6–23 months): evidence from a cross-sectional survey in India. *BMC Nutrition*, 8(1), 1–12. <https://doi.org/10.1186/s40795-022-00655-z>
- Borrego, A. (2021). No 主観的健康感を中心とした在宅高齢者における健康関連指標に関する共分散構造分析Title. 10, 6.
- Cisse, K., Samadoulougou, S., Ouedraogo, M., Kouanda, S., & Kirakoya-Samadoulougou, F. (2021). Prevalence of abdominal obesity and its association with cardiovascular risk among the adult population in Burkina Faso: Findings from a nationwide cross-sectional study. *BMJ Open*, 11(7), 1–12. <https://doi.org/10.1136/bmjopen-2021-049496>
- FAO. (2010). Guidelines for measuring household and individual dietary diversity. In *Fao*. <https://doi.org/613.2KEN>
- Golpour-Hamedani, S., Rafie, N., Pourmasoumi, M., Saneei, P., & Safavi, S. M. (2020). The association between dietary diversity score and general and abdominal obesity in Iranian children and adolescents. *BMC Endocrine Disorders*, 20(1), 1–8. <https://doi.org/10.1186/s12902-020-00662-w>
- Gonete, K. A., Tariku, A., Wami, S. D., & Akalu, T. Y. (2020). Dietary diversity practice and associated factors among adolescent girls in Dembia district, northwest Ethiopia, 2017. *Public Health Reviews*, 41(1), 1–13. <https://doi.org/10.1186/s40985-020-00137-2>
- Kabir, A., Miah, S., & Islam, A. (2018). Factors influencing eating behavior and dietary intake among resident students in a public university in Bangladesh: A qualitative study. *PLoS ONE*, 13(6), 1–17. <https://doi.org/10.1371/journal.pone.0198801>
- Kayode, O., & Oshineye, A. (2022). Anthropometric Status and Food Consumption Pattern of Undergraduates in Oduduwa University , Ipetumodu , Osun State. *Journal of Nutrition and Dietary Intervention*, 1(1), 1–11.
- Khamis, A. G., Ntwenya, J. E., Senkoro, M., Mfinanga, S. G., Kreppel, K., Mwanri, A. W., Bonfoh, B., & Kwesigabo, G. (2021). Association between dietary diversity with overweight and obesity: A cross-sectional study conducted among pastoralists in Monduli District in Tanzania. *PLoS ONE*, 16(1 January), 1–14. <https://doi.org/10.1371/journal.pone.0244813>
- Kolliesuah, N. P., Olum, S., & Ongeng, D. (2023). Status of household dietary diversity and associated factors among rural and urban households of Northern Uganda. *BMC Nutrition*, 9(1), 1–16. <https://doi.org/10.1186/s40795-023-00739-4>
- Kothari, C. . (2004). *Research Methodology Method and Techniques* (2nd ed.). New Age International (P) Ltd., Publishers.
- Liu, J., Garstka, M. A., Chai, Z., Chen, Y., Lipkova, V., Cooper, M. E., Mokoena, K. K., Wang, Y., & Zhang, L. (2021). Marriage contributes to higher obesity risk in China: findings from the China Health and Nutrition Survey. *Annals of Translational Medicine*, 9(7), 564–564. <https://doi.org/10.21037/atm-20-4550>
- Minja, E. G., Swai, J. K., Mponzi, W., Ngowo, H., Okumu, F., Gerber, M., Pühse, U., Long, K. Z., Utzinger, J., Lang, C., Beckmann, J., & Finda, M. (2021). Dietary diversity among households living in Kilombero district, in Morogoro region, South-Eastern Tanzania. *Journal of Agriculture and Food Research*, 5(June). <https://doi.org/10.1016/j.jafr.2021.100171>
- Mogeni, B. K., & Ouma, L. O. (2022). Dietary patterns, behaviours, and their associated factors among university students in coastal Kenya. *Cogent Food and Agriculture*, 8(1). <https://doi.org/10.1080/23311932.2022.2132873>
- Molla, M. D., Wolde, H. F., & Atnafu, A. (2020). Magnitude of central obesity and its associated factors among adults in urban areas of Northwest Ethiopia. *Diabetes, Metabolic Syndrome and Obesity*, 13, 4169–4178. <https://doi.org/10.2147/DMSO.S279837>
- Munyogwa, M. J., & Mtumwa, A. H. (2018). The Prevalence of Abdominal Obesity and Its Correlates among the Adults in Dodoma Region, Tanzania: A Community-Based Cross-Sectional Study. *Advances in Medicine*, 2018, 1–8. <https://doi.org/10.1155/2018/6123156>
- Munyogwa, M. J., Ntalima, K. S., & Kapalata, S. N. (2021). Setting – based prevalence and correlates of central obesity: findings from a cross-sectional study among formal sector employees in Dodoma City, Central Tanzania. *BMC Public Health*, 21(1), 1–8. <https://doi.org/10.1186/s12889-020-10142-4>
- Ntimana, C. B., & Choma, S. S. R. (2023). Modifiable

- determinants of central obesity among the rural black population in the DIMAMO HDSS, Limpopo, South Africa. *Frontiers in Public Health*, 11. <https://doi.org/10.3389/fpubh.2023.1165662>
- Pallangyo, P., Mkojera, Z. S., Hemed, N. R., Swai, H. J., Misidai, N., Mgopa, L., Bhalia, S., Millinga, J., Mushi, T. L., Kabeya, L., Omar, A., Kaijage, A., Mulashani, R., Mosha, S., Mwapinga, F., & Janabi, M. (2020). Obesity epidemic in urban Tanzania: A public health calamity in an already overwhelmed and fragmented health system. *BMC Endocrine Disorders*, 20(1), 1–9. <https://doi.org/10.1186/s12902-020-00631-3>
- Pimentel C, Philippi S, Simomura V, & Teodorov E. (2019). *Nutritional Status, Lifestyle and Lipid Profile in Vegetarians. International Journal of Cardiovascular Sciences [revista en Internet]* 2019 [acceso 22 de julio de 2021]; 32(6): 623-634. 32(6), 623–634. <https://www.scielo.br/ijics/a/bbGgckCXD9B3y4yzfW8MsCs/?lang=en&format=pdf>
- Pori, D. B., Msigula, P., & Massawe, H. B. (2022). Assessment of the Soil Information and Analysis of Related Land Constraints to the Selected Detailed Town Planning Schemes in Morogoro Municipal. *Current Urban Studies*, 10(03), 479–499. <https://doi.org/10.4236/cus.2022.103029>
- Powell, B., Bezner Kerr, R., Young, S.L. et al. The determinants of dietary diversity and nutrition: ethnonutrition knowledge of local people in the East Usambara Mountains, Tanzania. *J Ethnobiology Ethnomedicine* 13, 23 (2017). <https://doi.org/10.1186/s13002-017-0150-2>
- Quiliche Castañeda, R. B., Turpo-Chaparro, J., Torres, J. H., Saintila, J., & Ruiz Mamani, P. G. (2021). Overweight and Obesity, Body Fat, Waist Circumference, and Anemia in Peruvian University Students: A Cross-Sectional Study. *Journal of Nutrition and Metabolism*, 2021. <https://doi.org/10.1155/2021/5049037>
- Sprake, E. F., Russell, J. M., Cecil, J. E., Cooper, R. J., Grabowski, P., Pourshahidi, L. K., & Barker, M. E. (2018). Dietary patterns of university students in the UK: A cross-sectional study. *Nutrition Journal*, 17(1), 1–17. <https://doi.org/10.1186/s12937-018-0398-y>
- Sumari, N. S., Cobbinah, P. B., Ujoh, F., & Xu, G. (2020). On the absurdity of rapid urbanization: Spatio-temporal analysis of land-use changes in Morogoro, Tanzania. *Cities*, 107(July), 102876. <https://doi.org/10.1016/j.cities.2020.102876>
- Tekalegn, Y., Solomon, D., Sahiledengle, B., Assefa, T., Negash, W., Tahir, A., Regassa, T., Mamo, A., Gezahegn, H., Bekele, K., Zenbaba, D., Tasew, A., Desta, F., Atlaw, D., Regassa, Z., Nugusu, F., Engida, Z. T., Tesfaye, D. G., Kene, C., ... Mwanri, L. (2022). Prevalence of central obesity and its associated risk factors among adults in Southeast Ethiopia: A community-based cross-sectional study. *PLoS ONE*, 17(8 August), 1–16. <https://doi.org/10.1371/journal.pone.0265107>
- Tladi, D. M., Mitchell, R., Mokgothu, C. J., Gabonthone, T., Hubona, O., Mokgathe, L., Nell, T., & Shaibu, S. (2020). Determination of optimal cut-off values for waist circumferences used for the diagnosis of the metabolic syndrome among Batswana adults (ELS 32). *Cardiovascular Journal of Africa*, 31(6), 314–318. <https://doi.org/10.5830/CVJA-2020-025>
- Tok, C. Y., Ahmad, S. R., & Koh, D. S. Q. (2018). Dietary habits and lifestyle practices among university students in universiti Brunei Darussalam. *Malaysian Journal of Medical Sciences*, 25(3), 56–66. <https://doi.org/10.21315/mjms2018.25.3.6>
- United Nations. (2015). UN General Assembly, Transforming our world: The 2030 agenda for sustainable development. *Resolution Adopted by the General Assembly on 25 September 2015*, 16301(October), 1–35. <https://www.refworld.org/docid/57b6e3e44.html>
- United Republic of Tanzania. (2018). Tanzania National Nutrition Survey using SMART Methodology (TNNS) 2018. In *Dar es Salaam, Tanzania: MoHCDGEC, MoH, TFNC, NBS, OCGS, and UNICEF* (Issue June).
- Verger, E. O., Le Port, A., Borderon, A., Bourbon, G., Moursi, M., Savy, M., Mariotti, F., & Martin-Prevel, Y. (2021). Dietary Diversity Indicators and Their Associations with Dietary Adequacy and Health Outcomes: A Systematic Scoping Review. *Advances in*

- Nutrition, 12(5), 1659–1672.
<https://doi.org/10.1093/advances/nmab009>
- Wells, J. C., Sawaya, A. L., Wibaek, R., Mwangome, M., Poullas, M. S., Yajnik, C. S., & Demaio, A. (2020). The double burden of malnutrition: aetiological pathways and consequences for health. *The Lancet*, 395(10217), 75–88. [https://doi.org/10.1016/S0140-6736\(19\)32472-9](https://doi.org/10.1016/S0140-6736(19)32472-9)
- Zhang, Q., Chen, X., Liu, Z., Varma, D. S., Wan, R., & Zhao, S. (2017). Diet diversity and nutritional status among adults in southwest China. *PLoS ONE*, 12(2), 1–9. <https://doi.org/10.1371/journal.pone.0172406>