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Prevalence and Predictors of Obesity among Undergraduate Students at a Private University, Nairobi, Kenya

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Abstract

Background: Obesity, especially central obesity, is a major risk factor for cardiovascular diseases and type-2 diabetes, known for their significant morbidity and mortality. University students are at increased risk of obesity due to adoption of unhealthy lifestyles and school-related stress. However, there is scant information regarding the prevalence and risk factors of obesity among university students in Kenya. The study aimed to determine the prevalence and factors associated with general and abdominal obesity among undergraduate students of The Catholic University of Eastern Africa, Kenya. **Methods:** A cross-sectional study design was employed among undergraduate students (n = 245) of The Catholic University of Eastern Africa, Nairobi. A systematic random sampling method was used to select the study participants. Lifestyle risk factors associated with obesity were collected using a structured questionnaire adopted from the WHO STEP-wise approach to non-communicable disease risk factor surveillance. Anthropometric measures of weight, height, and waist circumference were appropriately measured. The data were analyzed using SPSS software (ver: 22). The chi-square test of independence and binary logistic regression was used to establish an association between dependent and independent variables. **Results:** The prevalence of general and abdominal obesity was 19.6% and 27.8%, respectively. Risk factors of general obesity were age ≥ 20 years (OR, 9.95; 95% CI, 3.09 - 32.08, $p < 0.001$), sedentary lifestyle (OR, 11.36; 95% CI, 2.08 - 61.96, $p = 0.005$), staying with parents (OR, 3.22; 95% CI, 1.09 - 9.58, $p = 0.035$), consumption of fast/processed foods (OR, 7.83; 95% CI, 1.90 - 32.21, $p = 0.004$). Risk factors for abdominal obesity were being female (OR, 38.76; 95% CI, 5.07 - 296.54, $p < 0.001$), staying with parents (OR, 3.02; 95% CI, 1.14 - 7.99, $p = 0.026$) and sedentary lifestyle (OR, 6.55; 95% CI, 1.80 - 23.81, $p = 0.004$). **Conclusion:** Being female, sedentary lifestyle, and consumption of fast/processed foods

were found as predictors of obesity. Behavioural intervention is required to mitigate the burden of obesity among university students in Kenya. This can be achieved through promoting intervention programmes that lead to changing the built environment, counseling, and behavioral-lifestyle modification of students.

Keywords

Obesity, Predictors of General and Abdominal Obesity, Unigraduate University Students

1. Introduction

Obesity has become a public health concern for both developed and developing countries. General obesity is defined as body mass index (BMI) ≥ 30 kg/m^2 [1] [2]. Whereas, abdominal obesity is defined as waist circumference (WC) ≥ 102 cm for men and ≥88 cm for women [3]. BMI has been used as an indicator to assess the nutritional status of individuals. Whereas, WC has been suggested as superior to BMI in predicting CVD risk and all-cause of mortality in young and middle-aged adults compared to older people [4].

Studies among university students in Sub-Saharan African (SSA) countries show a high prevalence of obesity. For example; an obesity prevalence of 25.3% - 59.4% has been reported among university students in Egypt [5], 36.8% in Botswana [6], 10.8% - 24% in South Africa [7] and 10% in Nigeria [8]. The public health importance of obesity lies in its associated risk of cardiovascular disease (CVD), type-2 diabetes, and some forms of cancers, the major non-communicable diseases [9] [10]. Specifically, central obesity is a major risk factor for insulin resistance, inflammatory process, atherogenic dyslipidemia, metabolic syndrome and subsequently increases CVDs-related morbidity and mortality [11]. According to the WHO, 2.8 million people die annually due to obesity-related complications, majorly CVDs [12]. The burden of heart disease, type-2 diabetes, and cancer attributable to overweight and obesity is 44%, 23% and 41%, respectively [13].

The rising trend in obesity and its related CVDs in developing countries is due to urbanization and adoption of unhealthy lifestyles characterized by increased consumption of processed/fast foods, sedentary lifestyle, and stress [10] [14] [15]. University students are more likely to consume processed/fast foods rich in sugar, salt, refined carbohydrates, and fat- factors that favour the development of obesity [16] [17]. Evidence shows that the highest percentage of college students who consume fast foods are in the obese group [18]. A study revealed that university students consume more calories from eating fast food, which results in obesity [19]. Busy college schedules and activities, examination and assignments related pressure and the peer pressure to socialize results in consumption of easily accessible junk foods [20] [21], a major risk factor for obesity [22]. Additionally, university students have greater convenience when they eat out [23].

The widely available fast-food restaurants and advertising media in urban places influence people's food choices, particularly college students [18] [24]. Targeting Universities students may provide an opportunity to reach out to a large number of young adults through education intervention programmes that may positively influence students' behavioral/lifestyle habits [25]. Furthermore, the use of WC in conjunction with BMI to assess abdominal and general obesity has not been extensively examined, particularly among university students in Kenya. Hence, the study aimed to determine the prevalence and factors associated with general and abdominal obesity among undergraduate students of The Catholic University of Eastern Africa, Kenya.

2. Methods

2.1. Study Settings

The study was conducted at The Catholic University of Eastern Africa (CUEA), a private lead institution in Nairobi, Kenya. The University offers courses ranging from undergraduate to doctorate. The institution has seven undergraduate faculties including Arts & Social Sciences, Commerce, Education, Science, Law, and Theology. We involved all undergraduate students who were in session at the time of data collection.

2.2. Study Design, Sampling, and Respondents

This was a descriptive, cross-sectional study employed among undergraduate students (n = 245). The study was conducted between in 2019. During the study period, there were 5300 undergraduate students in the seven faculties. After calculating a proportionate sample from the seven faculties, a systematic random sampling technique was used to select 245 study participants. The 5300 number of undergraduate students was divided by the adjusted sample size (246) to get the sampling interval = 22. Therefore, every 22nd undergraduate student from each faculty was included in the study until the required sample size was achieved. Students who were not available during the period of the study and those who declined to sign the consent were excluded from the study.

2.3. Sample Size Determination

The Fischer's formula below was used to calculate the sample size.

$$n = \frac{z^2(p)(q)}{d^2},$$

where:

n = Sample size

Z = Normal deviation at the desired confidence interval. In this case it will be taken at 95%, Z value at 95% is 1.96.

P = Proportion of the population with the desired characteristic.

$Q(1 - P)$ = Proportion of the population without the desired characteristic.

d^2 = Degree of precision; will be taken to be 5%.

The proportion of overweight and Obesity among undergraduate student in university colleges was taken to be 20% from a study carried out in Uganda (Waweru *et al.*, 2016)

Therefore-

$$n = \frac{Z^2 P(1-P)}{d^2}$$

$n = (1.96)^2 \times 0.2 \times 0.8 \div (0.05)^2$

$n = 3.8416 \times 0.16 \div 0.0025$

$n = 0.614656 \div 0.0025 = 245.824$

$n = 246$

2.4. Data Collection

The data were collected using a structured questionnaire adopted from the WHO STEP-wise approach to non-communicable disease risk factor surveillance [26]. The assessment comprised socio-demographic, lifestyle characteristics (dietary intake patterns, physical activity, alcohol intake, cigarette smoking), and anthropometric measurements.

Assessment of dietary intake patterns: Dietary intake patterns was assessed using food frequency questionnaires (FFQ) adopted from the WHO STEP-wise approach to non-communicable disease risk factor surveillance [26]. The respondents were asked to estimate the number of times per day/week they consumed particular food products and the amount usually eaten per food item by making comparisons with specified reference portions. Dietary intake patterns included frequency consumption of processed/fast foods, daily servings of fruit and vegetables, amount of sugars, and salts intake were captured.

Alcohol consumption and smoking status: Current alcohol consumption status including frequency and amount (number of standard drinks per day) was captured. Frequency was assessed by asking: "in the past, 30 days, 1 week, how often did you drink any alcoholic beverages?" We grouped responses into four categories (daily, 5 - 6 days per week, 3 - 4 days per week, 1 - 2 days per week, less than 1 day per week). The usual amount was assessed by the question: "on those days when you drank alcoholic beverages, on average, how many standard drinks (SDs) did you have?" We grouped responses into three categories (one, two, and more than two drinks per drinking occasion). Men who consumed more than two drinks per day and women more than one drink per day were classified as drinking above the WHO dietary guidelines [27]. We considered as one drink of alcohol: 1 can/bottle of beer (350 ml), 1 glass of wine (120 - 150 ml), or 1 shot of spirits (40 ml).

Assessments of Physical Activity: The Global Physical Activity Questionnaire (GPAQ) was used to measure the level of physical activity of the participants [28]. The frequency and duration of time spent engaging in physical activity are measured in 3 domains: activity at work, travel to and from places, and recreational activities. Energy expenditure, measured in metabolic equivalents

(MET), was estimated using duration, intensity, and frequency of physical activities performed within 7 days. MET is the ratio of specific physical activity metabolic rates to the resting metabolic rate (1 MET = the energy cost of sitting quietly and is equivalent to a caloric consumption of 1 kcal/kg/hour). According to the GPAQ scoring protocol, the responses were converted to MET-minutes/week: total minutes over the last 7 days spent on moderate, and vigorous activity were multiplied by 4.0, and 8.0, respectively, to obtain MET scores for each activity level. Respondents who scored ≥ 600 MET-minutes/week were categorized as active, while those who scored below 600 MET-minutes/week were categorized as inactive.

Anthropometric measurements: Bodyweight in light clothes was measured to the nearest 0.1 kg using a calibrated, Sohenle mechanical weighing scale. Height was measured using a portable stadiometer to the nearest 0.5 centimeters. BMI was calculated as weight in kilograms divided by the square of height in meters. According to the WHO [3], individuals with a BMI ≥ 30 kg/m^2 are categorized as obese, 25.0 - 29.9 kg/m^2 as overweight, 18.5 - 24.9 kg/m^2 as normal, while those with less than 18.5 kg/m^2 as underweight. WC was taken at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest (hip bone) [29]. Abdominal obesity was determined as a WC > 102 cm in men and >88 cm in women according to the WHO cutoff points and risk of metabolic complications for WC [3].

2.5. Validity and Reliability of the Study Tools

Assessment tools were reviewed for content validity by experts in the field of cardiovascular disease to ascertain relevance and completeness. To measure the reliability of the questionnaire, a test re-test method was employed whereby, a repeat pre-test was carried out after two weeks, and Cohen's kappa statistic was used to measure the level of agreement of the two results. The result of the repeated questions had a kappa value of 0.90 therefore, the questionnaire was considered reliable.

2.6. Ethical Consideration

Ethical approval to conduct this study was obtained from Kenyatta National Hospital-University of Nairobi Ethical Review Committee (KNH-UoN ERC) (Approval number (UP89/02/2019). We also sought study approval from the National Commission for Science, Technology and Innovation (NACOSTI) (Approval number NACOSTI/P/19/53639/2870). The institutional permission was granted by the administration of the Catholic University of Eastern Africa. Consent was obtained from the study participants prior to data collection after explanation of the study's aim and objectives.

2.7. Data Analyses

Statistical analyses were performed using the statistical package for the Social

Sciences (SPSS: version 22). Data were descriptively analyzed into means and proportions. The chi-square test of independence and binary logistic regression were employed to determine associations between the dependent (obesity) and various independents variables. A multiple logistic regression model with *backward conditional* was carried out to determine the variables that independently contributed to the occurrence of general and abdominal obesity. A p-value of less than 0.05 was considered to be significant.

3. Results

3.1. Characteristics of the Respondents

The respondents (n = 245) were university students. Majority of them were single (95%, n = 233), females (64.1%, n = 157), with a mean age of 22.32 ± 4.0 (Mean ± SD) years (Table 1). The number of students who live in hostels was significantly (X^2 = 21.745, df = 2, p < 0.001) higher in females (78.6%) relative to males (21.4%). Most (83.7%, n = 205) of the respondents were physically inactive, with significantly (X^2 = 12.945, df = 2, p = 0.001) higher in females (68.8%) compared to males (31.2%). Almost half (47.8%, n = 99) of the respondents spent 4 - 6 hours in a day while sitted. Approximately one-fifth (19.6%, n = 48) of the respondents had general obesity with significantly (X^2 = 20.022, p < 0.001 higher in females (83.3%) than males (16.7%). While, about a quarter (27.8%, n = 68) of them had abdominal obesity, with substantially (X^2 = 47.056, df = 2, p < 0.001) higher in females (97.1%) than males (2.9%). Abdominal obesity was more prevalent than general obesity (Table 1).

3.2. Predictors of General Obesity Determined by Body Mass Index (BMI)

Age, sex, accommodation status, physical activity, sedentary time, rate of eating fast/processed foods, and vegetables were significantly associated with general obesity. Students aged ≥ 20 years were at about 6-fold (OR, 3.858; 95% CI, 1.563 - 9.526, p = 0.003) increased risk of general obesity compared to those aged below 20 years. Female students were 3-times (OR = 3.42; 95% CI, 1.52 - 7.69, p = 0.003) more likely to suffer from general obesity compared to males. Students who lived with their parents (OR = 2.46; 95% CI, 1.08 - 5.57, p = 0.032) and in hostels (OR = 3.08; 95% CI, 1.42 - 6.67, p = 0.005) were at increased risk of general obesity compared to students who rented private houses. Physically inactive students were 5-times (OR, 5.49; 95% CI, 1.277 - 23.652, p = 0.022) more likely to develop general obesity compared to active individuals. Students who spent 7 or more hours sitting in a day were at about 7 times (OR = 6.939 (95% CI, 1.512 - 31.838) increased risk of general obesity relative to those who spent less sedentary time. Of the respondents, one-third (31.4%, n = 77) were alcohol consumers. However, there was no association between alcohol intake and general obesity. The odds of developing general obesity was higher among respondents who often (OR, 6.24; 95% CI, 2.09 - 18.63, p = 0.00) and sometimes (OR, 3.47; 95%

Table 1. Characteristics of the respondents stratified by sex (n, %).

Characteristic	Male	Female	Total	p-value
Age in years (Mean ± SD)	22.43 ± 3.2	22.25 ± 4.4	22.32 ± 4.0	0.741**
Marital status				
Single	84 (36.1)	149 (63.9)	233 (100)	0.848*
Married	4 (33.3)	8 (66.7)	12 (100)	
Accommodation				
Stay with parents	15 (24.2)	47 (75.8)	62 (100)	<0.001*
Hostel	15 (21.4)	55 (78.6)	70 (100)	
Rent a private house	58 (51.3)	55 (48.7)	113 (100)	
Physical activity				
Active (≥ 600 MET-minute/week)	24 (60.0)	16 (40.0)	40 (100)	0.001*
Inactive (< 600 MET-minute/week)	64 (31.2)	141 (68.8)	205 (100)	
Sedentary time per day[a]				
7 hours or more	22 (33.3)	44 (66.7)	66 (100)	0.800*
4 - 6 hours	38 (38.4)	61 (61.6)	99 (100)	
Less than 4 hours	16 (38.1)	26 (61.9)	42 (100)	
Body mass index				
Underweight (<18.5)	3 (33.3)	6 (66.7)	9 (100)	<0.001*
Normal (BMI 18.5 - 24.9)	61 (48.8)	64 (51.2)	125 (100)	
Overweight (BMI 25.0 - 29.9)	16 (25.4)	47 (74.6)	63 (100)	
Obese (BMI ≥30.0)	8 (16.7)	40 (83.3)	48 (100)	
Total	88 (35.9)	157 (64.1)	245 (100)	
Abdominal obesity				
Normal	77 (51.0)	74 (49.0)	151 (100)	<0.001*
Overweight	9 (34.6)	17 (65.4)	26 (100)	
Obese	2 (2.9)	66 (97.1)	68 (100)	
Total	88 (35.9)	157 (64.1)	245 (100)	

*Analysis with chi-square test of independence, **Analysis with independent t-test, [a]had missing responses.

CI, 1.07 - 11.27, p = 0.038) consumed fast/processed foods compared to those who rarely consumed such foods. Respondents who did not daily consume vegetables were 2-times (OR, 2.33; 95% CI, 0.99 - 5.49, p = 0.054) more likely to develop general obesity than those who consumed vegetables on daily basis (**Table 2**).

3.3. Predictors of Abdominal Obesity

Sex, accommodation status, physical activity, sedentary time, rate of eating fast/processed foods, and vegetables were significantly associated with abdominal

Table 2. Predictors of general obesity using body mass index (≥30 kg/m^2).

Characteristic	Obese	Not obese	Total	COR (95% CI)	p-value
Age (years)					
Above 20	42 (24.9)	127 (75.1)	169 (100)	3.858 (1.563 - 9.526)	0.003
20 and below	6 (7.9)	70 (92.1)	76 (100)	Reference	
Sex					
Female	40 (25.5)	117 (74.5)	157 (100)	3.42 (1.52 - 7.69)	0.003
Male	8 (9.1)	80 (90.9)	88 (100)	Reference	
Accomodation					
Stay with parents	15 (24.2)	47 (75.8)	62 (100)	2.46 (1.08 - 5.57)	0.032
Hostel	20 (28.6)	50 (71.4)	70 (100)	3.08 (1.42 - 6.67)	0.005
Rent private house	13 (11.5)	100 (88.5)	113 (100)	Reference	
Physical activity					
Inactive (<600 MET-min/week)	46 (22.4)	159 (77.6)	205 (100)	5.497 (1.277 - 23.652)	0.022
Active (≥600 MET min/week)	2 (5.0)	38 (95.0)	40 (100)	Reference	
Sedentary time per day					
7 hours or more	17 (25.8)	49 (74.2)	66 (100)	6.939 (1.512 - 31.838)	0.013
4 - 6 hours	19 (19.2)	80 (80.8)	99 (100)	4.750 (1.054 - 21.409)	0.043
Less than 4 hours	2 (4.8)	40 (95.2)	42 (100)	Reference	
Alcohol consumption					
Yes	17 (22.1)	60 (77.9)	77 (100)	1.18 (0.48- 2.23)	0.747
No	31 (18.75	137 (81.5)	168 (100)	Reference	
Rate of eating fast/processed foods					
Often	31 (28.7)	77 (71.3)	108 (100)	6.24 (2.09 - 18.63)	0.001
Sometimes	13 (18.3)	58 (81.7)	71 (100)	3.47 (1.07 - 11.27)	0.038
Rarely	4 (6.1)	62 (93.9)	66 (100)	Reference	
Rate of eating vegetables per week					
Not daily	41 (22.4)	141 (77.5)	182 (100)	2.33 (0.99 - 5.49)	0.054
Daily	7 (11.1)	56 (88.9)	63 (100)	Reference	

obesity. Females had higher odds of abdominal obesity (OR, 31.19; 95% CI, 7.41 - 131.27, $p < 0.001$) compared to males. Students who used to live with their parents (OR, 4.38; 95% CI, 2.11 - 9.10, $p < 0.001$) and in hostels (OR, 3.58; 95% CI, 1.75 - 7.34, $p < 0.001$) were more likely to suffer from abdominal obesity relative to those students who rented private houses. Physically inactive students were at about 6-fold (OR = 5.726, 95% CI, 1.703 - 19.256, $p = 0.005$) increased risk of abdominal obesity compared to active students. The occurrence of abdominal obesity was higher among students who drank alcohol (35.1%) compared to those who never drank (24.4%), however, the difference was significant. Students who often (OR, 3.94; 95% CI, 1.70 - 9.10, $p = 0.001$) and sometimes (OR,

3.26; 95% CI, 1.33 - 7.96, p = 0.010) consumed fast/processed foods were more likely to develop central obesity compared to students who rarely consumed such foods. The odds of developing abdominal obesity were 2-times (OR, 2.16; 95% CI, 1.04 - 4.44, p = 0.037) higher among students who did not daily take vegetables compared to students who daily consumed vegetables (Table 3).

3.4. Risk Factors for General and Abdominal Obesity

A multivariate logistic regression analysis was performed to assess the risk factors independently associated with general and abdominal obesity. Risk factors independently associated with general obesity were age ≥ 20 years (OR, 9.95;

Table 3. Predictors of abdominal obesity.

Characteristic	Obese	Not obese	Total	COR (95% CI)	p-value
Age					
More than 20	52 (30.8)	117 (69.2)	169 (100)	1.667 (0.878 - 3.164)	0.118
20 years or less	16 (21.1)	60 (78.9)	76 (100)	Reference	
Sex					
Female	66 (42.0)	91 (58.0)	157 (100)	31.19 (7.41 - 131.27)	<0.001
Male	2 (2.3)	86 (97.7)	88 (100)	Reference	
Accommodation					
Stay with parents	26 (41.9)	36 (58.1)	62 (100)	4.38 (2.11 - 9.10)	<0.001
Hostel	26 (37.1)	44 (62.9)	70 (100)	3.58 (1.75 - 7.34)	<0.001
Rent private house	16 (14.2)	97 (85.8)	113 (100)	Reference	
Physical activity					
Inactive (<600 MET-min/week)	65 (31.7)	140 (68.3)	205 (100)	5.726 (1.703 - 19.256)	0.005
Active (≥600 MET min/week)	3 (7.5)	37 (92.5)	40 (100)	Reference	
Sedentary time per day					
7 hours or more	25 (37.9)	41 (62.1)	66 (100)	5.793 (1.845 - 18.186)	0.003
4 - 6 hours	25 (25.3)	74 (74.7)	99 (100)	3.209 (1.041 - 9.892)	0.042
Less than 4 hours	4 (9.5)	38 (90.5)	42 (100)	Reference	
Alcohol consumption					
Yes	27 (35.1)	50 (64.9)	77 (100)	1.45 (0.66 - 2.89)	0.067
No	41 (24.4)	127 (75. 6)	168 (100)	Reference	
Rate of eating fast/processed foods					
Often	38 (35.2)	70 (64.8)	108 (100)	3.94 (1.70 - 9.10)	0.001
Sometimes	22 (31.0)	49 (69.0)	71 (100)	3.26 (1.33 - 7.96)	0.010
Rarely	8 (12.1)	58 (87.9)	66 (100)	Reference	
Rate of eating vegetables per week					
Not daily	57 (31.3)	125 (68.7)	182 (100)	2.16 (1.04 - 4.44)	0.037
Daily	11 (17.5)	52 (82.5)	63 (100)	Reference	

95% CI, 3.09 - 32.08, p < 0.001), staying with parents (OR = 3.22; 95% CI, 1.09 - 9.58, p = 0.035), sedentary time (OR = 11.36; 95% CI, 2.08 - 61.96, p = 0.005) and often consumed processed/fast foods (OR = 7.83; 95% CI, 1.90 - 32.21, p = 0.004). Risk factors for abdominal obesity were being female (OR, 38.76; 95% CI, 5.07 - 296.54, p < 0.001), staying with parents (OR = 3.02; 95% CI, 1.14 - 7.99, p = 0.026) and sedentary time (OR = 6.55; 95% CI, 1.80 - 23.81, p = 0.004) (Table 4).

4. Discussion

The objective of the study was to determine the prevalence and predictors of obesity among undergraduate university students of a private institution in Kenya. Our study found that the prevalence of general and abdominal obesity was 19.6%

Table 4. Risk factors for general and abdominal obesity.

Variables	General obesity		Abdominal obesity	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Age (years)				
Above 20	9.95 (3.09 - 32.08)	<0.001	-	-
≤20	Reference		-	-
Sex				
Female	2.21 (0.79 - 6.20)	0.133	38.76 (5.07 - 296.54)	<0.001
Male	Reference		Reference	
Accommodation				
Stay with parents	3.22 (1.09 - 9.58)	0.035	3.02 (1.14 - 7.99)	0.026
Hostel	2.43 (0.85 - 6.93)	0.096	2.38 (0.91 - 6.21)	0.076
Rent private house	Reference		Reference	
Physical activity				
Inactive (< 600 MET-min/week)	8.03 (0.88 - 73.70)	0.065	3.43 (0.65 - 18.07)	0.146
Active (≥ 600 MET min/week)	Reference		Reference	
Sedentary time per day				
7 hours or more	11.36 (2.08 - 61.96)	0.005	6.55 (1.80 - 23.81)	0.004
4 - 6 hours	5.62 (1.11 - 28.49)	0.037	3.72 (1.07 - 12.91)	0.038
Less than 4 hours	Reference			
Fast food consumption				
Often	7.83 (1.90 - 32.21)	0.004	2.83 (0.91 - 8.79)	0.071
Sometimes	2.39 (0.56 - 10.20)	0.239	2.37 (0.70 - 7.98)	0.164
Rarely	Reference		Reference	
Vegetable intake				
Not daily	-	-	1.87 (0.54 - 6.44)	0.324
Daily			Reference	

and 27.8%, respectively. Age, accommodation status, sedentary time per day and regular consumption of processed/fast foods were the predictors of general obesity. Sex, accommodation status and sedentary time per day were the variables independently associated with abdominal obesity. The prevalence of obesity in the current study was in agreement with a study done among college students in South African where the prevalence of obesity was 10.8% - 24% [7], but higher than that of Nigerian university students at 10% [8]. However, it was much lower than that of Egyptian university students at 25.3% - 59.4% [5] and Botswana at 36.8 [30]. Indeed, the occurrence of obesity at an earlier age is a real problem as it can contribute to premature morbidity and mortality from non-communicable diseases. Creating awareness of a healthy lifestyle is a potential approach to reduce the burden of obesity and related health consequences in university students.

Our study revealed that students aged ≥ 20 years were at about a 10-fold increased risk of general obesity compared to those aged below 20 years. This is an interesting finding which indicates that the burden of obesity starts early in adulthood with potentially predisposing such individuals to non-communicable diseases in their early productive ages. Our finding is in line with a study conducted among university students in Botswana [30] that reported a direct relationship between age and obesity. Likewise, Peltzer and colleagues [31] reported that the development of obesity increases with age and level of study. The likely explanation for the direct relationship between age and obesity is probably due to increased exposure to unhealthy lifestyles as the duration of study is directly related age of the students. Our study found that female students were more likely to develop abdominal obesity compared to their male counterparts. This finding is consistent with studies in several African countries that showed female students were at increased risk of abdominal obesity compared to male students [32]. This can be explained by the fact that female students are more likely to consume fast/processed foods and have a sedentary lifestyle than their male counterparts, known risk factors for abdominal obesity [23].

Our study revealed that the odds of developing both general and abdominal obesity were substantially higher among respondents who used to stay with their parents compared to those who rented private houses. The reason might be students who live with their parents in Nairobi, the capital city of Kenya, usually come from families with higher socioeconomic classes which in turn might be exposed to high energy-dense foods. High-income earners in developing countries frequently consume unhealthy fatty foods/sugars and have a sedentary form of lifestyle compared to developed countries [33]. In addition, a student from high economic classes usually uses private vehicles for transportation and, therefore, they are less active. A recently carried out cross-sectional study in India showed that adolescents from high family income were at a higher risk of being obese than those from low income [34].

Our study found that sedentary time (sitting for 7 or more hours per day) was a risk factor for both general and abdominal obesity. This finding concurs with a

study conducted among university students in Botswana [30] whereby obesity was more common among physically inactive students. Similar to our finding, a study conducted among high school students in Ghana revealed that obesity was more prevalent among those who were less physically active [35]. Likewise, reports by Issa [36] and Peltzer *et al.* [37] showed that there was an inverse relationship between the level of physical activities and obesity. The beneficial effect of physical activity against obesity can be explained by several facts. Physical activity burns off body fat and is thus associated with less risk of obesity [38] [39]. Whereas, insufficient physical activity promotes the development of obesity and increases body fat [40].

Our study revealed that students who often consumed fast/processed foods were more likely to develop general obesity compared to those who rarely ate such foods. In line with this finding, a study carried out in the united states among college students showed that obesity was linked to increased fast food consumption [20]. Among various dietary factors, fast food consumption has been evaluated as a key determinant of obesity [41] [42]. Poor eating habit is a major public health concern among young adults who experienced a transition into University life during which they are exposed to unhealthy lifestyle, and stress [43]. The deleterious effects of the unhealthy diet have become apparent in the Kenyan diet, especially in urban settings like Nairobi [44]. Suleiman and colleagues. [45] found out that various factors determine college student's selection of food. These factors include shortage of time, convenience, cost, taste, physical and social environment. Most urban residents may not have time to cook low-calorie meals at home, rather they buy high-calorie meals [46]. Several mechanisms are describing the association between processed food intake and Obesity. The nutritional content of fast foods is mainly refined carbohydrates, saturated fat, salt, and processed or simple sugars, which favours the development of obesity [13] [26] [47].

Strengths and Limitations of This Study

The study provides valuable data that could be used by university managers/directors to plan strategies aiming at improving the health status of University students. The use of both general and abdominal obesity is another strength of the study.The findings may be useful to reinforce the importance of dietary consideration in public health interventions to control obesity and related non-communicable diseases. The study was limited by its cross-sectional design which may not draw inference about the cause-effect relationship. The self-reported dietary patterns and practices may suffer from information bias.

5. Conclusion

The prevalence of general and central obesity was high, 19.6% and 27.8%, respectively among undergraduate university students. This highlights that obesity is a public health problem among University students in Kenya, particularly in

females. A sedentary lifestyle and intake of fast/processed foods were the lifestyle factors substantially associated with both general and central obesity. Behavioural intervention is required to mitigate the burden of obesity among university students in Kenya. This can be achieved through promoting intervention programmes that lead to changing the built environment, counseling, and behavioral and lifestyle modification of students. Facilities should be provided for outdoor games in schools, with compulsory hours of sports and games. There is also an urgent need to educate university students on the aspects of healthy lifestyles. More attention should be given to female students as they are at higher risk for obesity. Thus gender-specific promotional approaches should be discovered.

Data Availability

The dataset analysed for the current study is available from the corresponding author on a reasonable request.

Conflicts of Interest

The authors do not have any competing interests.

Authors' Contribution

Sr. Syliva and Tekeste conceptualized the research problem and involved in proposal writing and data collection. Tekeste and Kimani did data analysis, interpretation and paper preparation.

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Consent to Participate

Consent was obtained from the study participants prior to data collection.

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