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Impact of Nutrient Intake and Physical Activity Level on Nutritional Status among University Students in Ghana

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Authors' contributions

This work was carried out in collaboration between all authors. Authors NA, PPMD and YA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors NA and PPMD managed the analyses of the study. Author YA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aim: This study assessed the impact of nutrient intake and physical activity level on nutritional status of undergraduate university students
Study Design: Cross sectional study design.
Place and Duration of Study: School of allied health sciences, University for development studies, Tamale, Ghana between January 2015 and May 2015.
Methodology: Two hundred and fifty-two (252) undergraduate students were randomly selected for this study. Data was collected on sociodemographic characteristics using a structured questionnaire, dietary intake using a 24-hour dietary recall questionnaire; anthropometry and physical activity level were recorded. Nutritional status was assessed by computing the body mass index, waist

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circumference and waist to hip ratio.
Results: The mean age of the studied population was 22±2.24. The population was made of 103(40.87%) females and 149(59.13%) males. The results obtained show that the prevalence of overweight and obesity prevalence ranged from 9.13%-12.30% and 1.19%-2.78% respectively. The prevalence of underweight was 8.33%. Females were generally more overweight (p=<0.0001 and p=<0.0001 for WC and WHR respectively) and obese (p=0.0029 and p=0.0012 for WC and WHR respectively) than males. More males were involved in high physical activity (p=<0.0001) whiles more females were involved in low physical activity (p=<0.0001). The mean calorie intake of the study population was 2005±879.70. Males consumed more calories (p=0.0043) and proteins (p=0.0406) than females. Generally, the prevalence of underweight, overweight, obesity and low physical activity was higher among first year students.
Conclusion: This study highlights the increasing prevalence of underweight, overweight and obesity among undergraduate students. It also brings to bare the higher prevalence of overweight and obesity among female university students as a consequence of reduced physical activity. Prevalence of obesity and overweight as well as underweight tends to be higher among first year university students, a resultant effect of low level of nutritional knowledge.

Keywords: Physical activity; students; calorie intake; nutritional status.

1. INTRODUCTION

Good nutrition is the basic component of good health. A balance between nutrient intake and nutrient utilization determines a person's nutritional status. Imbalance between energy (nutrient intake) and utilization may lead to under nutrition or over nutrition [1]. Bad eating habits is linked to obesity and cardiovascular disease and undernutrition can cause other health related hazards although genetic predisposition cannot be ruled out. For this reason, good nutrition should be coupled with physical exercise in order to maintain a healthy weight thus prevent occurrence of overweight and obesity and its related morbidity and mortality [2].

Anthropometric measurements, biochemical tests and dietary evaluation are means by which a person's nutritional status are assessed [3]. Individuals characterized as undernourished (underweight) are classified with body mass index (BMI) less than 18.5 kg/m^2. Excess calories are stored as body fats which may results in overweight (BMI of 25.0 - 29.9 kg/m^2) and/or obese (BMI >30 kg/m^2) according to World Health Organization criteria [2].

Some studies have reported positive association between energy intake, physical activity and nutritional status. Bakr, Ismail [4], accessed nutritional status of medical students of Ain Shan University found that, 41.8% of the students were of normal weight while 9.5% were underweight. Bakr, Ismail [4] concluded that about half of the students were overweight and obese attributing it to unhealthy and sedentary lifestyles lived by the students. A similar study was carried out by Sakamaki, Toyama [5], in Chinese university students. The results showed that 80.5% of the students had a normal BMI and 16.6% of students were overweight [5].

Transition into university life is often linked with living out of the home. Poor eating habits has been a major public health concern among young adults who experienced transition into university life [6] since they are exposed to stress and lack of time [7]. Studies have shown that students especially female students conform to certain dietary behaviors that compromise their ability to maintain a good nutritional status [8]. Needless to say poor nutritional practices, stress, snacking, skipping meals, easy access to fast foods are attributed to university life [9].Other studies have shown that, among these populations especially female students, energy intake is often below the recommended level [10]. Despite the deteriorating health status among young adults and especially university students these generations are potential targets for the promotion of healthy lifestyles as this may help prevent life style-related disorders later in life [11]. This study among university students seeks to show the impact of nutrient intake and physical activity on nutritional status.

2. MATERIALS AND METHODS

2.1 Study Design

This study was a cross-sectional survey conducted among undergraduate students at the

University for Development Studies, Tamale campus. The study was carried out between January and July 2015.

2.2 Sampling Technique

A convenience Sampling technique was employed in this study. Study was explained to students in class and at other university settings including canteens and study rooms, and interested persons recruited for the study.

2.3 Sample Size Calculation

The necessary minimum sample size for the study is calculated to be 179 undergraduate students, based on the assumption that that 13.5% of the students were overweight [12] with an expected difference of 5% between the sample and the general population and a type I error (α) of 0.05.

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

Where n = minimum sample size; Z = standard normal variance=1.96 to obtain a power of 95% confidence interval (β=5%) and a type 1 error probability of 5%; d=Absolute standard error=0.05; p=prevalence=13.5%.

In the present study, which was limited to only undergraduate university students who answered at least 75% of the questions in the questionnaire, the sample size is recalculated to evaluate any possible loss of precision. Given a response rate of 90%, the sample size is recalculated as: 179/0.90. Using the above formula, the calculated sample size is approximately 199. Two hundred and fifty-two (252) students were therefore recruited for this study.

2.4 Data Collection

A structured questionnaire was administered to each consented participant for sociodemographic information including age, gender, programme and programme level and behavioral activities (smoking and alcohol consumption). Alcohol intake was defined as the intake of at least one bottle of an alcoholic beverage per week and smoking was defined as smoking at least one cigarette a day. Anthropometric and body composition measurements were obtained from each participant. The height was measured using a microtoise to the nearest 0.1 cm and weight was taken with an electronic scale to the nearest 10 g. Body Mass Index (BMI) was calculated as body weight in kilogram divided by height in meter square (kg/m^2). The classifications of BMI was based on the World Health Organization [2] criteria; BMI <18.5 kg/m^2 was reported as underweight BMI 25 - 29.9 kg/m^2 and BMI >30kg/m^2 were overweight and obese respectively. Waist to hip circumferences were measured with a flexible measuring tape to the nearest 0.5 cm. Central obesity was then calculated and defined on the basis of WHR. The cut-off value of central obesity was considered high risk WHR= >0.80 or waist measurement >80% of hip measurement for women for females and >0.95 for males that is >95% for men indicates central (upper body) obesity and is considered high risk for diabetes & CVS disorders. A WHR below these cut-off levels is considered low risk [2].

A short IPAQ questionnaire which contains details on physical activity habits such as type, duration and frequency of physical activity participation was also administered. The types of physical activity was categorized into three intensity levels and assigned metabolic equivalent values according to the compendium of physical activity. Energy expenditure at rest equals one metabolic equivalent or roughly 3.5 ml of oxygen consumed per kg of body weight per minute. The types of physical activity categorized included the following; vigorous intensity activities like heavy lifting, digging, aerobics, or fast bicycling (metabolic equivalent =7), moderate physical activity like carrying light loads, bicycling at a regular pace, or doubles tennis (metabolic equivalent =6), and mild intensity activities such as walking (metabolic equivalent =2.5). The vigorous and moderate physical activity intensity was based on at least 10 minutes of physical activity.

The participants were asked to recall and describe carefully all foods (including beverages) that were taken in the last 24 hours period. Quantities of food consumed were estimated in household measures. One single 24-h recall was collected for every participant, details on the type of food and the amount consumed was recorded. For the transformation of household measurements into grams, the portion sizes were weighed with a digital household dietary scale. Data obtained were then transported and analyzed using the local food composition table

of the National Institute Nutrition and the Nutribase 7 software clinical edition to obtain the mean daily intake of energy, macronutrient and some micronutrients. Adequacy of the macronutrients and micronutrients intake was evaluated according to the Dietary Reference Intakes (DRI) of The Institute of Medicine of The National Academies, 2003. The reported energy intakes were compared with estimated minimal energy requirements to assess adequacy.

2.5 Statistical Analysis

Data was analyzed using Microsoft Excel 2010 and Graph Pad Prism Version 6.0. Means and standard deviations was then determined for relevant variables. Comparison of categorical variables was done using the chi-square test whiles continuous variables was compared using the unpaired t-test. In all cases, a P -value<0.05 will be seen as significant.

3. RESULTS AND DISCUSSION

3.1 Results

3.1.1 General and anthropometric characteristics of the studied population

Two hundred and fifty-two (252) students from the University for Development Studies, Tamale Campus participated in the study even though the sample size targeted was 300, giving a response rate of 84.0%. The students were from various departments with 21(8.3%) from medical laboratory science, 29(11.5%), 84(33.3%), 27(10.7%), 91(36.0%) from medicine, nursing/midwifery, health science and community nutrition respectively. As shown in Table 1; 59.1% were males and 40.9% were females. Majority of the students were single (96.0%), 99.6% did not smoke and94.1% consumed alcohol. The mean age ± SD for the participants was 22.1±2.24years, with the males being older than the females (*P*<.001) (Table 1).

Table 1. General Characteristics of the Study Population

Variable	Total (n=252)	Male (n=149)	Female (n=103)	P-value
Age(years)	22.10±2.24	22.60±2.25	21.37±2.01	<.001
Programme				
Medical laboratory science	21(8.3%)	14(9.4%)	7(6.8%)	.463
Medicine	29(11.5%)	22(14.8%)	7(6.8%)	.051
Nursing/Midwifery	84(33.3%)	41(41.8%)	43(41.8%)	.019
Health science	27(10.7%)	21(14.1%)	6(5.8%)	.037
Nutrition	91(36.0%)	51(934.2%)	4038.8%)	.454
Level				
100	84(33.3%)	52(34.9%)	32(31.1%)	.526
200	62(24.6%)	29(19.5%)	33(32.0%)	.023
300	66(26.2%)	41(27.5%)	25(24.3%)	.565
400	40(15.9%)	27(18.1%)	13(12.6%)	.240
Arital status				
Single	242(96.0%)	143(95.9%)	99(96.1%)	.954
Smoking				
Yes	1(0.4%)	(0.7%)	0(0.0%)	.405
Alcohol intake	15(5.9%)			
Yes		7(4.7%)	8(7.8%)	.311
Anthropometry				
Weight(kg)	61.15±8.29	62.79±7.33	58.77±9.02	.001
Height(cm)	167.80±9.72	171.50±7.21	162.50±10.43	< .001
BMI(kg/m^2)	22.01±6.21	21.40±2.56	22.88±9.17	.064
WC(cm)	75.03±10.59	74.28±5.60	76.12±15.11	.174
HC(cm)	93.64±9.31	91.15±5.23	97.24±12.31	< .001
WHR	0.81±0.14	0.82±0.04	0.79±0.21	.205
Physical activity				
METscore(min/week)	2137±2294	2660±2508	1381±1688	< .001
Sedentary(min/week)	253.30±211.90	261.10±216.30	241.90±205.90	.481

Categorical data are presented as proportion and compared using chi-square whilst continuous data are presented using Mean ± SD and compared using T-test

The mean weight ± SD, height, body mass index (BMI), waist circumference (WC), hip circumference (HC), waist to hip ratio (WHR) and metabolic (MET) Score were 61.15±8.29 kg, 167.8±9.72 cm, 22.01±6.21 kg/m^2, 75.03±10.60, 93.64±9.31, 0.81±0.14, and 2137±2294 min/week respectively. Generally, the males were heavier (*P*<.001), taller (*P*<.001), and recorded higher levels of physical activity (*P*<.001) than their female counterparts, whiles the females had broader hips (*P*<.001) than the males (Table 1).

3.1.2 The distribution of underweight, normal weight, overweight and obese using BMI, WC and WHR among participants stratified by gender

The prevalence of overweight and obesity ranged from 9.1% to 12.3% and 1.2% to 2.78% respectively using BMI, WC and WHR as criteria for weight classification (Fig. 1 and Table 2). When BMI, was used as a criterion for classification, the proportion of male that were normal was higher than that in females (*P*=.008). Prevalence of overweight and obesity were generally higher among the females than males but this was not statistically significant (Fig. 1). When WC and WHR were used as criteria for classification, the prevalence of overweight and obesity were higher among the female population whiles the proportion of normal weight was higher (*P*<.001 and *P*<.001 for WC and WHR respectively) among the male as shown in Table 2.

3.1.3 The distribution of low (A), moderate (B) and (C) high physical activity level among the study participants

About 25.4% of the studied population were involved in low physical activity, 51.6% moderate and 23.0% involved in high physical activity. When the population was stratified by gender, more females were involved in low physical activity than their male counterparts (*P*<.001) whiles more males were involved in high physical activity than females (*P*<.001) (Fig. 2).

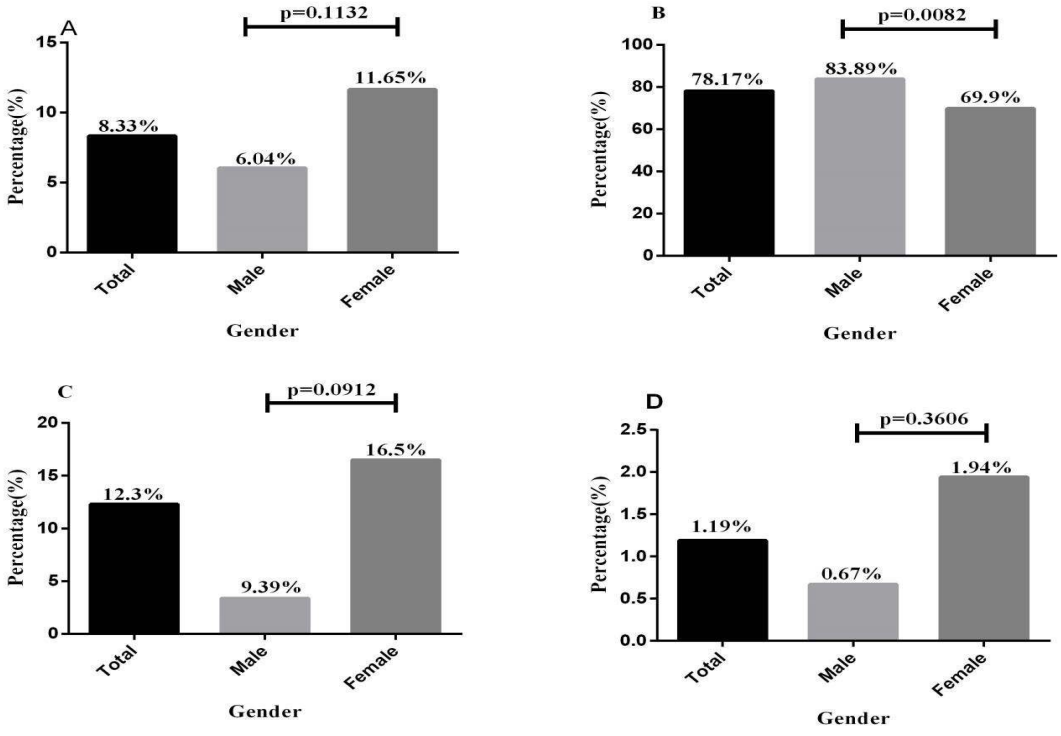

Fig. 1. The distribution of underweight (A), normal weight (B), Overweight (C) and obese (D) using BMI among the study participants classified by gender

Table 2. Nutritional status based on WC and WHR indicators of students

Variable	Total (n=252)	Male (n=149)	Female (n=103)	P-value
WC				
Normal	223(88.5%)	149(100.0%)	74(71.8%)	< .001
Overweight	23(9.1%)	0(0.0%)	23(23.3%)	< .001
Obese	6(2.4%)	0(0.0%)	6(5.8%)	.003
WHR				
Normal	216(85.7%)	143(95.9%)	73(70.9%)	< .001
Overweight	29(11.5%)	6(4.0%)	23(22.3%)	<.001
Obese	7(2.8%)	0(0.0%)	7(6.8%)	.001

Categorical data are presented as proportion and compared using chi-square

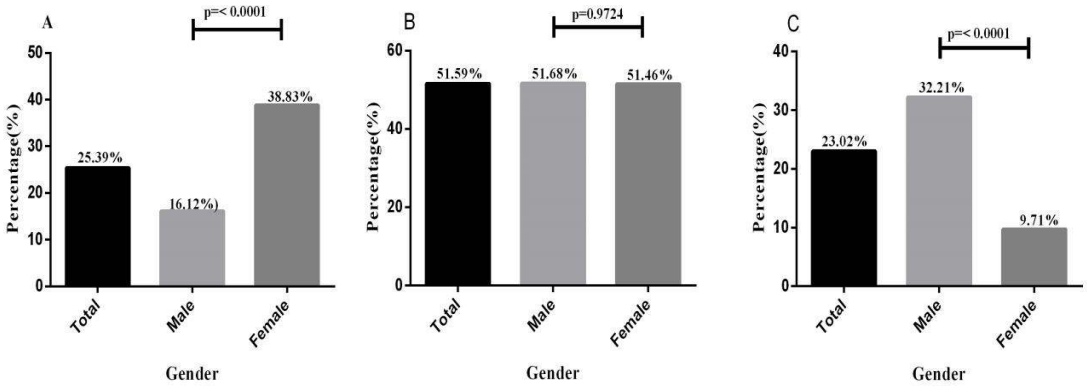

Fig. 2. The distribution of Low (A), Moderate (B) and (C) High physical activity level among the study participants

3.1.4 Daily nutrient intake of students classified by gender

From Table 3, the mean ± SD for daily energy intake, carbohydrates, protein, fat, calcium, phosphorus, iron, Vitamin A and Vitamin C were 2005±879.7 kcal, 1265±759.0 g/day, 268.3±213.8 g/day, 518.3±283.2 mg, 764.9±1271 mg, 626.1±408.7 mg, 26.18±43.48 mg, 361.3±390.1 µg, 36.23±31.55 µg respectively. When the studied population was stratified based on gender, the males were found to consume more protein than the females (*P*=.04) and had a higher total calorie intake as compared to the females (*P*=.004). There were variations in the level of consumption of various other nutrients but these were not statistically significant (Table 3).

Table 3. Daily nutrient intake of students classified by gender

Variable	Total (n=252)	Male (n=149)	Female (n=103)	P-value
Total calories(kcal)	2005±879.7	2136±954.1	1816±722.7	.004
Carbohydrate(g/day)	1265±759.00	1327±711.10	1176±818.70	.12
Protein(g/kg/day)	268.3±213.8	291.2±251.3	235.2±137.9	.04
Fat(mg)	518.3±283.2	545.6±297.2	479.1±258.3	.06
Calcium(mg)	764.9±1271	733.6±1146	810.1±1437	.64
Phosphorus(mg)	626.1±408.7	615.9±307.2	640.9±523.2	.63
Iron(mg)	26.18±43.48	24.35±15.65	28.83±65.46	.42
Vitamin A(µg)	361.3±390.1	336.4±209.0	397.4±555.7	.22
Vitamin C(µg)	36.23±31.55	37.32±33.94	34.66±27.82	.51

continuous data are presented using Mean ± SD and compared using T-test

3.1.5 Energy intake and the physical activity level of students among the weight classes

The proportion of the studied population who consumed higher than the RDI increased from underweight to obese, with no observable trend in the proportion of subjects in the various weight classes who were either taking below or within the required dietary intake (Table 4). Also, the proportion of students who were involved in high physical activity generally decreased from underweight to obese.

3.1.6 Nutritional status classification among the various year groups

The nutritional status was classified based on the various year group. For BMI classifications; those who were underweight and obese for level 100 students were 47.6% and 66.7% whiles (23.8%, 33.3%), (14.3%, 0.0%), (14.3%, 0.0%) were for level 200s, 300s and 400s respectively. Majority of level 100 and 200 students were overweight for waist circumference classifications whiles level 300 and 400 students were more obese. WHR classifies level 100 as the highest level with normal weight 33.33% and obesity was highest among the level 300 students (57.14%) (Table 5).

3.1.7 Daily energy and physical activity level students among the various year groups

Table 6, summarizes the energy intake among the various year groups. The proportions of students whose energy intake was below the RDI decreased from level 100 to level 400 (*P*=0.001) whiles the proportions of students whose energy intake was within (*P*=0.043) or above (*P*=0.015) the required energy intake was increased from level 100 to 400.

Table 4. Energy intake and the physical activity level of students among the weight classes

Variable	Underweight (n=21)	Normal (n=197)	Overweight (n=31)	Obese (n=3)	P-value
RDI					
Less RDI	17(80.9%)	123(62.4%)	20(64.5%)	2(66.7%)	.388
Normal RDI	4(19.1%)	43(21.8%)	6(19.4%)	0(0.0%)	.673
High RDI	0(0.0%)	31(15.7%)	5(16.1%)	1(33.3%)	.098
Physical activity level					
Low	10(47.6%)	44(22.3%)	9(29.0%)	1(33.3%)	.375
Normal	12(57.1%)	103(52.3%)	17(54.8%)	2(66.7%)	.901
High	3(14.3%)	50(25.4%)	5(16.1%)	0(0.0%)	.615

Categorical data are presented as proportion and compared using chi-square

Table 5. Nutritional status classification among the various year groups

Variables	Level 100 (n=84)	Level 200 (n=62)	Level 300 (n=66)	Level 400 (n=40)	P-value
BMI					
Underweight	10(47.6%)	5(23.8%)	3(14.3%)	3(14.3%)	.194
Normal	63(31.9%)	46(23.4%)	56(28.4%)	32(16.2%)	.229
Overweight	9(29.0%)	10(32.3%)	7(22.6%)	5(16.1%)	.947
Obese	2(66.7%	1(33.3%)	0(0.0%)	0(0.0%)	.141
WC					
Normal	75(33.6%)	52(23.3%)	60(26.9%)	36(16.1%)	.697
Overweight	8(34.8%)	8(34.8%)	4(17.4%)	3(13.0%)	.459
Obese	1(16.7%)	2(33.3%)	2(33.3%)	1(16.7%)	.560
WHR					
Normal	72(33.3%)	53(24.5%)	57(26.4%)	34(15.7%)	.981
Overweight	10(34.5%)	9(31.0%)	5(17.2%)	5(17.2%)	.698
Obese	2(28.6%)	0(0.0%)	4(57.1%)	1(14.3%)	.420

Categorical data are presented as proportion and compared using chi-square

Table 6. Daily energy and physical activity level students among the various year groups

Variables	Level 100 (n=84)	Level 200 (n=62)	Level 300 (n=66)	Level 400 (n=40)	P-value
RDI					
Less RDI	78(48.2%)	32(19.8%)	44(27.2%)	26(16.1%)	.001
Normal RDI	4(7.5%)	19(35.9%)	14(26.4%)	7(13.2%)	.043
More RDI	2(5.4%)	11(29.7%)	8(21.6%)	7(18.9%)	.015
Physical activity level					
Low	27(42.2%)	14(21.9%)	16(25.0%)	7(10.9%0	.088
Moderate	37(28.5%)	42(32.3%)	30(23.1%)	21(16.2%)	.725
High	20(34.5%)	6(10.3%)	20(34.5)	12(20.7%)	.178

Categorical data are presented as proportion and compared using chi-square

3.2 Discussion

Variation in prevalence of obesity epidemic in various races and communities of the world may be attributed to heredity, age, sex, diet, eating patterns and life style [13]. This study sought to show the impact of nutrient intake and physical activity level on the nutritional status of university students. The prevalence of overweight and obesity in this study ranged from 9.1%-12.3% and 1.2-2.8% respectively. These findings are consistent with Gan, Mohd [14], who reported an overweight and obesity prevalence of 9.4% and 3.4% among university students in Malaysia but higher than that of [15], who reported a prevalence of 4.6% and 0.5% for overweight and obesity respectively. This increasing prevalence in this study may be due to socioeconomic changes over the years. The effect of globalization coupled with speedy economic transition over recent years may have resulted in higher intake of foods saturated with fats and salts [16] with changes in lifestyle and physical activity [17], hence the resultant increase in the prevalence of overweight and obesity.

In contrast, Obembe, Olaogun [18] and [12] reported a much higher prevalence (22.4% and 6%) and (13.5% and 7.5%) of overweight and obesity among university students in Nigeria and Malaysia respectively. A lower prevalence in this study compared to the two studies may be as a result of higher urbanization and modernization in these countries. The disparity could also be as a result of differences in criteria for the classification of weight classes among the various studies. Different criteria have been reported impart differently on the prevalence of various weight classes among similar populations [19]. In this study, the prevalence overweight and obesity were higher among females than males. Higher prevalence of overweight and obesity in females have been reported in several studies [20-22]. Higher prevalence of overweight and obesity in females may be due to biological changes associated with female hormones [22] coupled with other lifestyle changes associated with female university students. Beauty has been defined as an elusive commodity, and ideas about what is beautiful varies across cultures and changes over time [23] and in Ghanaian societies, females associate beauty with fatness [21], and therefore make efforts to put on weight.

The study showed that fewer proportions of females were involved in high physical activity than their male counterparts and vice versa. Low physical activity has been found to be associated with increased prevalence of overweight and obesity [24]. In this study, even though males consumed more calories and proteins, they had a lower prevalence of overweight and obesity as compared to the females. This could be as a result of a higher physical activity levels in males as shown by higher metabolic score (METScore) and a higher proportion of males involved in higher physical activity. A positive balance in dietary intake and energy expenditure through physical activity has been found to be associated with overweight and obesity [25] hence, a higher prevalence of overweight and obesity in females, despite a lower calorie and protein intake by females. The prevalence of underweight (8.3%) in this study is lower than results obtained among similar population in Nigeria [26] and Chinese [27] university students where underweight prevalence was highest in females (20.9%) than in males (16.7%) [26] and 27.5% in females and 14.2% in males [27] respectively. This may due to low intake of caloric diet by the females due to meal skipping, snacking and other poor nutritional practices which are common with female university students.

The study also sought to find out the variations in the nutritional status of students in different levels. The prevalence of obesity and underweight was highest among students in their first year and lowest among those in the final year. Higher prevalence of overweight and obesity in first year students was reported by [28], in the study of prevalence of physical activity and obesity among biomedical college students in a Nigerian university. The higher prevalence of obesity and underweight in the first years could be attributed to bad dietary habits resulting from inadequacy of nutritional knowledge. Proper dietary knowledge among students has been found to be associated with proper dietary habits [29].

4. CONCLUSION

This study highlights the increasing prevalence of underweight, overweight and obesity among undergraduate students. The study also brings to bare the higher prevalence of overweight and obesity among female university students as a consequence of reduced physical activity level. Prevalence of obesity and overweight as well as underweight tends to be higher among first year university students, a possible resultant effect of low level of nutritional knowledge. University students are potential targets for the promotion of healthy lifestyles as this may help prevent life style- related disorders later in life, hence it would be useful to adopt educational programs of dietary consumption and physical activity in order to promote good health in this population.

CONSENT

A consent was sought from each participant before being included in the study. Subjects who did not give their consent were excluded from the study.

ETHICAL APPROVAL

Ethical clearance was sought from the Ethical Review Board of the School of Allied Health Sciences and the Tamale Teaching Hospital, Tamale.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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