Prevalence of Overweight and Obesity and its relation to Diet and Physical Activity among Medical Students in Accra, Ghana

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Summary

BACKGROUND

Obesity is a rising problem in developing countries including Ghana. Adolescents and young adults are increasingly being affected which is driven mainly by sedentary lifestyle and excess calorie intake. We sought to determine the prevalence of overweight and obesity among final year medical students of the University of Ghana and its relationship with dietary habits and physical activity

MATERIALS AND METHODS

We assessed body mass index (BMI) and its association with dietary habits and physical activity among 129 final year students of the University of Ghana Medical School.

RESULTS

Twenty-nine students (22.5%) were overweight whilst 10 (7.8%) were obese giving a combined prevalence of overweight and obesity as 30.3% (n=39). Prevalence of overweight or obesity was 47.6%, 25.0% and 32.7% among those involved in the low, moderate and high levels of physical activities respectively. Ready to eat meals (χ^2=7.86, p=0.020) and sugar (χ^2=8.46, p=0.015) were the only food items significantly associated with overweight/obesity. The odds of overweight or obesity were 72% significantly lower for those with moderate physical activity levels compared to those with low physical activities (AOR: 0.28, 95% CI: 0.09-0.93, p=0.037). Relative to those who consume ready to eat meals on the daily basis, the adjusted odds of overweight or obesity were 2-folds higher among those who consume ready to eat meals on the monthly basis (AOR: 2.80, 95% CI: 1.09-7.18, p=0.033).

CONCLUSION

Vigorous awareness creation of the need for healthy dietary choices and increased physical activity among medical students is urgently needed.

Keywords: *Obesity, Overweight, Diet, Physical Activity, Medical Students*

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Introduction

Obesity is a rising problem worldwide including in developing countries like Ghana [1-3]. The WHO estimated that more than 1.9 billion adults older than 18 years were overweight in 2016 with 650 million of these adults being obese [2]. Several studies have shown a variable high prevalence of overweight and obesity ranging from 10-59.4% in Africa [4-7] and 2.9%-52.6% in Asia [8-10].

Some of the negative effects of obesity include increased cardiovascular and metabolic diseases such as hypertension, raised cholesterol, triglyceridaemia and insulin resistance, stroke,

as well cancers and other non-communicable diseases [2, 11-13]. According to the Ghana Demographic and Health Survey of 2014, the percentage of Ghanaian overweight/obese women rose from 30% in 2008 to 40% in 2014 [14]. These direct and indirect effects of obesity impose an economic burden on the healthcare budget of countries and individual citizens [2, 15]. These individuals may miss a lot of work and school hours for hospital visits leading to low productivity [2, 15].

Lifestyle changes related to westernization and socio-economic improvement are responsible for this increasing phenomenon of obesity and overweight [2, 16]. Reduction in physical activity has been identified as a risk factor [17], which on the global level causes 3.2 million related deaths [2]. Another major cause of obesity is a relatively higher amount of calories consumed compared to that which is expended [2, 16]. In Sub-Saharan Africa, increased body fat composition is regarded as beautiful and a sign of wealth, which is a cultural driver for the increasing prevalence of overweight and obesity in young adults [3].

A study by Yousif *et al* [18] among medical students in Sudan found that there is an alarming increase in overweight among medical students as a result of poor eating habits and decrease physical activity.

We sought to determine the prevalence of overweight and obesity among final year medical students of the University of Ghana and its relationship with dietary habits and physical activity.

Materials and Methods

Study design and site

A cross-sectional study design was used to assess the prevalence of obesity and its association with diet and physical activity among final year medical students of the University of Ghana Medical School, which was established in 1962. It is affiliated with the Korle-Bu Teaching Hospital and is located on the same premises as the hospital. The Korle-bu Teaching Hospital is the premier hospital in Ghana and is located in the capital city of Accra, with a 2000 bed capacity and average daily attendance of 1500 patients. It has 17 departments that offer clinical and diagnostic services. It serves as a clinical training centre for the University of Ghana Medical School. The total number of medical students on the Korle-Bu campus is 1200.

Sample size determination

The sample size was determined using a simplified formula for finite population correction for proportions.

Sample Formula, n = $\frac{N}{1+N(e)^2}$

Where; n = sample size

N= population size= 178

e = margin of error (0.05)

Confidence level= 95%

n = $\frac{178}{1+178(o.o5)^2}$

n= 123.18, but approximated to 123. A total of 129 students participated in the study.

Sampling

Convenient sampling was used because of the restrictions imposed by the COVID-19 pandemic. Consenting final year students were enrolled to respond to the questionnaires as and when they were available and ready to. Students who were absent from school, ill/feeling unwell and who did not provide written informed consent were excluded.

Data collection

A 4-part data abstraction instrument was used in assessing demography, dietary habits, and physical activity level and for recording, weight and height measured to calculate the BMI.

A food consumption questionnaire adapted to suit the Ghanaian setting was used to assess dietary habits. The Long Form

International Physical Activity Questionnaire (IPAQ) [19] was used to assess the physical activity level.

Measurements

The ZT-160 weighing scale and stadiometer were used to measure the weight and height of the students in kilograms to the nearest 0.5kg and the nearest 0.5cm respectively.

The weighing scale was calibrated to zero. The BMI was calculated using the formula;

BMI= $\frac{weight(kg)}{(height)^2 m^2}$ [20]

Categorization of BMI was considered as follows:

$$BMI\ categorization \begin{cases} Underweight, if\ BMI\ score < 18.49 kgm^{-2} \\ Normal\ weight, if\ 18.5 kgm^{-2} \leq BMI\ score \leq 24.99 kgm^{-2} \\ Overweight, if\ 25 kgm^{-2} \leq BMI\ score \leq 29.99 kgm^{-2} \\ Obese, if\ BMI\ score > 29.99 kgm^{-2} \end{cases}$$

Level of physical activity

In determining the level of physical activities for each study participant, the number of days that each study participant was involved in each vigorous, moderate and walking activity was determined. The metabolic equivalent minutes (MET-minutes) per week for each of the three domains were also computed. In some scenarios, the Met-minutes per activity per day was also determined by dividing the MET-minutes per activity per week by 7. Together, the MET minutes per week or per day for the various activities and the number of days the various activities are undertaken were used to categorize the level of physical activities in each study participants are involved. The categorization follows the procedure described by IPAQ [19]. The figure below shows the criteria for categorization of the level of physical activities [19].

Food frequency data

A food frequency questionnaire was administered with the various types of meals, fruits and vegetables eaten, the quantities taken and the frequency with which they were eaten attached for participants to tick. The percentage frequency distribution of each meal was found and categorized on a monthly, weekly and daily basis.

High Physical Activity
• Vigorous-intensity activity on at least 3 days and accumulating at least 1500 MET-minutes/week **OR** • 7 or more days of any combination of walking, moderate-vigorous-intensity activities accumulating at least 3000 MET-minutes/week • ***(if the two conditions are not met)***
Moderate Physical Activities
• 3 or more days of vigorous-intensity activity of at least 20 minutes per day. **OR** • 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day activities accumulating at least 3000 MET-minutes/week. **OR** • 5 or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum of at least 600 MET-min/week • ***(if the three conditions are not met also)***
• **Low Physical Activity**

Figure 1:
Criteria for Categorization of the Level of Physical Activities

Data analysis

STATA version 16 was used to analyse the data set. Microsoft office 2016 was also used to design the bar charts and pie charts. Frequency and percentages were used to describe categorical variables and the mean and standard deviations were used to describe continuous variables. The minimum, 1st quartile, median, 3rd quartile, maximum and range was used to describe the MET-minutes per week among study participants. The Pearson's chi-square test was used to assess the association between demographic characteristics of study participants and overweight and level of physical activities.

Due to low frequencies and expected values in the cross-tabulation, Fischer's exact chi-square test was used to assess the association between overweight and the frequency of consumption of the various food items. Also, Fischer's exact chi-square test was used to assess the frequency of the consumption of the various food items that were associated with the level of physical activities. An association between overweight and physical activities was also assessed. The binary logistic regression model was used to assess the crude and adjusted odds associated with the level of physical activities on being overweight or obese among study participants after controlling for demographic characteristics. All statistical analysis was considered significant with p-values less than 0.05.

Due to low frequencies in underweight categories, underweight was added to normal weight whilst obese was added to overweight for subsequent analysis after descriptive analysis of the categories of BMI score.

Table 1
Demographic Characteristics and Body Mass Indices of Study Respondents

Characteristics	Frequency (N=129)	Percentage
Age		
20-24	81	62.79
25-29	44	34.11
30-34	4	3.10
Sex		
Male	70	54.26
Female	59	45.74
Religion		
Christianity	125	96.9
Muslim	2	1.55
Traditional	1	0.78
Others	1	0.78
Marital status		
Single	125	96.9
Currently married	4	3.10
Weight in kg *(Mean ± SD)*	68.32 ± 11.98	
Height in meters *(Mean ± SD)*	1.69 ± 0.11	
BMI score in kgm^{-2} *(Mean ± SD)*	23.94 ± 4.48	
Underweight	7	5.4
Normal weight	83	64.3
Overweight	29	22.5
Obese	10	7.8

*SD: standard deviation; BMI: Body Mass Index

Results

Demographics and BMI

A total of 129 participants were interviewed for the study. Most (62.8%, n=81) of the participants were in the age group 20 to 24 years and 54.3% (n=70) were males. The mean body mass index (BMI) score was 23.9 kgm^{-2} with a standard deviation of 4.5 kgm^{-2} (Table 1).

Also, 5.4% (n=7) were underweight, 64.3% (n=83) had normal weight, 22.5% (n=29) were overweight and 10 people (7.8%) were obese, giving a combined prevalence of overweight and obesity as 30.3% (n=39) (Fig. 1).

By gender, males and females compared as follows respectively: underweight 7.3% vs. 3.5%, normal weight 63.8% vs. 64.9%, overweight 23.2% vs. 21.1% and 5.8% vs. 10.5%.

Frequency of food consumption

Table 2 shows the percentage distribution of the frequency of each of the food items among the study participants. Consumption of 1 cup of whole milk was never or once a monthly among 30.2%, 1-3 times a month among 24.8%, once a week among 16.3%, 2-4 times a week among 17.8%, 5-6 times a week among 3.9% and once a day among 2.3% of the study participants. Eight (6.2%) of the participants consumed an egg once a month or never, 9.3% consumed an egg 1-3 times per month, 22.5% consumed an egg once a week, 44.2% consumed an egg 2-4 times a week, 10.9% consumed egg 5-6 times a week and 6.2% consumed an egg once every day (Table 2).

Food consumption

Figure 2 summarizes the frequency of consumption of the various foods on a monthly, weekly and daily basis. Daily consumption of food was highest with sugar (18%), rice (18%), vegetables cooked (12%), meals from a fast-food restaurant (10%), fresh or raw vegetables (9%), and ready to eat meals (7%) and eggs (7%). Weekly consumption was highest with eggs (78%), rice (70%), and fruits (69%). Monthly consumption was highest with salted fish (86%), organ meats (81%) and ice creamed or sweetened yoghurt (67%) and skimmed milk or low-fat milk (67%). Fig. 2 shows further descriptive of the monthly, weekly and daily basis of the consumption of the various food items.

Weekly physical activities

Figure 2 describes the number of days study participants undertake vigorous, moderate and walking activities within a week. More than half (55.8%) of the 129 study participants do not perform vigorous activities each week, 6.2% did vigorous activities one day a week whilst 11.6% did vigorous activities on all 7 days of the week. Nine (7.0%) of the study participants did not do moderate activities each week, 8.5% did moderate activities one day in a week whilst 40.3% were involved in moderate activities each day of the week. 7.0% of the respondents did not do walking activities each week, 3.9% did walking activities every 2 days in a week whilst 69.8% did walking activities each day of the week.

MET-Minutes per week

Table 3 presents the summary of the MET minutes per week for the study participants for the various activities and domains. For all activities within a week, the walking MET minutes per week had a minimum of 0, a median of 990 and a maximum of 20160, the moderate MET minutes per week had a minimum of 0, a median of 286.6, and a maximum of 9600, the vigorous MET-minutes per week had a minimum of 0, a median of 0 and a maximum of 2880. Overall, the MET minutes for all activities had a minimum of 0, a median of 1756 and a maximum of 21840.

Table 2

Frequency of Consumption of Foodstuffs among Study Respondents

		Frequency of consumption (n=129)							
Food item	**Units**	**never/ once a month**	**1-3 times/ month**	**once / week**	**2-4/ week**	**5-6 times/ week**	**once/ day**	**2-3 times/ day**	**>=4 times/ day**
		%	**%**	**%**	**%**	**%**	**%**	**%**	**%**
Whole milk [d]	1 cup	30.2	24.8	16.3	17.8	3.9	2.3	0.8	0.8
Skimmed milk/low-fat milk [d]	1 cup	45.0	21.7	10.1	17.1	1.6	0.8	0.8	0.0
Ice cream/ sweetened yogurt	½ cup	26.4	41.1	17.1	14.7	0.8	0.0	0.0	0.0
Eggs	1 egg	6.2	9.3	22.5	44.2	10.9	6.2	0.0	0.8
Chicken with skin [c]	90-120g	18.6	11.6	19.4	33.3	10.1	3.1	1.6	0.0
Chicken without skin [c]	90-120g	24.0	16.3	20.2	26.4	7.8	2.3	0.8	0.0
Red meat with fat [c]	90-120g	38.0	26.4	15.5	14.0	2.3	1.6	0.0	0.0
Red without fat [b]	90-120g	37.2	28.7	16.3	14.0	1.6	0.8	0.0	0.0
Organ meat e.g. Intestine, liver	90-120g	58.9	21.7	9.3	7.0	2.3	0.8	0.0	0.0
Fish cooked [d]	Fillet(100g)	20.9	24.8	24.0	20.9	4.7	0.8	0.0	0.8
Fish fried [b]	Fillet(100g)	15.5	20.9	28.7	22.5	8.5	2.3	0.0	0.0
Fish salted [a]	20g	59.7	26.4	7.0	4.7	0.0	1.6	0.0	0.0
Legumes [b]	120g	14.7	29.5	25.6	23.3	4.7	0.0	0.8	0.0
Bread white [a]	1 slice	13.2	20.2	26.4	24.0	10.1	4.7	0.0	0.8
Bread (Whole wheat/multigrain) [d]	1 slice	20.9	23.3	19.4	27.1	3.1	1.6	0.0	0.0
Fruits [a]	1 medium	8.5	15.5	27.1	33.3	8.5	5.4	0.8	0.0
Vegetables fresh/raw [c]		7.8	13.2	21.7	33.3	13.2	5.4	2.3	0.8
Vegetables cooked [d]	½ cup	9.3	9.3	17.8	36.4	11.6	7.0	3.1	2.3
Vegetables fried [d]	½ cup	36.4	19.4	14.7	17.8	4.7	1.6	0.0	0.8
Vegetables stir-fried [c]	½ cup	34.1	20.2	17.8	18.6	3.9	2.3	0.0	0.8
Fried foods e.g. Potatoes, yam, plantain	½ cup	21.7	16.3	31.0	24.0	7.0	0.0	0.0	0.0
Soft drink regular [a]	1 cup	17.8	18.6	19.4	27.1	10.1	6.2	0.0	0.0
Rice [a]	1glass/can	5.4	6.2	11.6	31.0	27.1	11.6	3.9	2.3
Maize [b]	1 cup	29.5	27.1	17.8	17.8	4.7	1.6	0.0	0.0
Root tuber [a]	1 cup	21.7	24.0	24.8	24.0	3.1	1.6	0.0	0.0
Confectionary, sugary baked goods, sweet breakfast cereals	1 cup	23.3	24.8	24.8	19.4	5.4	2.3	0.0	0.0
Meals from a fast food restaurant		14.0	31.8	19.4	17.8	7.0	7.8	2.3	0.0
Meals from non-fast food restaurants [b]		27.1	20.2	21.7	20.9	3.9	3.9	0.0	0.0
Ready to eat meals		22.5	30.2	14.7	22.5	3.1	6.2	0.8	0.0
Sugar [d]	1 tsp.	22.5	14.7	19.4	10.1	12.4	14.7	2.3	0.8

*** %: Row percentages**

a: 1 non-response. b: 2 non-response. c: 3 non-response. d: 4-6 non-response

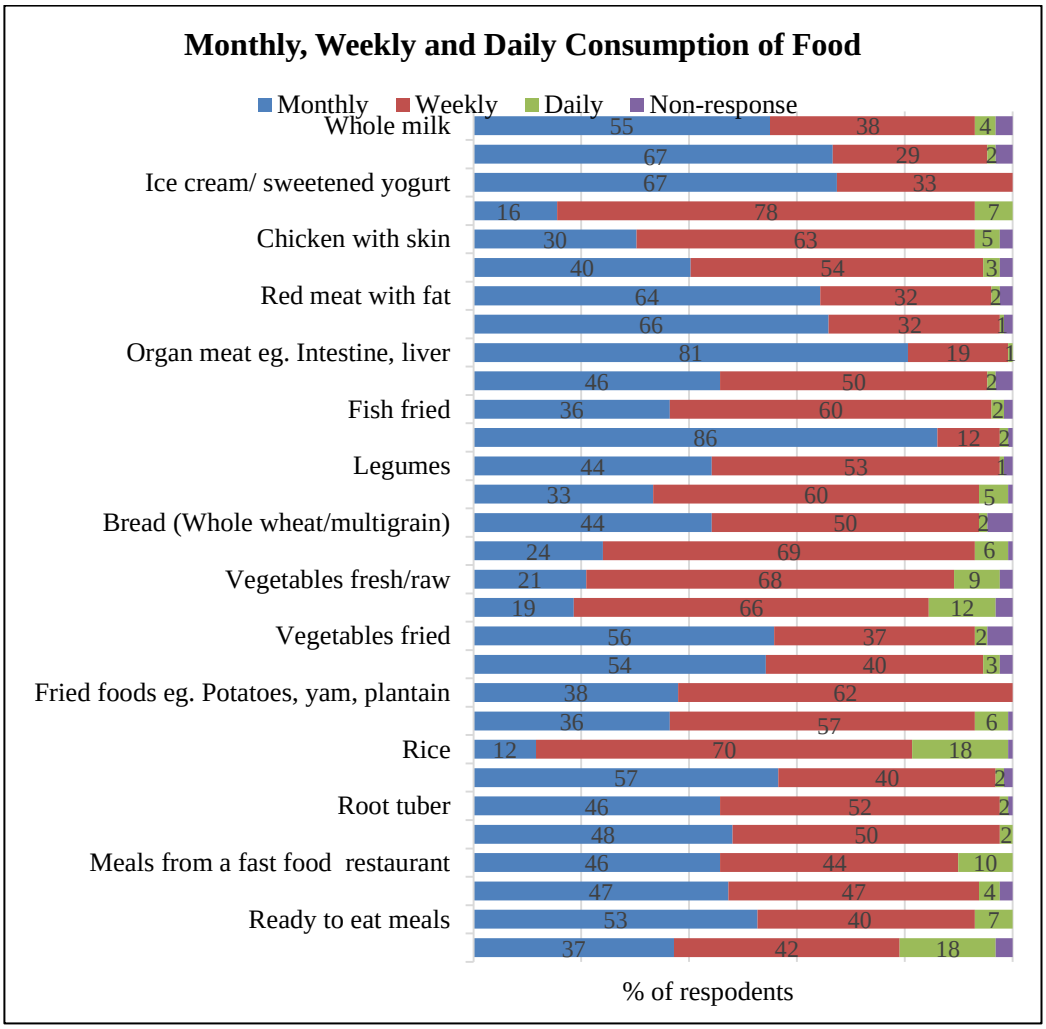

Figure 1
Monthly, Weekly and Daily Basis of Consumption of Various food Items

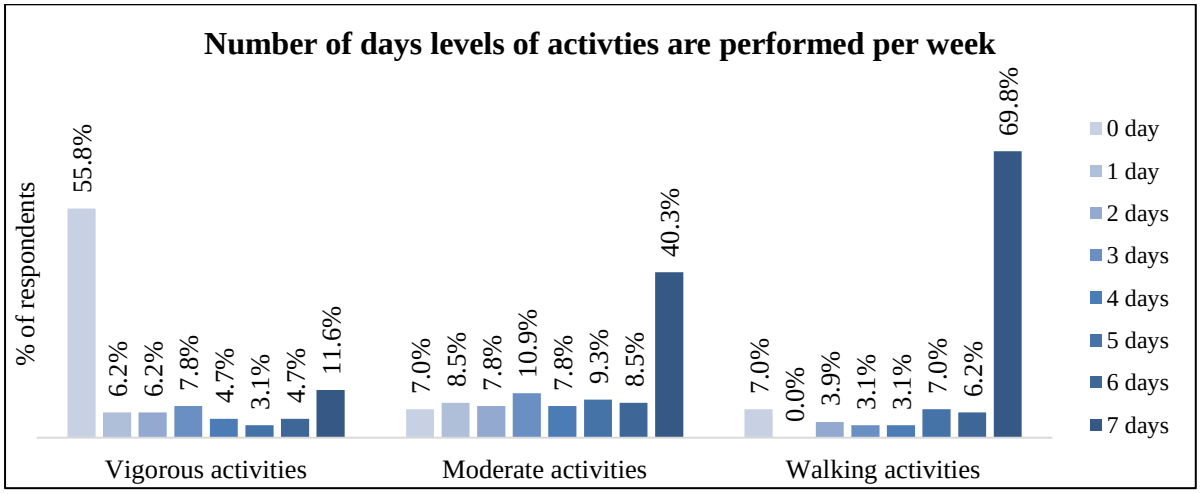

Figure 2
Weekly Vigorous, Moderate and Walking Activities among Study Participants

Level of Physical activity

The level of physical activities for each study participant was computed using the number of days and Met-minutes per week for the three domains of activities (Walking, Moderate and Vigorous activities). Of the 129 study participants, 16.3% were involved in a low level of physical activities, 43.4% were involved in a moderate level of physical activities and 40.3% were involved in a high level of physical activities.

Association between demographic characteristics and overweight

The Pearson's chi-square test was used to assess the association between overweight and demographic characteristics. None of the demographic characteristics of the respondents was associated with overweight (p-value>0.05), Table 4.

Association between Overweight and food consumption frequency

Table 5 shows the association between weight and the frequency of consumption of the various food items based on a monthly, weekly and daily basis. From table 5, ready to eat meals (χ^2=7.86, p=0.020) and sugar (χ^2=8.46, p=0.015) were the only food items significantly associated with overweight/obesity.

Prevalence of overweight/obese was 42.6% (21/61) among those who consume ready to eat meals on monthly basis, 19.2% (10/52) for those who consume ready to eat meals on weekly basis and 22.2% (2/9) for those who consume ready to eat meals on daily basis. Prevalence of overweight/obesity was 45.8% (22/48) among those who consumed sugar monthly and 27.8% (15/54) among those who consume sugar weekly and 13.0% (3/23) consume sugar daily (Table 5).

Table 3
Summaries of MET-Minutes Per Week among Study Participants

	MET-minutes per Week					
Variable	**Minimum**	**1st Quartile**	**Median**	**3rd Quartile**	**Maximum**	**Range**
Work activities						
Walking	0	0	0	0	4158	4158
Moderate	0	0	0	0	1440	1440
Vigorous	0	0	0	0	2880	2880
Overall work	0	0	0	0	6696	6696
Transport domain						
Cycling	0	0	0	0	66	66
Walking as transport	0	60	840	1680	20160	20160
Overall transport	0	60	840	1680	20160	20160
Domestic and Garden activities						
Vigorous gardening	0	0	0	0	1320	1320
Moderate home	0	0	0	280	6720	6720
Moderate gardening	0	0	60	270	2520	2520
Overall domestic & gardening	0	0	240	700	6810	6810
Leisure time						
Walking	0	0	0	247.5	1980	1980
Moderate	0	0	0	0	5040	5040
Vigorous	0	0	0	160	2880	2880
Overall Leisure	0	0	153	612	9108	9108
All activities						
Walking	0	346.5	990	2547	20160	20160
Moderate	0	0	286.6	840	9600	9600
Vigorous	0	0	0	600	2880	2880
Total	0	766.5	1756	5220	21840	21840

Association of the level of physical activity and demographic characteristics

None of the demographic characteristics showed significant association with the level of physical activities among the study participants (p>0.05). Physical activity was high among 34.6% (28/81) of those in the age group 20 to 24 years, 47.7% (21/44) among those aged 25 to 29 years and 75% (3/4) among those aged 30 to 34 years.

Association of the level of physical activity and food consumption frequency

Frequencies of consumption of fried fish (p=0.001) and whole wheat or multigrain bread (p=0.019) were significantly associated with the level of physical activities from the Fischer's exact chi-square test (Supplementary A).

Physical activity was high among 21.3% (10/47) of those who consumed fried fish on monthly basis, 53.3% (41/77) of those who consumed fried fish on the weekly basis and 0% (0/3) among those who consumed fried fish on the daily basis. Also, physical activity was high (38.6%, 22/57) among those who consumed whole wheat or multigrain bread on the monthly basis; it was 43.8% (28/64) among those who consumed them on weekly basis and 50.0% (1/2) of those who consumed them on the daily basis (Supplementary File A).

Association of Overweight/Obesity and level of physical activity

Prevalence of overweight or obesity was 47.6% among those involved in a low level of physical activities, 25.0% among those involved in moderate activities and 32.7% among those involved in a high level of physical activities. There was no significant association between overweight and level of physical activities from the Pearson's chi-square test (p-value>0.05) (Supplementary File B).

Table 4
Association between Demographic Characteristics and Overweight

Characteristics		**Normal/ Underweight**	**Overweight/ Obese**		
	N	**n (%)**	**n (%)**	**χ^2-value**	**P-value**
Total	129	88 (68.2)	41 (31.8)		
Age group				5.68	0.058
20-24	81	60 (74.1)	21 (25.9)		
25-29	44	27 (61.4)	17 (38.6)		
30-34	4	1 (25.0)	3 (75.0)		
Sex				0.22	0.636
Male	70	49 (70.0)	21 (30.0)		
Female	59	39 (66.1)	20 (33.9)		
Religion				0.09	0.767
Christian	125	85 (68.0)	40 (32.0)		
Non-Christian	4	3 (75.0)	1 (25.0)		
Marital status				3.56	0.059
Single	125	87 (69.6)	38 (30.4)		
Married	4	1 (25.0)	3 (75.0)		

Logistic regression model of factors associated with Weight

Table 6 shows a binary logistic regression model of factors associated with overweight or obesity among study participants. All the demographic characteristics were introduced in the model irrespective of the significant level from the Pearson's chi-square test. None of the food consumption frequencies was introduced because they were not significant from the Pearson's chi-squared test.

Table 5:
Association between Overweight and Food Consumption Frequency

	Food Consumption Frequency						
	Monthly basis		**Weekly basis**		**Daily basis**		**Fischer's exact p-value**
		Overweight		**Overweight**		**Overweight**	
Food item		**n n (%)**	**n**	**n (%)**	**n**	**n (%)**	
Whole milk [d]	71	21(29.6)	49	14(28.6)	5	3(60.0)	0.402
Skimmed milk/low-fat milk [d]	86	27(31.4)	37	10(27.0)	2	1(50.0)	0.633
Ice cream/ sweetened yoghurt	87	29(33.3)	42	12(28.6)	0	-	[#] 0.586
Eggs	20	6(30.0)	100	33(33.0)	9	2(22.2)	[#] 0.788
Chicken with skin [c]	39	13(33.3)	81	27(33.3)	6	1(16.7)	0.844
Chicken without skin [c]	52	17(32.7)	70	24(34.3)	4	0(0.0)	0.499
Red meat with fat [c]	83	26(31.3)	41	14(34.1)	2	1(50.0)	0.786
Red without fat [b]	85	26(30.6)	41	13(31.7)	1	1(100.0)	0.419
Organ meat e.g., Intestine, liver	104	35(33.7)	24	5(20.8)	1	1(100.0)	0.167
Fish cooked [d]	59	17(28.8)	64	20(31.3)	2	1(50.0)	0.721
Fish fried [b]	47	15(31.9)	77	24(31.2)	3	1(33.3)	1.000
Fish salted [a]	111	37(33.3)	15	3(20.0)	2	1(50.0)	0.446
Legumes [b]	57	21(36.8)	69	20(29.0)	1	0(0.0)	0.624
Bread white [a]	43	12(27.9)	78	27(34.6)	7	1(14.3)	0.501
Bread (Whole wheat/multigrain) [d]	57	18(31.6)	64	21(32.8)	2	2(100.0)	0.183
Fruits [a]	31	10(32.3)	89	30(33.7)	8	1(12.5)	[#] 0.468
Vegetables fresh/raw [c]	27	7(25.9)	88	32(36.4)	11	2(18.2)	[#] 0.340
Vegetables cooked [d]	24	5(20.8)	85	31(36.5)	16	3(18.8)	[#] 0.178
Vegetables fried [d]	72	25(34.7)	48	15(31.3)	3	0(0.0)	0.650
Vegetables stir-fried [c]	70	27(38.6)	52	13(25.0)	4	0(0.0)	0.113
Fried foods e.g., Potatoes, yam, plantain	49	14(28.6)	80	27(33.8)	0	-	[#] 0.540
Soft drink regular [a]	47	20(42.6)	73	20(27.4)	8	1(12.5)	[#] 0.105
Rice [a]	15	3(20.0)	90	31(34.4)	23	7(30.4)	[#] 0.531
Maize [b]	73	25(34.2)	52	16(30.8)	2	0(0.0)	0.732
Root tuber [a]	59	22(37.3)	67	18(26.9)	2	0(0.0)	0.322
Confectionary, sugary baked goods, sweet breakfast cereals	62	21(33.9)	64	19(29.7)	3	1(33.3)	0.867
Meals from a fast-food restaurant	59	20(33.9)	57	15(26.3)	13	6(46.2)	[#] 0.342
Meals from non-fast food restaurants [b]	61	21(34.4)	60	18(30.0)	5	1(20.0)	0.796
Ready to eat meals	68	29(42.6)	52	10(19.2)	9	2(22.2)	[#] **0.020**
Sugar [d]	48	22(45.8)	54	15(27.8)	23	3(13.0)	[#] **0.015**

* %: row percentages. #: p-value from the Pearson's chi-square test
a: 1 non-response. b: 2 non-responses. c: 3 non-responses. d: 4-6 non-response

The physical activity model was introduced because it was the primary independent variable of the study (Table 6).

From the adjusted models, the odds of being overweight or obese were 72% significantly lower for those with moderate physical activity levels compared to those with low physical activities (AOR: 0.28, 95% CI: 0.09-0.93, p=0.037). Relative to those who consume ready to eat meals on the daily basis, the adjusted odds of overweight or obesity were 2-folds higher among those who consume ready to eat meals on the monthly basis (AOR: 2.80, 95% CI: 1.09-7.18, p=0.033). Also, relative to those who consume, sugar on the daily basis, the adjusted odds of overweight or obesity were 5 times high among those who consume sugar on the monthly basis (AOR: 5.06, 95% CI: 1.18-21.75, p=0.029) (Table 5).

Discussion

This study was necessary due to the increasing prevalence of obesity and its associated complications and the pressing need to curb it [2, 21]. This present study found that there was quite a high prevalence of overweight/obesity (30.3%) among final year medical students with 22.5% being overweight and 7.8% obese.

Table 6
Logistic Regression Model of Factors Associated with Overweight among Study Participants

	Overweight/Obese			
	Unadjusted logistic regression model		**Adjusted logistic regression model**	
Variables	**UOR [95% CI]**	**P-value**	**AOR [95% CI]**	**P-value**
Age				
20-24	1.00 [reference]		1.00 [reference]	
25-29	1.80 [0.82 - 3.94]	0.142	2.40 [0.92 - 6.22]	0.072
30-34	8.57 [0.84 - 86.97]	0.069	3.09 [0.21 - 45.20]	0.410
Sex				
Male	1.00 [reference]		1.00 [reference]	
Female	1.20 [0.57 - 2.52]	0.636	0.76 [0.30 - 1.90]	0.553
Religion				
Christian	1.00 [reference]		1.00 [reference]	
Non-Christian	0.71 [0.07 - 7.02]	0.768	0.23 [0.02 - 3.56]	0.295
Marital status				
Single	1.00 [reference]		1.00 [reference]	
Currently married	6.87 [0.69 - 68.17]	0.100	6.09 [0.29 - 130.01]	0.248
Physical activities				
Low	1.00 [reference]		1.00 [reference]	
Moderate	0.37 [0.13 - 1.05]	0.061	**0.28 [0.09 - 0.93]**	**0.037**
High	0.53 [0.19 - 1.50]	0.235	0.34 [0.10 - 1.14]	0.081
Ready to eat meals				
Monthly	**3.12 [1.35 - 7.24]**	**0.008**	**2.80 [1.09 - 7.18]**	**0.033**
Weekly	1.20 [0.22 - 6.68]	0.835	0.97 [0.13 - 7.28]	0.977
Daily basis	1.00 [reference]		1.00 [reference]	
Sugar				
Monthly	**5.64 [1.48 - 21.54]**	**0.011**	**5.06 [1.18 - 21.75]**	**0.029**
Weekly	2.56 [0.66 - 9.91]	0.172	2.70 [0.61 - 11.94]	0.190
Daily basis	1.00 [reference]		1.00 [reference]	

UOR: unadjusted odds ratio. AOR: adjusted odds ratio. CI: confidence interval.

The prevalence of overweight in our study population was similar to a study conducted among college students in the United States which found 21.6% of students to be overweight [22]. This differed significantly from studies conducted in Lahore, where 21% of medical students were overweight or obese [23]. The majority of the study students in our study fall within the adult age group of 20 to 24, this made the BMI the best tool for overweight and obesity estimation [20].

Prevalence of overweight did not differ significantly with gender although more males (23.19%) were overweight than females (21.05%). However, more females (10.53%) were obese than males (5.80%). This is dissimilar to a study carried out on Sudanese medical students where males (9.4%) were predominantly obese than females (3.8%) [24]. This may be due to the likelihood of the males eating large food portions than their female counterparts. Marital status was not associated with overweight/obesity in our study. However, a study found out that marriage was associated with overweight/obesity in women (p-value=0.04) whilst divorce was associated with weight loss [25].

In this present study, there was an association between overweight and obesity and consumption of ready to eat meals and sugar. However, it is not clear why infrequent consumption of these foods (monthly) has increased the odds of being obese/overweight compared with those who consume them more frequently (daily). We speculate that these persons may be consuming other more energy-dense foods or eating large portions of food thereby increasing their risk of being overweight/obese [16]. Hamam *et al.* [26] also found that there was no significant relationship between intake of high caloric diets and obesity and overweight even though theoretically there is a link between the two. There was also no significant association between BMI and frequency of food consumption according to a study by Khan *et al* [23] in India. The finding from this study varies from a study conducted on college students from 22 countries that found an unexpected association between obesity and increased fibre intake and a low cholesterol diet [27]. This was attributed to false reporting or the individuals taking measures to reduce their weight [27]. One study found a significant association between overweight/obesity in tertiary students and insufficient intake of fruits and vegetables and fibre; 69.4% took less than the recommended daily intake of fruit and vegetables and 67.1% also took less than the recommended daily intake of fibre [22]. This may be due to a shift in dietary habits as a result of being in college. Most students obtain food from food vendors on and around campus, which may be unhealthy, and of high-energy dense type.

The results show that a high proportion of participants who were overweight/obese (47.6%) engaged in minimal physical activity suggesting the need for greater attention to diet and exercise interventions to prevent their progression to obesity. Physical activity is protective against weight gain and overweight. This is comparable to another study in Lahore, where 80.7% of medical students played no sports and only 11.7% were registered in a gym, indicating low physical activity levels [23]. This can be attributed to the demanding nature of the course and the long study periods hence the probability of a sedentary lifestyle. However, a study among Sudanese medical students showed an insignificant association between obesity and physical activity levels [24].

The daily recommended physical activity is a minimum of 30 minutes of physical activity 5 days per week [28] and a majority of our respondents met this criterion which may explain why a greater percentage (64.3%) had normal BMI. Our study showed a significant association between overweight and level of physical activities with the odds of being overweight/obese being 75% lower if

one had moderate physical activity levels (p-value=0.037) compared to those with low physical activity levels. A study carried out at the University of Development Studies, Tamale, Ghana, had distinct results where vigorous physical activity level was associated with less risk of overweight/obesity (p-value=0.004) [29]. Interestingly, the study among medical students in Lahore determined predictors of obesity as studying in a private medical college, high caloric intake and higher training year [23]. Those training in a private medical college were from high socioeconomic status and the increased risk of being overweight during higher training years was attributed to more stress and longer study hours [23].

Limitations

The questionnaire was long and may have caused participant bias. It assessed 3 variables; BMI, dietary habits and physical activity level. Only one University was used for the research which could have narrowed the results and affected the generalizability of the results.

The research assessed only two associated factors of obesity (diet and physical activity). Obesity is multifactorial and hence, there may be other factors that were not explored in this study.

Being a cross-sectional study, findings are only associations and do not infer causality.

Future directions

Future studies must explore other factors that influence obesity such as income, sources of prepared food (self-prepared or from vendors), medications, co-morbidities and other factors.

Longitudinal studies can be carried out to find the relationship between physical activity levels, good dietary habits and obesity.

Conclusion

Overweight and obesity were substantial (about 30%) among final year medical students in Accra with increased odds relating to low physical activity levels and consumption of ready to eat meals and sugar on monthly basis.

Vigorous awareness creation on the need for a healthy lifestyle especially increasing physical activity among medical students is urgently needed.

List of Abbreviations

AOR: Adjusted odds ratio
BMI: Body mass index
CI: Confidence Interval
IPAQ: International Physical Activity Questionnaire
MET: Metabolic equivalent minutes
UOR: Unadjusted odds ratio
WHO: World Health Organisation

Ethical approval considerations

The study was approved by the Proposal Review Committee of the Community Health Department of the University of Ghana Medical School before commencement. All participants provided written informed consent and the study complied with the Helsinki Declaration of 1964 (Revised 2013) on human experimentation. The respondents were made to understand that they had a right to participate or withdraw anytime from the study. The questionnaires were completed anonymously and information gathered was kept secure and was available only to the principal investigator.

Availability of data and materials

All data generated or analysed during this study are included in this published article and its supplementary information files

Competing Interests

There is no competing interest involving any of the authors of this manuscript.

Author contributions

AA, EY and VB conceived the study, participated in its design, data collection, and analysis, and drafted the manuscript and collation of all drafts. All authors read and approved the final version of the manuscript.

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