

# Factors associated with central overweight and obesity in students attending the University for Development Studies in Tamale, Ghana: a cross-sectional study

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## Abstract

**Objectives:** This study assessed the prevalence of central overweight and obesity in students of the University for Development Studies in Tamale, Ghana. Lifestyle factors associated with central overweight and obesity were also investigated in this study population.

**Design:** A cross-sectional study design was employed.

**Setting:** School of Medicine and Health Sciences, University for Development Studies, Tamale, Ghana.

**Subjects:** A sample of 552 students was randomly selected to participate.

**Method:** Waist and hip circumference was measured with appropriate tools and computed into a waist-to-hip ratio (WHR). Demographic and socio-cultural factors, such as age, sex, smoking status and coffee and alcohol consumption, were recorded. Physical activity was assessed using the World Health Organization Global Physical Activity Questionnaire.

**Results:** Generally, 29.3% of the participants had a normal WHR (44.1% males, 3.0% females). 60.9% (55.9% males, 69.7% females) were centrally overweight and 9.8% (0.0% males, 27.3% females) centrally obese. Age and smoking status were not associated with central overweight and obesity. Being female was significantly associated with a higher prevalence of central obesity. The prevalence of central obesity was 13.9% in non-coffee drinkers, 6.7% in coffee drinkers, 11% in non-alcohol drinkers and 0% in alcohol drinkers. Almost 95% of centrally obese participants engaged in light or moderate physical activity, and 5.6% in vigorous physical activity ( $p$ -value  $< 0.0001$ ). Conversely, 55% of normal weight participants engaged in light or moderate physical activity and 44% in vigorous physical activity ( $p$ -value 0.0008).

**Conclusion:** Physical activity, female gender, alcohol and coffee consumption were associated with central obesity.

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## Introduction

Currently, overweight and obesity have been recognised as conditions affecting people in both developed and developing countries.<sup>1-3</sup> In the USA, recent studies have indicated that overweight and obesity prevalence is increasing astronomically, and it has been suggested that 86.3% of adults will be overweight or obese by the year 2030.<sup>4-6</sup> Ghana and other sub-Saharan African countries are no exception in that overweight and obesity are becoming more prevalent.<sup>7-11</sup>

Obesity, and central obesity in particular, have been shown to be a strong risk factor for chronic diseases, such as cardiovascular diseases, type-2 diabetes, some types of cancer and several other metabolic or health problems.<sup>12-15</sup> Moreover, physical inactivity, smoking and alcohol consumption are modifiable lifestyle factors that may also increase the development of obesity and the aforementioned chronic diseases.<sup>8,16,17</sup>

Several studies have recognised childhood obesity as a possible cause of adult obesity.<sup>18-20</sup> Recent studies have shown the presence of overweight and obesity in children in Ghana.<sup>21,22</sup> However, less is known about the prevalence of obesity in young adults, and especially in university students in Ghana. The few studies that have been conducted on this age group used body mass index (BMI), and none used waist-to-hip ratio (WHR) to measure obesity. Assessing the prevalence of central obesity and its association with some lifestyle factors in university students would clarify the situation in young adults in Ghana. It would also serve as the basis upon which health educators could develop nutrition-related education programmes for the adoption of healthy lifestyles by young adults.

The purpose of this study was to assess the prevalence of central overweight and obesity, measured by WHR, in university students in a Ghanaian university. The study also investigated modifiable

lifestyle factors (physical activity, smoking status, alcohol and coffee consumption) associated with central overweight and obesity in this group of students.

## Method

### Participants

This cross-sectional study was conducted in 552 students aged 20–34 years, studying various health-related academic programmes in the School of Medicine and Health Sciences of the University for Development Studies, Tamale, Ghana. The school currently runs five academic programmes and has a student population of 1 809. Students from the five academic programmes were eligible to participate in the study. Participants who were pregnant or had recently undergone childbirth were excluded from the study. Participants were selected using a proportionate random sample which included those from larger academic programmes through the use of a random-number statistical table. Demographic and sociocultural variables, such as age, smoking status, alcohol and coffee intake, were recorded. Participation in the study was voluntary, and informed consent was obtained from each participant. The Ethics Committee of the University for Development Studies, School of Medicine and Health Sciences, Ghana, approved the study.

### Anthropometric variables

Anthropometric variables of waist and hip circumference were measured. Waist circumference was measured midway between the inferior angle of the ribs and the suprailiac crest.<sup>23</sup> Hip circumference was measured as the maximal circumference over the buttocks in centimetres. Both measurements were measured to the nearest 1 cm, using a nonstretchable fibre-glass measuring tape. During both measurements, participants stood in an upright position, with their arms relaxed at the side, feet evenly spread apart, and their body weight evenly distributed in accordance with the World Health Organization expert consultation report on waist circumference and WHR.<sup>23</sup> WHR was calculated by dividing the waist circumference (cm) by the hip circumference (cm). Men with WHR < 0.90, 0.90–0.99 and  $\geq 1$  were classified as normal, centrally overweight and centrally obese, respectively, while women were classified in the same categories on the basis of WHR of < 0.80, 0.80 – 0.84 and  $\geq 0.85$ .<sup>23</sup>

### Physical activity level

The Global Physical Activity Questionnaire was used to measure the level of physical activity of the participants.<sup>24</sup> It consists of 16 questions on physical activity level in a typical week. The frequency and duration of time spent carrying out the physical activity were measured in three domains: activity at work, travel to and from places, and recreational activities.

The Global Physical Activity Questionnaire was used because it is standardised, easy to administer, and is relatively unobtrusive and inexpensive. Its reliability and validity has been found to be 0.67–0.81 and 0.54, respectively.<sup>25</sup> Without modifications, the questionnaire was fully adapted for the study. However, to suit the Ghanaian

context, local examples of types and intensity of activities were used. The Global Physical Activity Questionnaire analysis protocol for the collection of data and processing was followed.<sup>24</sup> Activity duration was converted into minutes. Energy expenditure, measured in metabolic equivalents (MET), was estimated using the duration, intensity and frequency of physical activities performed within seven days. MET is the ratio of specific physical activity metabolic rates to the resting metabolic rate (1 MET is the energy cost of sitting quietly, and equivalent to a caloric consumption of 1 kcal/kg/hour). A MET minute showed the total activity volume on a weekly basis, and was calculated by multiplying the time spent on each activity during a week by the MET values of each level of activity. Using the compendium of physical activities,<sup>26</sup> MET values for the various levels of activities were established. MET values of 4 and 8 were set for moderate-intensity (transport-related walking or cycling) and vigorous-intensity physical activity, respectively. Total MET/minutes/week were computed by the sum of all moderate- to vigorous-intensity physical activities performed at work, when travelling and for recreation. The physical activity of the subjects was classified as being of light, moderate or vigorous intensity, as defined by the Global Physical Activity Questionnaire analysis framework, based on the total MET/minutes/week.<sup>24</sup>

### Vigorous

Vigorous activity was classified as one of either of the following categories:

- Vigorous-intensity activity on at least three days achieving at least 1 500 MET minutes/weeks, or
- Seven or more days of any combination of walking, moderate- or vigorous-intensity activities, achieving at least 3 000 MET minutes/week.

### Moderate

Moderate activity was classified as not achieving the criteria for the high category, but fulfilling any of the following three criteria:

- Three or more days of vigorous-intensity activity, of at least 20 minutes/day, or
- Five or more days of moderate-intensity activity and/or walking for at least 30 minutes/day, or
- Five or more days of any combination of walking, moderate- or vigorous-intensity activities, accumulating at least 600 MET minutes/week.

### Light

Light activity was classified as reported activity that was lower than that in the outlined categories, or no activity at all.

### Statistical analysis

The results were expressed as a proportion and compared using Fisher's exact test or the chi-square test for trend analysis, as appropriate. A level of p-value < 0.05 was considered to be statistically significant. GraphPad Prism® version 5 for Windows® was used for the statistical analysis.

**Results**

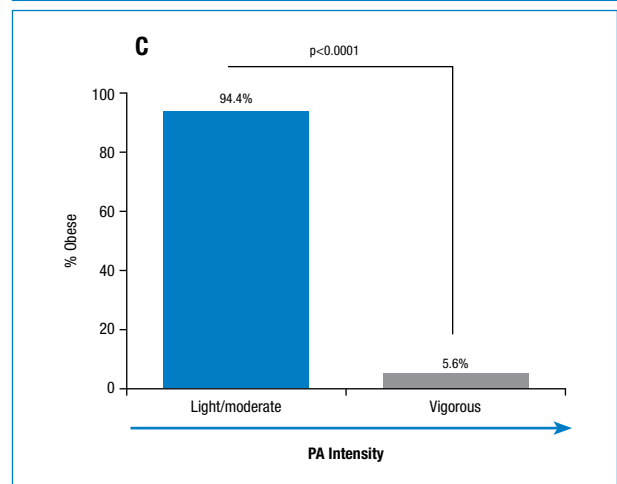
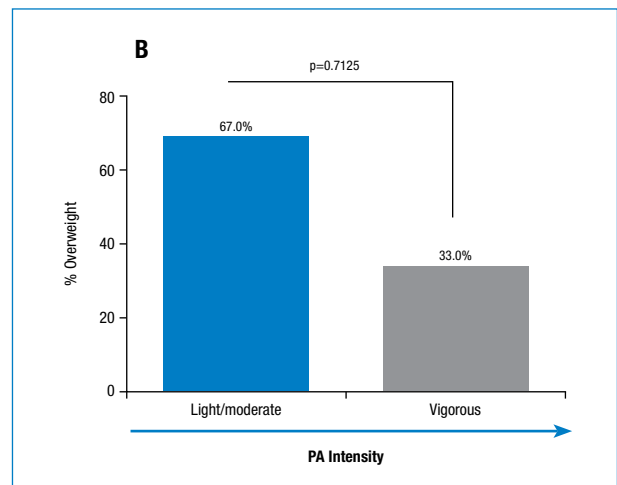
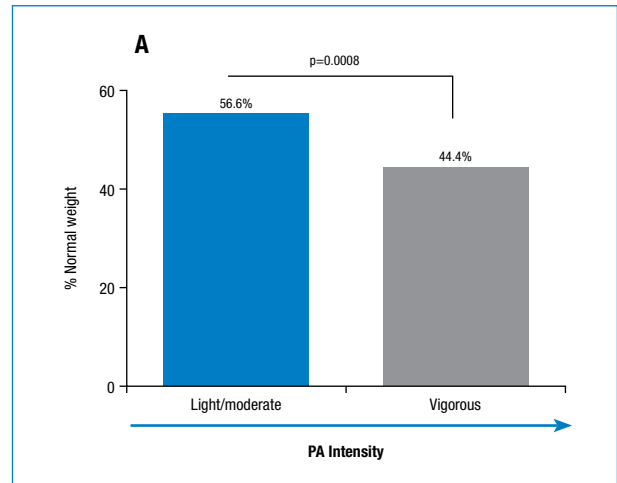
The general characteristics of the study population stratified by gender are presented in Table I. In general, almost 80% of the participants were aged 20-24 years, 16.3% 25-29 years, and 3.8% 30-34 years. Whereas a higher proportion of females than males were aged 20-24 (92.4% vs. 72.9%, p-value < 0.0001), a higher proportion of males than females were aged 25-29 years (23.7% vs. 3%, p-value < 0.0001). With regard to smoking, 98.9% of the participants were non-smokers. Thirteen per cent of the participants drank alcohol and 57.1% coffee. It is of significance that 16.1% of males drank alcohol, compared to 7.6% of females (p-value 0.0038).

**Table I:** General characteristics of the study population, stratified by gender

Variable	Total, n (%) (n = 552)	Male, n (%) (n = 354)	Female, n (%) (n = 198)	p-value
<b>Age</b>				
20-24	441 (79.9)	258 (72.9)	183 (92.4)	< 0.0001
25-29	90 (16.3)	84 (23.7)	6 (3)	< 0.0001
30-34	21 (3.8)	12 (3.4)	9 (4.5)	0.4950
<b>Do you smoke cigarettes?</b>				
Yes	6 (1.7)	6 (1.7)	0 (0)	0.0928
No	546 (98.9)	348 (98.3)	198 (100)	
<b>Do you drink alcohol?</b>				
Yes	72 (13)	57 (16.1)	15 (7.6)	0.0038
No	480 (87)	297 (83.9)	183 (92.4)	
<b>Do you drink coffee?</b>				
Yes	315 (57.1)	207 (58.5)	108 (54.5)	0.3719
No	237 (42.9)	147 (41.5)	90 (45.5)	
<b>Physical activity status</b>				
Light	63 (11.4)	27 (7.6)	36 (18.2)	0.0003
Moderate	303 (54.9)	159 (44.9)	144 (72.7)	< 0.0001
Vigorous	186 (33.7)	168 (47.5)	18 (9.1)	< 0.0001
<b>Waist-to-hip ratio status</b>				
Normal	162 (29.3)	156 (44.1)	6 (3)	< 0.0001
Centrally overweight	336 (60.9)	198 (55.9)	138 (69.7)	0.0015
Centrally obese	54 (9.8)	0 (0)	54 (27.3)	< 0.0001

Data are presented as a proportion and were compared using Fisher's exact test

11.4%, 54.9% and 33.7% of participants were involved in light, moderate and vigorous physical activity. More males (n = 168, 159) than females (n = 18, 144) underwent vigorous and moderate physical activity, respectively, and more females (n = 36) than males (n = 27) took part in light physical activity. The differences were significant (p-value < 0.0001) when physical activity intensity was stratified by gender, using Fisher's exact test.



PA: physical activity  
Data were analysed using the chi-square test for trend analysis

**Figure 1:** The association between the physical activity levels and normal weight (A), central overweight (B) and central obesity (C)

Central obesity was found in 9.8%, and overweight in 60.9% of participants. The prevalence of central overweight and obesity was significantly higher in the female participants (69.7% and 27.3%, respectively) than in the male participants (55.9% and 0%, respectively).

**Table II:** General characteristics of the study population stratified according to waist-to-hip ratio status

Variable	Total, n (%) (n = 552)	Normal,** n (%) (n = 162)	Central overweight,** n (%) (n = 336)	Central obesity,** n (%) (n = 54)
<b>Age</b>				
20-24	441 (79.9)	129 (29.3)	264 (59.9)	48 (10.8)
25-29	90 (16.3)	30 (33.3)	57 (63.3)	3 (3.3)
30-34	21 (3.8)	3 (14.3)	15 (71.4)	3 (14.3)
p-value		0.6142	0.2534	0.2445
<b>Do you smoke?</b>				
Yes	6 (1.1)	0 (0)	6 (100)	0 (0)
No	546 (98.9)	162 (29.7)	330 (60.4)	54 (9.9)
p-value		0.1873	0.0863	1.0000
<b>Do you drink alcohol?</b>				
Yes	72 (13)	24 (33.3)	48 (66.7)	0 (0)
No	480 (87)	138 (28.8)	288 (60)	54 (11.3)
p-value		0.4877	0.3025	0.0005
<b>Do you drink coffee?</b>				
Yes	315 (57.1)	99 (31.4)	195 (61.9)	21 (6.7)
No	237 (42.9)	63 (26.6)	141 (59.5)	33 (13.9)
p-value		0.2213	0.5974	0.0057

\*: Column proportions

\*\*: Row proportions. Data are presented as a proportion and compared using the chi-square test (for trend analysis) and Fisher's exact test

The general characteristics of the study population were stratified by WHR status and are presented in Table II. Of the participants aged 30-34 years, 14.3% were of normal weight, 71.4% were overweight and 14.3% obese. The prevalence of central overweight and obesity increased proportionally with an increase in age. However, the differences were not significant when WHR status was stratified by age using the chi-square test for trend analysis.

More than 60% of non-smokers were centrally overweight, compared to 100% of smokers, although this was not statistically significant (p-value 0.0863). Slightly more than 11% non-alcohol drinkers were obese, compared to 0% of alcohol drinkers (p-value 0.0005). Between 60% and 67% of both alcohol and non-alcohol drinkers were overweight. Interestingly, 13.9% of non-coffee drinkers, compared to 6.7% of coffee drinkers, were obese. The differences were significant (p-value 0.0057) using Fisher's exact test.

The association between physical activity and WHR status is presented in Figure 1. One hundred and sixty-two participants were within the normal range of weight. Of these, 55.6% engaged in either light or moderate physical activity, and 44.4% in vigorous physical activity. In this regard, the prevalence of normal weight participants decreased with an increase in physical activity intensity. On the other hand, 336 participants were centrally overweight, of whom

67% engaged in either light or moderate physical activity, while 33% took part in vigorous physical activity. There were no significant percentage differences in terms of physical activity in this group (p-value 0.7125). Lastly, 54 participants were centrally obese. From these, 94.4% engaged in either light or moderate physical activity, and 5.6% in vigorous physical activity. The prevalence of obese participants decreased drastically and significantly with an increase in physical activity intensity (p-value 0.0001).

## Discussion

The current research highlights the high prevalence of central overweight and obesity in students in a Ghanaian university, measured by WHR. It highlights the emergence of noncommunicable diseases and their possible risk factors as major contributors to the burden of ill health in urban populations in sub-Saharan Africa.

The present study revealed a central obesity prevalence of 9.8%. This was consistent with the 10.7% reported for incoming university students in Taiwan.<sup>27</sup> Our finding was lower than the 33.4% and 21.7% central obesity prevalence found in male and female third-year medical students, respectively, in Greece;<sup>28</sup> and the 31.2% central obesity prevalence in civil servants aged 20-60 years in Ghana.<sup>7</sup>

Even though a relatively low prevalence of central obesity was reported in this study, 60.9% of the participants were overweight. This implies that a greater proportion of the participants were at increased risk of developing cardiovascular and other chronic diseases.<sup>29</sup> WHR is a better predictor of cardiovascular disease, type 2 diabetes and all-cause mortality in young and middle-aged adults.<sup>30-32</sup>

Another important finding of this study was that a higher proportion of females than males were both centrally overweight and obese, respectively, in contrast to several works from Western countries.<sup>17,28,33</sup> However, this is consistent with the findings of Mogre et al<sup>7</sup> on civil servants in Tamale, on adults in Cameroon,<sup>34,35</sup> and those in several other studies performed elsewhere.<sup>11,36,37</sup> This finding could be the result of the notion that being obese is considered to be an indicator of well-being in Africa. A study on university students in Nigeria showed that most subjects believed that being obese garnered them respect and was a sign of living well.<sup>38</sup> In addition, female students in this study were found to be less active than the male students. These factors probably contributed to the markedly high prevalence of central obesity and overweight that was found in the females in this study.

Another significant finding was that while 94.4% and 67% of centrally obese and overweight participants, respectively, engaged in either light or moderate physical activity, 5.6% and 33% of them engaged in vigorous physical activity. Largely, this suggests that the prevalence of central obesity and overweight decreased with an increase in physical activity intensity. The same results were found in studies in Tamale, Ghana on civil servants,<sup>7</sup> as well as in several other countries.<sup>39-42</sup> This highlights the important role that

physical activity plays in preventing obesity and its co-morbidities. Physical inactivity is a modifiable risk factor of obesity and its co-morbidities, and should be considered when designing future health interventions. Surprisingly, the prevalence of normal weight in participants decreased significantly with an increase in physical activity intensity. This implies that a large proportion of the normal weight participants either engaged in light or moderate physical activity, as opposed to vigorous physical activity. It suggests that the probable effect of other factors, such as diet and genetics,<sup>43,44</sup> may have influenced body weight, but were not controlled for in the present study. The findings also imply that engagement in light to moderate physical activity might be adequate for the maintenance of weight in normal weight participants, but not for centrally obese and overweight participants wishing to reduce their weight. Therefore, it is recommended that individuals intending to reduce their weight should engage in vigorous physical activity.

A study on randomly selected male and female adults aged  $\geq 18$  years in Brazil showed that there was a higher probability of participants who consumed alcohol being centrally obese.<sup>45</sup> A similar association was reported with respect to Korean adults.<sup>46</sup> These are inconsistent with the findings of this study, which showed that the prevalence of central obesity was significantly higher in non-alcohol drinkers, than in alcohol drinkers. Our findings concur with a study on middle-aged women in which the risk of becoming overweight was almost 30% lower for women who consumed 1-2 alcohol beverages a day, than for non-drinkers.<sup>47</sup> The findings of past cross-sectional studies on the relationship between alcohol intake and body weight have been inconsistent for men and women.<sup>41,48-50</sup> Further empirical research needs to be conducted to establish the true relationship.

Interestingly, the prevalence of central obesity was higher in non-coffee drinkers than it was in coffee drinkers in this study. The literature on the effect of coffee on adiposity has been inconsistent. A cross-sectional study on a non-institutionalised USA population showed that coffee consumption did not relate to BMI or waist circumference in either gender.<sup>51</sup> However, a study by Lopez-Garcia et al<sup>52</sup> found that an increase in coffee consumption was associated with less weight gain. The discrepancy between studies on coffee consumption and adiposity is unclear, and further studies are suggested.

There were inherent limitations in this study that should be noted. This was a cross-sectional study, and as such, it was unable to establish causality. Also, the study did not assess the dietary patterns of the participants which been shown to have an effect on weight status. The method of assessment of the effect of coffee and alcohol on adiposity was limited in the sense that we did not consider the frequency and quantity of the consumed coffee or alcohol. However, the findings of this study provide first-hand information on the effect of coffee and alcohol on adiposity, and form the basis for further studies.

## Conclusion

A high prevalence of central overweight and obesity was reported in this cross-sectional study. Age and smoking status was not associated with central obesity. Coffee and alcohol consumption

were associated with a lower prevalence of central obesity. In addition, physical inactivity and gender, in this case female, were associated with a higher prevalence of central obesity. The findings of this study suggest that a comprehensive approach is needed by health educators when developing health and nutrition strategies to help to reduce the rising prevalence of obesity in young adults.

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