

Body Mass Index of University Students and Gender Differential: Survey in Rajshahi University, Bangladesh

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ABSTRACT: Body Mass Index (BMI) can be used as an indicator for health status of a population. BMI is particularly important for developing countries like Bangladesh where health is a major public issue. The aim of the study was to investigate the BMI among university students in Bangladesh and gender differential. Data were collected from 911 (male 727 and female 184) Rajshahi University students from January to June, 2014 using stratified sampling technique. Students t-test and z- proportional test were used in this study. In this study male and female students were analyzed separately. The results suggest that more than 26% female students have been suffering from chronic energy deficiency, and under nutrition is the common phenomenon in Bangladesh especially for female population. Consequently, under nutrition can be considered as one of the major health problems of Bangladeshi university students and requires attention.

INTRODUCTION

Body mass index (BMI) is an indirect measure of nutritional status in a particular population, and BMI is calculated from person's weight and height. This indicator provides a method that can assist in

planning interventions to help eliminate many preventable diseases. An obese (BMI ≥ 30 kg/m²) individual is more likely to get hypertension, heart disease, diabetes mellitus, cardiovascular disease, gall bladder disease and various types of cancer. Overweight and obesity are the fifth leading risk of global deaths, in worldwide, obesity has increased

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more than doubled since 1980. In 2008, more than 1.4 billion adults of 20 years and older were overweight. Of these, over 200 million men and nearly 300 million women were obese (WHO, 2014). On the other hand, underweight individual ($BMI \leq 18.5 \text{ kg/m}^2$) has a chance to get hip fracture (Gnudi *et al.*, 2009; Morin *et al.*, 2009). Underweight female is more likely to get low birth weight baby (Hosegood and Campbell, 2003). The prevalence helps to estimate the magnitude of healthy or disease problems in the community, and identify potential high-risk populations. These rates can be used especially for administrative and planning purpose such as hospital beds, manpower needs and rehabilitation facilities. The study on prevalence of nutritional status among a population is important to measure the health status of that nation, and it will help the health authorities for developing health policies to remove the health problem of the people. It is particularly important for developing countries like Bangladesh where health and medically related reforms are being actively implemented.

Overweight and obesity is a major public health problem currently, and globally, there is rising prevalence of overweight and obesity in both developing and developed countries (Flegal *et al.*, 2002; Haidar and Cosman, 2014). Some studies observed that first year university students have significant weight gain (Vella-Zerb and Elgar, 2009), followed by ongoing slow but steady increase in weight (Gorse, 2008).

In Bangladesh, researchers have investigated the relationship between BMI and mortality (Hosegood and Campbell, 2003; Pierce *et al.*, 2010) and socio-economic and demographic factors (Pryer *et al.*, 2003; Shafique *et al.*, 2007; Khan and Kraemer, 2009) in female population. Efforts have been made to improve the general conditions of this population, and BMI can be used as a tool for evaluation of the effectiveness of these measures.

Special attention should be paid to university students considering their potential influence on the family and their contribution to the nation's workforce in near future. Due to their unique role in near future for the society, it is important to investigate the nutritional status among the university students. To the best of our knowledge the study about the

nutritional status and the distribution of BMI categories of Bangladeshi university students are poorly documented.

The purpose of the present study was to investigate the prevalence of underweight and overweight among university students in Bangladesh and examine the difference in BMI between male and female students.

MATERIALS AND METHODS

This is a cross-sectional study, and considered 911 (727 males and 184 females) Rajshahi university students for collecting data. The age range of the students was 18-27 years at the time of measurement. Students were interviewed from January to June 2014 by the principal author of this study using a semi-structured pre- and post-tested questionnaire containing pre-coded and open-ended questions. Body mass index was calculated as the ratio of weight in kilograms divided by the square of height in meters, i.e. $BMI = \text{weight (kg)} / (\text{height(m)})^2$. Body height was measured as the distance from the top of the head in the midsagittal plane to the floor and it was measured by stadiometer without shoes to the nearest 0.1 cm. Body weight was taken while wearing thin clothing and without shoes using an electronic weighing machine (Digital Display Height and Weight Tester (sgsport.en.alibaba.com)) to the nearest 0.1kg. Some socio-economic, demographic and behavioral factors of students were also collected. Moreover, blood pressure of each student was measured. In this study, we used only height, weight and BMI for calculating the prevalence of under and over nutritional status among university students in Bangladesh. BMI was categorized into four groups as follows: underweight, $BMI < 18.5$; normal weight, $18.5 < BMI < 25$; overweight, $25 \leq BMI < 30$; and obese, $BMI \geq 30$ (Hossain *et al.*, 2012).

Target area: The target area of the present study was Rajshahi University (RU), Bangladesh. RU is situated in Rajshahi City Corporation. Rajshahi is one of the biggest cities in Bangladesh. This is the second largest university in Bangladesh, and having nearly 25,000 students at any particular time. These students come from different parts of the country (Rana *et al.*, 2015).

Ethics statement: We got the permission from the authority of RU and students' residential hall for

completing the present study and for collecting information from students, respectively. All rules and regulations of the ethics committee, *Institute of Biological Science (IBSc), RU, Bangladesh* were followed in this study. Written consent forms were collected from each participant after a detailed oral explanation about the study.

Sample size determination: The following formula was used for determining the sample size:

$$n = \frac{N}{1 + Nd^2} \text{ where, } n = \text{required sample size,}$$

N = population size (in here 25000), d = marginal error (we used, $d=0.05$), lastly, a 95% confidence level was utilized. The formula provided the significant sample size of 911 for the present study. The proportional allocation technique provided that 727 males and 184 female students would be needed for this study.

Sampling technique: Since we considered both male and female students, and these two groups were in between heterogeneous. So, two-stage stratified random sampling technique with a proportional allocation was used for selecting the samples from Rajshahi University. In the first stage, we separately selected residential halls of male and female students, 5 and 2 halls had been randomly selected from 11 and 5 halls for male and female respectively. In the second stage, we randomly selected 727 male and 184 female students from selected halls of male and female students.

Statistical analysis: In this study, male and female students were analyzed separately. Descriptive statistics was utilized for height, weight and BMI and student t-test was used for calculating significance difference in height, weight and BMI between male and female. Frequency distributions for the categories of BMI were carried out for finding the prevalence of underweight, normal weight, overweight and obese individuals for both genders. Z-proportional test was applied to find the significant difference between male and female for each BMI category. Statistical Package for Social Sciences (SPSS, IBM version 20) was used for analyzing our data. A value of $p<0.05$ was considered as statistically significant.

RESULTS

In this study 911 (male 727 and female 184) university students were considered as participants for investigating their nutritional status, and it was measured by their body mass index (BMI). Male and female sample were separately analyzed. The Kolmogorov–Smirnov test was used for testing the normality, and this test showed that our data (height, weight and BMI) were normally distributed.

The mean age of the male and female participants were 22.45 ± 1.18 years (95% CI: 22.31-22.58) and 21.58 ± 1.87 years (95% CI: 21.30-21.85), respectively. The mean height (168.22 ± 6.32 cm; 95% CI: 167.76-168.68) and weight (60.98 ± 8.01 kg; 95% CI: 60.40-61.56) of male students were significantly ($p<0.01$) higher than the height (157.17 ± 5.24 cm; 95% CI: 156.41-157.93) and weight (49.13 ± 6.76 kg; 95% CI: 48.14-50.11) of female students respectively. The mean BMI of both male (21.56 ± 2.61 kg/m²; 95% CI: 21.37-21.75) and female (19.89 ± 2.58 kg/m²; 95% CI: 19.51-20.26) students were within normal weight ($18.5 \text{ kg/m}^2 < \text{BMI} < 25 \text{ kg/m}^2$), however, the BMI of male students was significantly higher than female ($p<0.01$) (Table 1). The mean BMI among university students (male and female together) was 22.27 ± 1.86 kg/m² (95% CI: 22.15-22.39), which was greater than female BMI but close to male BMI (Table 1).

Table 2 shows the prevalence of body size among university students. The undernourished, healthy, overweight and obese among the university students (male and female together) was 14.10%, 78.43%, 7.20% and 0.27% respectively. Among the students, the prevalence of underweight among male and female students were 10.87% and 26.63%, respectively, and the difference between two proportions was statistically significant ($p<0.01$). More than 80% male and 69% female students were within healthy weight (normal weight), and the difference between these two proportions was significant ($p<0.01$). The prevalence of overweight among male students (7.98%) was significantly ($p<0.01$) higher than that of female students (4.35%). Only 0.27% male students were found as obese while we didn't find any obese female student (Table 2).

TABLE 1
Mean values of height, weight and body mass index (BMI) of university students by gender

Variable	Male (727)			Female (184)			Mean difference
	Mean	SD	95% CI of Mean, Lower-Upper	Mean	SD	95% CI of Mean, Lower-Upper	
Age	22.45	1.81	22.31-22.58	21.58	1.87	21.30-21.85	1.01
Height (cm)	168.22	6.32	167.76-168.68	157.17	5.24	156.41-157.93	11.05**
Weight (kg)	60.98	8.01	60.40-61.56	49.13	6.76	48.14-50.11	11.85**
BMI (kg/m ²)	21.56	2.61	21.37-21.75	19.89	2.58	19.51-20.26	1.67**
Male and Female together (911)	22.27	1.86	22.15-22.39				

N.B. **: (p<0.01)

TABLE 2
Frequency distribution of body size among university students by gender

BMI category	Male, frequency (%)	Female frequency (%)	P-value of proportiontest	Male and female together (%)
Underweight (BMI ≤ 18.5)	79 (10.87)	49(26.63)	(p<0.01)	14.10
Normal weight (18.5<BMI<25)	588 (80.88)	127(69.02)	(p<0.01)	78.43
Overweight (25 ≤ BMI<30)	58 (7.98)	8(4.35)	(p<0.01)	7.20
Obese (BMI ≥ 30)	2(0.27)	0(0.0)		0.27

DISCUSSION

Body Mass Index (BMI) is an important anthropometric index, and it is commonly used for determining the nutritional status of a nation. In the current study, we investigated the prevalence of nutritional status among university students in Bangladesh. Rajshahi University was our target area, and students of this university were our target population. Male and female students were analyzed separately in the present paper. The mean BMI of the male students was 21.56 kg/m², the mean body size of male students was within normal weight. When classified the sample into four categories according to body size on the basis of BMI, we found 10.87% male students had been suffering from chronic energy deficiency, more than 80% was healthy, on the other hand near to 8% and 0.27% male students were overweight and obese respectively. Bangladesh Demographic and Health Survey (BDHS, 2011) collected data overall Bangladesh from July 8, 2011 to December 27, 2011. They found that the mean BMI for ever-married men (age 15-34 years) was 20.50 kg/m² (NIPORT, 2013), the mean BMI of the male university students was somewhat higher than that of our national survey. The percentage of normal weight among university students (80.88%) was larger than

that of BDHS, 2011 data (67%), while the percentage of undernourished ever-married men (27%) was larger than that of university male students. The prevalence of overweight or obese among university students (more than 10%) was higher than that of ever-married men age 15-34 years (6%). The prevalence of overweight and obese among the university students (male and female together) in the present study was found more than 9%, and this was less than other some developing countries university students such as Nigeria (10%) (Nwachukwu *et al.*, 2010), Malaysia (20%-30.1%) (Gopalakrishnan, 2012; Boo *et al.*, 2010), Pakistan (13%-52.6%) (Chaudhry *et al.*, 2012), and India, (11%-37.5%) (Seo *et al.*, 2014; Balhara *et al.*, 2012; Bhongir *et al.*, 2011; Pengpid and Peltzer, 2014), Mexico (31.6%) (Trujillo-Hernández, 2010), Saudi Arabia (47.9%) (Al Qauhiz, 2010), Oman (28.2%) (Al-Kilani, 2012) and Turkey (10%-47.4%) (Kutlu and Memetoglu, 2013). WHO (2014) has reported that at least 3.4 million adults die each year as a result of being overweight or obese, in addition 44% of the diabetes burden, 23% of ischemic heart disease burden and between 7% to 41% of certain burdens are attributable to overweight and obesity, overweight and obesity are linked to more deaths worldwide than underweight.

In the present study we found that the mean BMI (19.89 kg/m²) of female university students was less than that of our national data (21.40 kg/m²), that was collected by BDHS, 2011 from ever-married women in reproductive age (15-49 years old) (NIPORT, 2013). The prevalence of undernourished among the female students (26.63%) was somewhat larger than ever-married female (24.00%) but the percentage of normal weight (69.02%) among female students was higher than that of national survey among ever-married women (59.00%) and the prevalence of overweight or obese among ever-married women (17.00%) was larger than that of female university students (4.35%). May be there are some reasons for getting different results between university female students and ever-married women in Bangladesh such as students are doing higher education and they are more conscious about their body size than ever-married women and most of the students are unmarried, and usually unmarried educated female wants to make zero figure (underweight) for that's why the number of underweight and normal weight among students are more than that of ever-married women. Unfortunately most of the university students don't have knowledge about the long term effect of underweight. It was found that undernourished female students had menstruation problems such as painful and irregular menstruation more than normal weight students (Hossain *et al.*, 2011). Moreover, underweight females are more likely to get hip fracture (Gnudi *et al.*, 2009; Morin *et al.*, 2009) and low birth weight baby (Hosegood and Campbell, 2003). In many countries, though, chronic energy deficiency, characterized by a BMI of less than 18.5 among adults remains the predominant problem, leading to low work productivity and reduced resistance to illness (NIPORT, 2013). Undernourished individual is considered as he/she has been suffering from chronic energy deficiency. As a chronic disease, prevalent in both developed and developing countries, and affecting children as well as adults, it is now so common that it is replacing the more traditional public health concerns including under nutrition. It is one of the most significant contributors to ill health (WHO, 2014). In this study we found that the prevalence of overweight among male students was higher than that of female students.

In the current study, we conducted as preliminary work to investigate the prevalence of underweight, overweight and obesity among university students. Body weight, physical inactivity and cigarette and alcohol consumption are important health-related lifestyle factors affecting the global burden of disease (Lim *et al.*, 2012). Some studies observed that first year university students have significant weight gain (Vella-Zarb and Elgar, 2009), followed by ongoing slow but steady increase in weight (Gores, 2008). The prevention and management programs for overweight and obesity include the availability of information about eating habits: a potential risk factors for overweight and obesity among various population group particularly university students. While availability of information about these health-related factors are important to health educators for designing and implementing health-related education programs that are geared towards maintenance of healthy weight, little is known about the links between BMI status and eating behaviors in Nigerian University students. In addition to obtaining information on weight distribution, an understanding of the relationship can help health and nutrition educator in planning a better eating therapy for healthy weight maintenance/weight loss program. The main purpose of that study was to clarify whether BMI status would be associated with eating behaviors and their subscales in a sample of university students. It is reasonable to assume that weight status could modulate the associations of eating behaviors. In that study, the absolute BMI classification was used to classify the students in three categories such as (i) underweight (ii) normal weight and (iii) overweight). In a previous review (Pengpid and Peltzer, 2014), the following factors were identified to be associated with overweight and obesity among university students or (young) adults: (i) socio-demographic factors (mainly male gender, older age and higher socioeconomic status; (ii) Social factors: lack of social support, capital and lack of religiousness; (iii) Dietary behavior: intakes of fiber, consumption of red meat, skip breakfast more often, high number of meals, snacking behavior; and (iv) Health risk behavior: Physical inactivity, frequent alcohol use, and smoking; (v) Mental health and childhood abuse: poor mental health (depression, anxiety) and childhood physical abuse, sexual and verbal abuse.

It is important to determine the risk factors which are to be associated to malnutrition among university students in Bangladesh. Clearly, more studies are required regarding BMI.

CONCLUSION

In the current study, we investigated the prevalence of underweight, normal weight, overweight and obesity among university students in Bangladesh, gender differential also observed. Data were collected from the students of Rajshahi University, Bangladesh. The prevalence of underweight, normal weight, overweight and obesity among university students were 14.10%, 78.43%, 7.20% and 0.27%, respectively. The prevalence of underweight among female students was higher than that of male students, while the prevalence of normal weight and overweight of male students was higher than that of female students. Also, we observed that the mean BMI of male students was larger than that of female students.

Study limitation: There are many limitations in this study such as (i) we considered only university students, this study can't represent the whole young population in Bangladesh, it might be considered in our future study, (ii) we only considered Rajshahi University students, in Bangladesh there are many universities, and therefore, the present data don't reflect the prevalence of underweight and overweight among university students in Bangladesh as a whole. It is recommended that a large scale study is conducted in the near future. (iii) Some students didn't agree to measure their height and weight, so these students had to be excluded.

Conflict interests: The authors declare that they have no conflict of interests.

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