Family Medicine and Community Health
ORIGINAL RESEARCH

Cross-sectional analysis of obesity and high blood pressure among undergraduate students of a university medical college in South India

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Abstract

Objective: To estimate the prevalence of obesity and high blood pressure among undergraduate students of a university medical college.

Methods: A cross-sectional study was conducted at a medical college among 434 medical students. A questionnaire was used to collect basic demographic details, followed by anthropometric measurements. Body mass index (BMI) was classified according to the World Health Organization classification. Blood pressure was measured with a standard mercury sphygmomanometer and classified according to the seventh report of the Joint National Committee (JNC VII) on prevention, detection, evaluation, and treatment of high blood pressure. Data were entered into and analyzed with SPSS version 15.0.

Results: Nearly 65.0% of students had normal BMI, 9.9% were underweight, 17.9% were overweight, and 7.6% were obese. Obesity was more prevalent among males than among females on the basis of anthropometric variables such as BMI, waist-hip ratio, and waist-stature ratio, and this difference was found to be statistically significant. Blood pressure was in the normal range among 55.0% of the students, 36.6% had blood pressure in the prehypertensive range, 7.6% had blood pressure in the stage 1 category of the JNC VII criteria, and 0.5% had blood pressure in the stage 2 category of the JNC VII criteria. Among the students who had blood pressure greater than 140/90 mm Hg, 63.0% were males and 37.0% were females, and this difference was statistically significant.

Conclusion: The prevalence of obesity was 7.6% and that of high blood pressure was 8.1% among the medical students, which were higher than those reported in the literature for the same age group and warrant further evaluation.

Statement of Significance: Non-communicable diseases have been described as the modern epidemic of the current era. A retrograde age shift is being noted in the prevalence of diseases such as diabetes mellitus, hypertension, and obesity, which is alarming. Young adults are at an increased risk of developing these diseases because of indulgence in faulty lifestyle practices. The present study attempted to quantify the risk among medical students. The prevalence of obesity was 7.6% and that of high blood pressure was 8.1% among the medical students, which were higher than those reported in the literature for the same age group. Future medical professionals need to be aware of their own risk factors and take proactive steps before advising and encouraging their patients to adopt healthy lifestyles.

Keywords: High blood pressure; body mass index; overweight; obesity; medical students

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Received: 2 February 2017;
Accepted: 11 July 2017

Family Medicine and Community Health 2018;6(2):63–69
www.fmch-journal.org DOI 10.15212/FMCH.2017.0134

Introduction

Noncommunicable diseases have been described as the modern epidemic of the 20th century. By 2020, noncommunicable diseases will account for 73.0% of deaths and 60.0% of the global disease burden [1]. Currently India is experiencing an epidemiological transition, with dual burden of both communicable and noncommunicable diseases [2]. Changes in lifestyle and sociocultural influences have been responsible for the increase in the incidence of noncommunicable diseases in the past few decades. Environmental and behavioral changes brought about by economic development, modernization, and urbanization have been linked to the rise in global obesity [3]. More specifically, the changes in food consumption, decrease in the levels of physical activity, and increase in the levels of stress experienced in everyday life are the main causative factors for the increased prevalence of obesity and hypertension. Obesity is emerging as a serious problem throughout the world not only among adults but also among children, teenagers, and young adults [4]. When obesity and hypertension are identified early, this age group is the right target group for promoting the importance of physical exercise and healthy eating [2].

Hypertension, known as the silent killer, leads to considerable morbidity and mortality worldwide. However, evidence on the burden of hypertension and associated factors is lacking among college students in resource-poor settings [5]. Measuring and appropriately disseminating knowledge of the modifiable risk factors at an early age is an essential preventive educational approach. Strategies to achieve even a modest lowering of the levels of blood pressure (BP) and obesity among young adults are therefore important to prevent future epidemics of these noncommunicable diseases [6].

In the literature, among medical students the prevalence of overweight and obesity ranges from 10.0% to 20.0% [2, 7, 8], while the prevalence of hypertension ranges from 4.0% to 15.0% [9, 10]. The younger age groups are at increased risk of developing these diseases because of excessive exposure to faulty food habits, academic stress, gadget use, and lack of physical activity. Medical education is stressful throughout the course of training because of the amount of study required, social isolation, pressure of examinations and peers, and discrepancies between expectations and reality, which could all contribute to psychological stress [4]. Studies have pointed to a shift in the age of onset of obesity and hypertension toward the younger age groups [11, 12]. This study was therefore designed to estimate the prevalence of obesity and high BP among medical students as there was limited information available for this age group pertaining to these risk factors for noncommunicable diseases.

Methods

This was a cross-sectional study done on even-semester undergraduate medical students (i.e., second, fourth, and sixth semesters) during April 2014 at a university medical college in coastal Karnataka. Institutional ethics approval was obtained, and permission was sought from the head of the institution before initiation of the study. Anticipating the prevalence of overweight and obesity among 17-21-year-old medical students to be 20.0% [7, 8], with 20.0% relative precision for the 95.0% confidence level, we estimated the sample size to be 400 participants.

Written informed consent was obtained from the students after the nature of the study had been explained to them. Basic demographic details were collected from the students by means of a predesigned, pretested questionnaire. Anthropometric measurements were made, and BP was measured for all the consenting students. The anthropometric details collected were height, weight, waist circumference, and hip circumference, obtained with standard protocols by trained investigators [13]. Weight was measured with a standard weighing scale in kilograms to the nearest 0.5 kg, without footwear, with the scale being placed on a flat firm surface. Height was measured with a stadiometer and recorded in centimeters, to the nearest 0.1 cm. Waist circumference was measured to the nearest 0.1 cm at the midpoint between the costal margin and the iliac crest with a nonstretchable measuring tape. Hip circumference was measured at the level of the greater trochanter (widest portion of the hip) to the nearest 0.1 cm with a measuring tape. The anthropometric details were collected by trained investigators. BP was measured for all participants in the study with a standardized mercury sphygmomanometer in the right arm with the participant sitting in a relaxed state. Postgraduate students and interns (residents) who were initially trained regarding the technique of measurement of BP by the palpatory and auscultatory method measured the BP of the participants. Obesity was classified according to body mass index (BMI), which was

computed as weight in kilograms divided by the square of the height in meters. In addition, obesity was also defined using waist circumference, waist-hip ratio and waist-stature ratio.

Criteria for defining obesity

Body mass index

A. WHO classification: BMI of less than 18 kg/m^2 corresponds to underweight, BMI of 18.00–24.99 kg/m^2 corresponds to normal weight, BMI of 25–29.99 kg/m^2 corresponds to overweight, and BMI of 30 kg/m^2 or greater corresponds to obesity [14].

B. Southeast Asian classification: BMI of 25 kg/m^2 or greater corresponds to obesity [15].

Waist circumference: Waist circumference of more than 90 cm in males and more than 80 cm in females corresponds to central/abdominal obesity [16].

Waist-hip ratio: Waist-hip ratio of 0.90 or greater in males and 0.85 or greater in females corresponds to truncal obesity [16].

Waist-stature ratio: Waist-stature ratio greater than 0.5 corresponds to obesity in both males and females [17].

Criteria for defining high blood pressure

Grading of BP was done according to the seventh report of the Joint National Committee (JNC VII) on prevention, detection, evaluation, and treatment of high BP [18]. Systolic BP (SBP) less than 120 mm Hg and diastolic BP (DBP) less than 80 mm Hg was considered as normal BP. SBP in the range of 120–139 mm Hg and/or DBP ranging between 80 and 89 mm Hg constituted prehypertension. SBP of 140–159 mm Hg and/or DBP of 90–99 mm Hg (stage 1 hypertension) and SBP of 160 mm Hg or greater and/or DBP of 100 mm Hg or greater (stage 2 hypertension) were considered to be high BP.

Data analysis

Data were entered into and analyzed with SPSS version 15.0. Data were summarized as frequencies and percentages. The unadjusted odds ratio with the 95.0% confidence interval was computed for binary variables. Association between demographic variables, anthropometric variables, and BP was analyzed by the chi-square test. $P<0.05$ was considered to be statistically significant.

Results

Four hundred thirty-eight students participated in the study, of whom 187 (42.7%) were males and 251 (57.3%) were females. Among them, 169 (38.6%) were in the second semester, 197 (45.0%) were in the fourth semester, and 72 (16.4%) were in the sixth semester. Hindus constituted the majority of the study population (370, 84.5%). More than 369 (84.6%) of the students were from nuclear families.

Of the 438 students, the anthropometric variables and BP of four students could not be measured. The results are therefore described for 434 students. The mean BMI of the study population was 28.2 kg/m^2. BMI was normal among 280 students (64.5%), and 43 students (9.9%) were underweight. As per BMI, 33 students (7.6%) were obese, and 78 students (18.0%) were overweight. Among the 33 students (7.6%) who were obese, 16 (48.5%) were males and 17 (51.5%) were females, while among the 78 overweight students (17.9%), 45 (57.7%) were males and 33 (42.3%) were females. There was a preponderance of obesity among males when compared with females (χ^2=8.918, two degrees of freedom, P=0.003), as depicted in Table 1. Obesity was more prevalent among males when compared with females on the basis of anthropometric variables such as BMI, waist-hip ratio, and waist-stature ratio, and this difference was statistically significant, as described in Table 1. Agewise comparison was done between obese and nonobese individuals, and no statistically significant difference was observed (χ^2=5.081, two degrees of freedom, P=0.079).

The mean SBP of the study population was 118 mm Hg and the mean DBP was 78 mm Hg. More than half of the students (240, 55.0%) had BP in the normal range. Prehypertension was present in 159 (36.8%) of the medical students. Approximately 8.0% (33) of the students had stage 1 hypertension, and only two students had BP readings in the range of stage 2 hypertension. No significant difference (χ^2=0.047, two degrees of freedom, P=0.977) was found when agewise comparisons were done between students with BP below 140/90 mm Hg and students with BP of 140/90 mm Hg or greater. Among the students who had BP 140/90 mm Hg or greater, 22 (62.9%)

Table 1. Anthropometric and blood pressure measurements of the study participants according to gender (*n*=434)

Anthropometric variables	Males (*n*=186)	Females (*n*=248)	Crude odds ratio	χ^2	*P* value
Body mass index (kg/m^2)					
<25	125 (67.2%)	198 (79.8%)	0.51 (0.33–0.80)	8.91	0.003
>25	61 (32.8%)	50 (20.2%)			
Waist circumference (cm)					
Normal	138 (74.2%)	199 (80.2%)	0.70 (0.45–1.11)	2.24	0.134
Abnormal (males >90 cm; females >80 cm)	48 (25.8%)	49 (19.8%)			
Waist-hip ratio					
Normal	97 (52.2%)	203 (81.9%)	0.24 (0.15–0.37)	43.94	<0.001
Abnormal (males ≥0.90; females ≥0.85)	89 (47.8%)	45 (18.1%)			
Waist-stature ratio					
Normal (≤0.5)	119 (64.0%)	196 (79.0%)	0.47 (0.30–0.72)	12.10	0.001
Abnormal (>0.5)	67 (36.0%)	52 (21.0%)			
Blood pressure (mm Hg)					
<140/90	164 (88.2%)	235 (94.8%)	0.41 (0.20–0.83)	6.28	0.012
>140/90	22 (11.8%)	13 (5.2%)			

The 95.0% confidence interval is given in parentheses.

were males and 13 (37.1%) were females, and the association between blood pressure values across gender was found to be statistically significant, as shown in Table 2. A quarter of the students with high BP had waist circumference more than the normal range, while 40.0% also had a high waist-hip ratio and 17.1% were obese by the WHO BMI classification. Among

Table 2. Univariate analysis of demographic and anthropometric variables with blood pressure among medical students (*n*=434)

Variables	Normal BP (*n*=240)	Prehypertension (*n*=159)	BP>140/90 mm Hg (*n*=35)	χ^2	*P* value
Sex					
Male	74 (30.8%)	90 (56.6%)	22 (62.9%)	32.15	<0.001
Female	166 (69.2%)	69 (43.4%)	13 (37.1%)		
Semester					
Second	90 (37.5%)	65 (40.9%)	13 (37.1%)	0.51	0.972
Fourth	109 (45.4%)	69 (43.4%)	16 (45.7%)		
Sixth	41 (17.1%)	25 (15.7%)	6 (17.1%)		
Obesity – SEA classification (BMI ≥25 kg/m^2)	43 (17.9%)	57 (35.8%)	11 (31.4%)	16.84	<0.001
Obesity – WHO classification (BMI ≥30 kg/m^2)	8 (3.3%)	19 (11.9%)	6 (17.1%)	25.10	<0.001
Obesity – WC classification (males >90 cm; females >80 cm)	43 (17.9%)	44 (27.7%)	10 (28.6%)	6.09	0.047
Obesity – WHR classification (males ≥0.90; females ≥0.85)	64 (26.7%)	56 (35.2%)	14 (40.0%)	4.76	0.092
Obesity – WSR classification (>0.5)	43 (17.9%)	49 (30.8%)	12 (34.3%)	10.96	0.004

BMI, body mass index; BP, blood pressure; SEA, Southeast Asian; WC, waist circumference; WHR, waist-hip ratio; WSR, waist-stature ratio.

students whose BP was greater than 140/90 mm Hg, four (11.4%) also reported a family history of hypertension. None of the students reported a documented history of screening or diagnosis of hypertension. Students were informed about their obesity and BP status, and suitable lifestyle modifications were suggested to the individuals at risk. In addition, they were advised on evaluation and further management at the tertiary care hospital attached to the medical college.

Discussion

The present study provides descriptive data on 434 medical students of a university college. Among the 434 students, 33 (7.6%) were obese, while 78 (18.0%) were overweight on the basis of the WHO BMI classification. In the study done by Dantu and Ujwala [7] on 263 undergraduate students, the prevalence of overweight and obesity was 19.6%, while another study from Pune, India [2], reported the prevalence of overweight and obesity to be 13.2%, which was less than the 26.0% prevalence of overweight and obesity in the present study. Dantu and Ujwala [7] also reported a higher prevalence of overweight and obesity in males when compared with females, and this sex difference was in conformity with the present study. In Lahore, Pakistan [9], the prevalence of obesity was 2.4%, on the basis of the Southeast Asian classification of obesity, while it was 25.6% in the present study. Higher prevalence among our medical undergraduates was noted in contrast to studies from Malaysia and Kolkata in India [3, 19]. But studies also reported 22.0% prevalence of obesity among dental students and other university students [8, 20]. The difference in prevalence might be attributed to the differences in the location of the studies, lifestyles, and different assessment methods, in addition to the participants being day scholars or residing in hostels.

In the present study, the combined prevalence of hypertension, including stage 1 and stage 2 hypertension, was 8.1%. The prevalence of prehypertension and high BP observed was also greater compared to university students from the Philippines [21], while in the state of West Bengal in India, the reported prevalence of hypertension was 13.0% [6, 22]. A study on 1022 urban Asian Indian adolescents identified a 6.4% prevalence of hypertension [23]. A study from Ethiopia reported a hypertension prevalence of 7.7% among university students [5]. This indicates a shift in the prevalence of hypertension towards younger age groups. A statistically significant sex difference ($P<0.001$) was noted in the study, with the prevalence of BP greater than 140/90 mm Hg among males (11.8%) being more than that among females (5.2%), which was in line with the study findings from Mangalore, a neighboring district in the Indian state of Karnataka [24].

Most of the students who were overweight also had higher waist circumference and waist-hip ratio. Flegal et al. [25] found a significant correlation between waist circumference and BMI, similar to our findings.

The prevalence of obesity in the younger age group is a matter of concern. The higher prevalence of obesity and hypertension among the undergraduate medical students could be due to several factors, such as food habits, lifestyle changes, academic stress, cultural differences, moving away from home, and residing in hostels. The students participated voluntarily in the study, so there is a possibility of a healthy volunteer effect, wherein mostly healthy students would have consented, thereby resulting in underestimation of the prevalence of obesity and hypertension in the study group. A single BP recording was taken because of time constraints as students had to go for their classes and clinical postings. However, a second reading was taken on the same day for students who had high BP readings, and a repeat measurement was done on the subsequent day. If BP was found to be consistently high, the students were referred to the Internal Medicine Department at the medical college hospital, as all the students have Medicare coverage, so further management was duly taken care of. The inability to assess other parameters, such as stress levels, sleep habits, and dietary intake, because of inadequate logistics was another shortcoming. An elaborate evaluation assessing all risk factors is a resource-intensive exercise and is difficult to implement given the demanding schedule of the medical school. In spite of these limitations, baseline identification of the risk factors among medical students was done as an initial step toward screening for chronic diseases. The data collection was limited to students from a single medical school, so generalizability is a matter of concern. Hence serial measurements of these parameters across the years in various medical schools following a common protocol is the need of the hour. It is highly desirable for such studies to be initiated so as to tackle the burden of noncommunicable diseases among the new-generation physicians.

Conclusions

The prevalence of obesity was 7.6% and that of high BP was 8.1% among the medical students, which is higher than the reported literature for the same age group. Subsequent follow-up and repeat measurements are required to confirm the diagnosis. Tracking of BP and follow-up of weight gain over several years would be ideal to curb the growing epidemic of noncommunicable diseases among the younger generation.

Acknowledgments

We are grateful to all the participants in the study and the institution for permitting us to conduct the study.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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