BLOOD PRESSURE AND ANTHROPOMETRY OBESITY INDICES IN FIRST PROFESSIONAL MEDICAL STUDENTS AT A PRIVATE MEDICAL COLLEGE OF PAKISTAN – A CROSS-SECTIONAL STUDY

Uzma Zafar, Muhammad Usman Ul Haque, Faiqa Jabeen Naeem, Musfirah Sufyan, Muhammad Usman Naeem

Department of Physiology, Lahore Medical & Dental College, University of Health Sciences, Lahore, Pakistan

ABSTRACT

Obesity, a significant public health issue, requires immediate attention to prevent obesity-mediated health concerns such as hypertension, metabolic syndrome, and adverse coronary and circulatory events. The present study aimed to determine blood pressure (BP) and anthropometric obesity indices (including BMI, waist circumference, waist-to-hip ratio, and mid-upper arm circumference) of 1st Professional MBBS students in a private medical college in Pakistan, and also to find the association of BP with anthropometric indices. It was a cross-sectional survey conducted at Lahore Medical and Dental College. Institutional Review Board approval was acquired before the study commencement. The duration of the study was from May to August 2022. The study population included all students registered in first-year MBBS who agreed to participate in the study. The present study included 120 participants. The mean ± standard deviation (SD) age of participants was 19.05±0.82 years. Mean systolic and diastolic BP was 116.05±13.21 and 74.85±9.81 respectively. Sixty-seven (56%) participants were having their BP ≥ 120/80 and were identified as pre-hypertensive or hypertensive respectively. Mean ± SD BMI was 22.18±4.31 kg/m^2; 67 (55.8%) were having normal BMI, 20(16.7%) were overweight and 33 (27.5%) obese. On the basis of waist circumference; 39 (70.9%) male subjects were normal and 16 (29.1%) centrally obese, whereas 47 (72.3%) females were normal and 18 (23.7%) obese. Overall central obese subjects were 35 (29%). Logistic regression analysis was applied; hypertension was taken as a dependent variable and all-other independent covariates such as anthropometry indices (BMI, waist circumference), gender, age, and residential status were controlled; association of hypertension was significant with gender (p=0.001) and waist circumference (p=0.000). Students need to modify lifestyle strategies for preventing obesity and hypertension.

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Corresponding author
Uzma Zafar
✉ uzma.zargham@gmail.com
Department of Physiology, Lahore Medical & Dental College, University of Health Sciences, Lahore, Pakistan.

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INTRODUCTION

Hypertension is a major public health concern in Pakistan and other countries because of its rising trend and significant association with adverse cardiovascular outcomes and premature morbidities. It is a preventable non-communicable disease and effective time management of hypertension can reduce the incidence of coronary artery disease, stroke, and metabolic syndrome-related derangements[1]. About one-fourth of the adult population globally is suffering from hypertension and this figure is expected to be 29% in 2029. On the basis of the evaluation of different population-based surveys, the pooled prevalence of hypertension in Pakistan was reported to be 26.43% with a higher urban burden (26.6%) as compared to that of the rural (21.3%). Prevalence in males was 24.99% and in females it was 24.74%. Its preponderance in the adult population was reported to be 23.23%[2]. Another epidemiological survey in Pakistan reported the age-adjusted prevalence of hypertension in Pakistan to be 46%, where 25% is self-reported and 21% is newly diagnosed[3]. The evolution of behavioral and environmental changes as a result of rapid urbanization, modernization, and economic up-gradation have been linked with the global crisis of hypertension. Changing trends in sociocultural and lifestyle influences have also been reported to be associated with the universal rise in non-communicable diseases such as obesity, hypertension, and metabolic syndrome[4].

Obesity is an epidemic worldwide now and according to an estimate by World Health Organization (WHO), 57.8% of the population will be identified as obese by 2030. Obesity is defined as excessive and abnormal fat accumulation that is associated with considerable comorbidities such as metabolic syndrome, insulin resistance, adverse coronary artery, and circulatory events. WHO and the National Institute of Health both have considered body mass index (BMI) as a criterion for obesity. It is the first screening step in the evaluation of an adult or pediatric subject for obesity. The data from National Health and Nutrition Examination survey states that obesity (based upon BMI> 30kg/m^2) affects 35% of males and 40% of females in the United States. Its burden in Asian adult males and females is about 12.5% respectively[5, 6].

Two commonly employed methods to determine whether one is a normal healthy weight or not are BMI and waist circumference measurements. BMI is calculated by dividing the weight (taken in kilograms) by the height (taken in meter square). It has certain limitations as it does not distinguish whether the fraction of weight is due to muscle or fat and it also can not discriminate about the fat distribution arrangement. Reliance on BMI alone is inadequate as susceptibility to obesity-linked comorbidities depends upon individual variations in the pattern of fat distribution[7]. Carrying excessive waist fat is significantly associated with a higher health risk as compared to the fat in thighs and buttocks. Therefore, waist circumference measurement is an estimation of alarming visceral fat that is coating the internal organs[8]. In addition to the above-mentioned anthropometric health indices, waist-to-hip ratio and mid-upper arm circumference have also been shown to be associated with central obesity, insulin resistance, and type 2 diabetes mellitus[9]. Mid-upper arm circumference measured

midway between the acromion and olecranon of the ulna is a body composition indicator in children and adults. It represents muscle mass and subcutaneous fat. Its value of less than 12.5 cm indicates malnutrition and greater than 13.5 cm is considered normal[10]. Asian Indians are at higher risk of getting obesity-related complications at a lower BMI and waist circumference as compared to white Caucasians. Therefore in this ethnic group, diagnosis of overweight and obese is done in accordance with the guidelines of Asian Indians at BMI cut-offs; ≥23kg/m^2 and 25kg/m^2; the cut-offs for central obesity in males and females are waist circumference ≥90 cm and 80 cm respectively[11].

Obesity a significant public health issue requires immediate attention to prevent obesity-mediated health concerns. Previous studies have reported prevalence of obesity among medical students to be 10-20% and hypertension 4-15%. There is an increased risk of developing these health issues at an early age due to physical inactivity, academic load, faulty lifestyle with an intake of sugary trans-fat-rich food, and use of mobiles or gadgets[12]. Medical education is a full-time stressful training span due to the quantity and quality of the study required, examination strain, and discrepancy between the expectations and outcome. These various psychological and physical modes of stress have resulted in premature onset of obesity and hypertension in medical undergraduates. Determination and management of modifiable risk elements at an early age should be a basic preventive educational strategy.

The present study aimed to determine blood pressure and anthropometric obesity indices (including BMI, waist circumference, waist-to-hip ratio, and mid-upper arm circumference) of 1st Professional MBBS students at a private medical college, in Lahore, Pakistan and also to find an association of BP with anthropometric indices.

MATERIALS AND METHODS

It was a cross sectional survey conducted in the Department of Physiology, Lahore Medical and Dental College (LMDC), Lahore, Pakistan. Duration of the study was three months from May 2022 to August 2022. Study population included all students registered in first year MBBS (150 students) who agreed to participate in the study. Sampling technique was convenience sampling. The inclusion criteria were both male and female subjects with age ranging from 18-30 years, and having normal cardiac and respiratory functions. Whereas, the exclusion criteria were participants with history of liver, respiratory, and cardiovascular diseases.

Data Collection Procedure

A structured questionnaire was used consisting of two sections. The first section of the questionnaire contained; background information of study participants such as gender (male or female), pre-medical qualification (F, Sc., A levels or American Board), and residential status (day scholar or residing in hostel). The second section included anthropometric indices and blood pressure. Blood pressure was taken using a standard mercury sphygmomanometer with the correct cuff size for arm circumference. Subject was made to sit on a chair with straight back and feet touching the ground. He was rested for 5 minutes before taking BP. Two BP readings were taken at an

interval of 5 minutes and average of the two was taken[13]. Unit of measurement was milimeter of mercury. Every subject's height was measured in meters while the participant stood still without shoes and weight was measured to the nearest 0.1 kg with electronic weight scale in kilograms with the participant lightly clothed. BMI was calculated as weight divided by square of height (kg/m^2)[14]. Waist circumference was measured in centimeters at the midpoint between the bottom of the ribs and the top of the iliac crest with non-stretchable measuring tape at the end of expiration. Subjects were in standing erect posture, arms by the side and feet nearly approximated[15]. Hip circumference was measured in cm at the widest extension of the buttocks. Waist to hip ratio was calculated by dividing these two values with each other. Mid upper arm circumference was measured in cm mid-way between the acromion of scapula and olecranon process of ulna with a non-stretchable measuring tape and rounded to the nearest 0.1 cm[16].

Operational definitions

Blood pressure (BP)

1. Normal BP is defined as: Systolic <120 and diastolic <80 mm of mercury.
2. Elevated BP is: Systolic BP of 120-129 and diastolic <80 mm of mercury.
3. Stage 1 hypertension: Systolic BP of 130–139 or a diastolic BP of 80–89 mm Hg.
4. Stage 2 hypertension: Systolic BP ≥ 140 mm of mercury and diastolic BP ≥ 90 mm of mercury [17, 18, 19].

Body mass index (BMI): A BMI

1. Range 18-22.9 kg/m^2 is normal.
2. Range 23-25 kg/m^2 is taken as overweight.
3. Greater than 25 kg/m^2 as obesity [20, 21].

Waist circumference (WC):

A WC of >90 cm in males and >80 cm in females is considered for abdominal obesity[20, 21, 22].

Waist to hip ratio (W/H):

• Women should have W/H ratio of 0.85 or less than this.

• Men should have W/H ratio of 0.9 or less than this.

• A ratio higher than 1.0 for either sex means a much higher chance of health problems. This is in accordance with WHO guidelines.

Mid upper arm circumference (MUAC):

A measurement of <23cm in men and <22 cm in women will be considered low and a value >30.9 cm in males and > 30 cm in females will be considered high[23].

Ethical Considerations

College Institutional Review Board (IRB) approval was acquired before commencement of the study. Informed verbal consent was obtained from the study participants, assuring maintenance of confidentiality during data processing and publication of the study results.

Data Analysis

Data were entered, cleaned and analyzed using Statistical Package for Social Sciences (SPSS), version 25. Descriptive statistics was used in terms of number, percentages and mean scores. Chi square test was applied to find the association of BP with gender and

anthropometric measurements. Binary logistic regression was used to find the association of BP with anthropometric measurements by controlling the confounder variables.

RESULTS

The present study included 120 participants. Out of total, 55 (46%) were males and 65 (54%) females. Mean ± standard deviation (SD) age of the participants was 19.05±0.82 years. Characteristics of the study population are presented in Table.1. Mean systolic and diastolic BP of the participants was 116.05±13.21 and 74.85±9.81 respectively. However, 67 (56%) participants were having their BP ≥ 120/80 mm of mercury and were identified as pre-hypertensive or hypertensive respectively and 53 (44%) were having normal BP. Out of 67 (56%) participants with deranged BP; 31 (26%) were hypertensive {10(8%) with stage 1 and 21 (17.5%) with stage 2 hypertension} and the rest 36 (30%) were having elevated BP (as presented in Figure-1). This grading of BP is in accordance with American Heart Association guidelines[17,18]. Three blood pressure measurements on multiple days for a clinical diagnosis of hypertension were undertaken.

Mean ± SD BMI was 22.18±4.31 kg/m^2. 67 (55.8%) subjects were having normal BMI, 20 (16.7%) were overweight and 33 (27.5%) were obese. On the basis of waist circumference, 39 (70.9%) male subjects were normal, 16 (29.1%) centrally obese, 47 (72.3%) females were normal and 18 (23.7%) were obese centrally. Overall central obese subjects were 35 (29%). Proportions of the study population on the cut-off basis of BP and anthropometry obesity indices are presented in Table 2 and Figures 2-4.

On application of chi-square test (non-adjusted model) there was significant association of hypertension with anthropometry indices such as BMI, waist circumference and mid upper arm circumference there was no significant association with waist to hip ratio (Table 3). Logistic regression analysis (adjusted model) was applied (Table 4) where hypertension was taken as dependent variable and all other independent covariates such as anthropometry indices (BMI, waist circumference, waist to hip ratio, mid upper arm circumference), gender, age and residential status were controlled; association of hypertension remained significant with gender (p=0.001) and waist circumference (p=0.000).

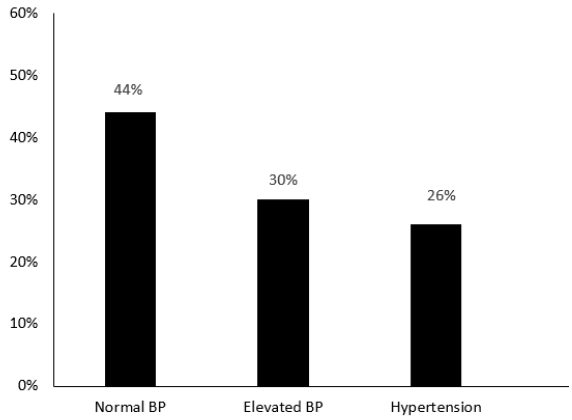

Figure 1: Proportion of study population on the basis of blood pressure

(Normal BP is defined as: Systolic <120 and diastolic <80 mm of mercury. Elevated BP is: systolic BP of 120-129 and diastolic <80 mm of mercury. Hypertension: systolic BP of >130 or a diastolic BP of ≥80 mm of mercury).

Table 1: Characteristics of the study population

Demographics of the study population					
Gender	Male		Female		
Frequency	55		65		
Pre-entry qualification	F, Sc.		A-level		
Frequency	109		11		
Residential status	Day-scholar		Host-elite		
Frequency	56		64		
H/O Smoking	No		Yes		
Frequency	120		nil		
H/O drug intake	No		Yes		
Frequency	116		4		
Range, central tendency (expressed as mean) and dispersion (expressed as standard deviation) of the study variables					
Study variables	Number	Minimum	Maximum	Mean	Standard deviation
Age in years	120	18	21	19.05	0.82
Pulse rate per minute	120	60	130	86.92	13.88
Systolic BP	120	90	160	116.05	13.21
Diastolic BP	120	60	100	74.85	9.81
BMI in Kg/m^2	120	14.80	35.70	22.18	4.31
Waist circumference in cm	120	31	110	76.7	12.33
Waist to hip ratio	120	0.66	1.07	0.82	0.07
Mid arm circumference in cm	120	19	35	26.38	3.60

Table-2: Proportions of the study population on the cut off basis of blood pressure and anthropometry obesity indices

Proportion of hypertension and obesity in study population	**Frequency**	**Percentage**
1. Blood pressure categories		
Normal < 130/80	89	74
Hypertension (≥ 130/80 either or both systolic & diastolic BP)	31	26
2. BMI categories		
Normal BMI 18-22.9 Kg/m^2	67	55.8
Overweight BMI; 18-22.9 Kg/m^2	20	16.7
Obese ≥ 23 Kg/m^2	33	27.5
3a. Waist circumference categories in males		
Normal ≤ than 90 cm	38	70.9
Central obesity > 90 cm	17	29.1
3b. Waist circumference categories in females		
Normal ≤ 80 cm	47	72.3
Central obesity > 80 cm	18	27.7
4a. Waist to hip ratio categories in males		
Normal ≤ 0.9	48	87.3
Central obesity > 0.9	7	12.7
4b. Waist to hip ratio categories in females		
Normal ≤ 0.85	52	81.3
Central obesity > 0.85	12	18.7
5a. Mid arm circumference categories in males		
Normal < 30.9 cm	44	80
Obesity ≥ 30.9 cm	11	20
5b. Mid arm circumference categories in females		
Normal < 30 cm	55	84.6
Obesity ≥ 30 cm	10	15.4

Table-3: Association of hypertension with gender and anthropometry obesity indices (non-adjusted model)

Gender & anthropometry obesity indices	Frequency of participants with hypertension	Frequency of participants with normal BP	Total	Odds ratio (confidence interval)	p-value
Gender					
Male	22	33	55		
Female	9	56	65	4.12 (1.71-10.07)	0.001*
Total	31	89	120		
Body mass index (BMI)					
BMI(>23kg/m^2)	20	30	50		
BMI(18-22.9kg/m^2)	11	59	70	3.57 (1.52-8.42)	0.003*
Total	31	89	120		
Waist circumference (WC)					
WC(>90cm in males and 80cm in females)	18	17	35		
WC(<90cm in males and 80cm in females)	13	72	85	5.86 (2.41-14.25)	0.0001*
Total	31	89	120		
Waist to hip ratio (W/H)					
W/H (>0.9 in males and >0.85 in females)	4	15	19		
Normal(≤0.9 in males and ≤0.85 in females)	27	74	101	0.73 (0.22-2.40)	0.63
Total	31	89	120		
Mid upper arm circumference (MUAC)					
MUAC (≥30.9 cm in males and ≥30cm in females)	11	10	21		
MUAC (<30.9 cm in males and <30cm in females)	20	79	99	4.35 (1.62-11.66)	0.005*
Total	31	89	120		

Table-4: Association of hypertension with gender and anthropometry obesity indices (adjusted model)

Binary logistic regression to determine association of hypertension with the study variables by controlling confounders	B	Exp(B)	95% confidence interval	p-value
Gender	**1.61**	**5.02**	**1.87-13.51**	**0.001***
Body mass index	0.61	1.83	0.49-6.78	0.36
Waist circumference	**1.94**	**6.97**	**2.63-18.48**	**0.000***
Waist to hip ratio	1.37	0.25	0.05-1.37	0.11
Mid upper arm circumference	0.90	2.45	0.64-9.39	0.18

Dependent variable was hypertension and rest all are independent variables.

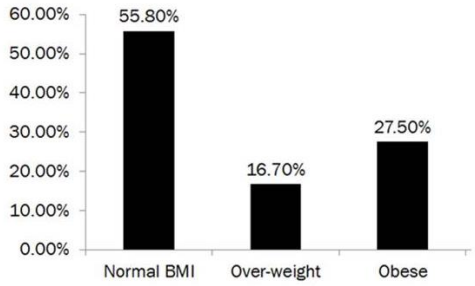

Figure-2: Proportion of study population on the basis of BMI

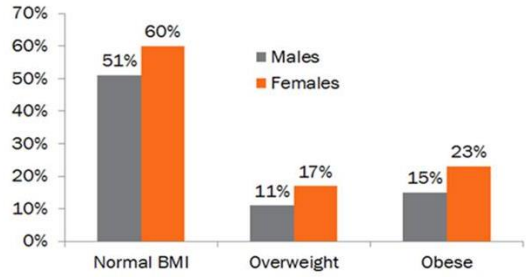

Figure-3: Proportion of study population on the basis of BMI and gender

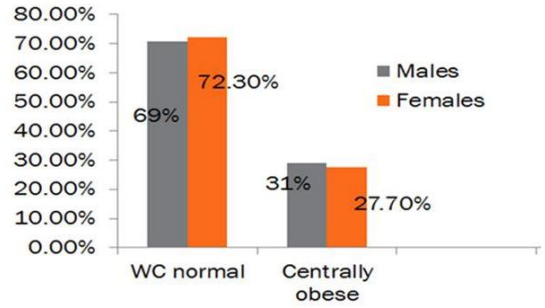

Figure-4: Proportion of study population on the basis of WC (waist-circumference)

DISCUSSION

The present study aimed to determine BP and anthropometry obesity indices of 1st year MBBS students. The mean systolic and diastolic BP of the subjects was found to be 116±13.21 and 74.85±9.81 respectively. These values were within the normal range and in accordance with the BP guidelines set by the American Heart Association[17]. However 26% of the study subjects were having their BP >130/80 (Figure 1) and were identified as hypertensive and 30% were pre-hypertensive[18]. This observation was in concordance with that of a previous study conducted on students of a medical school from Karnataka, India[24]. Another study from Qasim University, Saudi Arabia, reported 21% prevalence of hypertension among 130 medical students[25]. A study from Lincoln Memorial University reported 26% prevalence of hypertension in preclinical medical students[26]. A cross-sectional study on 1st and 2nd year American medical students reported prevalence of pre-hypertension of 16% and hypertension 29% respectively[27]. There was no history of smoking by any of the participants in the current study. However, hypertension was significantly associated with male gender. Out of 55 male subjects 22 were hypertensive, whereas 9 out of 65 females were hypertensive. There was 4 times increased risk of hypertension in males as compared to the females. This finding was in accordance with the previous studies on University students of Jordon and Saudi Arabia within the age group of 18-26 year as mentioned above.

Anthropometry obesity indices of the medical students were also measured and on the basis of BMI; 55.8% subjects were within the normal range, 16.7% were overweight and 27.5% were obese (figures: 2-4). This grouping was based upon ethnic specific guidelines for South East Asians; as previous studies have revealed that Asian ethnic class is at risk of diabetes mellitus and adverse coronary events at a lower body fat status. Asian Indians also have higher accumulation of hepatic and peri-visceral fat at a BMI of non-obese level (23-25 Kg/m^2) considered for other races.

Central adiposity indicators such as waist circumference or waist to hip ratio cut-off is also lower in Asian Indian ethnic group. Following these guidelines in this study 29% male and 27% female participants were having central adiposity, which is directly linked with insulin resistance, poor glucose disposal and future morbidities. Present results are in concordance with the previous epidemiological studies on Pakistanis, South Asians and Asian Indians[28].

In the current study, when chi-square test was applied there was significant association of hypertension with the obesity indices such as BMI, waist circumference and mid upper arm circumference. No considerable association was found with waist to hip ratio (tables 3,4). However, after controlling the confounder variables with the binary logistic statistics, significant association remained with gender and waist circumference. These results were in accordance with the previous study on Americans reporting significant association of hypertension with waist circumference[29]. Various studies have highlighted waist circumference as a prime determinant of cardiovascular and all-cause mortality beyond body mass index. Waist circumference is robustly related to absolute peri-visceral and abdominal fat mass compared to BMI. It is a considerable clinical marker in identifying the high risk adiposity phenotype[29]. In this study we were unable to find significant association of BP with BMI in adjusted model after controlling all the anthropometry indices however previous studies conducted on medical students in Pakistan reported significant association of BP with BMI[30, 31]. According to the present study, abdominal fat deposition depicted by waist circumference is found to be a high-risk phenotype associated with hypertension after controlling other confounder variables.

CONCLUSION

This study highlights an important health concern issue. Repeated surveys and regular monitoring can give information about the emerging trends in blood pressure. Students need to modify life style strategies for preventing obesity and hypertension.

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CONFLICT OF INTEREST

All Authors have no conflict of interest.

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AUTHOR CONTRIBUTION

All authors have contributed to all process in this research, including preparation, data gathering and analysis, drafting and approval for publication of this manuscript.

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