Original Article

Obesity and Hypertension in Female Medical Students; Frequency and Risk Factors

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ABSTRACT

OBJECTIVE: To determine the frequency and risk factors of obesity and hypertension in female medical students.
STUDY DESIGN: Descriptive cross sectional study.
SETTING: Department of Medicine, Sir Syed College of Medical Sciences and Hospital Karachi.
STUDY DURATION: 3 months (March 2014 to June 2014)
MATERIAL AND METHODS: Total 307 female medical students were included after ethical approval. Students with systemic illness, diabetes mellitus and taking corticosteroids were excluded. Demographic details obtained, followed by anthropometric measurements; height, weight, waist circumference and body mass index (BMI). Students were classified as underweight, at risk, overweight, obesity grade I and obesity grade II as per WHO criteria for Asians. Blood pressure of each student was measured at two occasions. Outdoor activity time, screen time, sedentary time, dietary preferences, sleep hours and family history documented. Data analyzed via SPSS version 17 with significant p-value < 0.05.
RESULTS: Among 307 students, obesity was found in 34% (25.4%obesity grade I and 8.8% obesity gradeII). Hypertension was found in 4.88 %. There was significant association between hypertension and obesity (12 % obese hypertensiveversus 1.9 % non obese hypertensive students). 35 % students had higher waist circumference that was associated with hypertension. Excessive use of soft drinks, diet drinks, meat, dairy products, chocolates, oversleep on weekends and daily screen time ≥2 hours were found to be associated with obesity.
CONCLUSION: Higher prevalence of obesity and obesity related hypertension in younger age group needs to be addressed. Those with obesity should be screened for the presence of hypertension at younger age. Waist circumference should be considered in addition to BMI while screening for obesity, and evaluation of its risk factors in Asians.Creating awareness and timely intervention in terms of dietary modification, adequate physical activity and sleep hours thus reducingthe screen time and sedentary time may help in controlling obesity and its complications among our young generation. Weight loss must be the first line of therapy in obesity related hypertension among younger obese population.

KEY WORDS: Body Mass index. Hypertension.Obesity.Screen time. Waist Circumference.

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INTRODUCTION

Overweight and obesity are defined by WHO as abnormal or excessive fat accumulation that may impair the health.[2] Obesity has been accepted as a recognized public health problem internationally with rapidly rising prevalence in several industrialized countries. Prevalence of obesity in American population in 2009-2010 was 36%.[2] In most of the Asian countries, prevalence of obesity has increased many folds since last few decades.[3] Prevalence in urban Pakistani population is 22-37%.[4]

There are several classifications and definitions of obesity. However, classification by WHO has been widely accepted all over the world that defines three grades of obesity on the basis of body Mass Index[2,5] However, as per consensus of WHO and WFIO: normal BMI for Asians is 18.5-22 kg/m^2, Overweight (BMI ≥23kg/m^2), at risk (BMI 23-24.9 kg/m^2), Obesity I (BMI 25-29.9 kg/m^2), Obesity II (BMI ≥30 kg/m^2) (Fig 1).[6]

Obesity contributes to pathogenesis of metabolic, cardiovascular, carcinogenic, musculoskeletal and cutaneous disorders.[7] Obesity is one of the contributing factors for hypertension. Possible mechanisms being increased blood flow, vasodilatation, high cardiac output and renal retention of sodium.Increased sympathetic tone, activation of rennin angiotensin system, hyper-insulinemia, structural changes in kidney and

leptins are also responsible for alteration in pressure-natriuresis curve in obese.[8]

Obesity related hypertension is associated with cerebrovascular and coronary artery disease, atrial fibrillation, congestive cardiac failure, atherosclerosis and renal insufficiency. In addition to standard pharmacological treatment, management of obesity related hypertension includes greater emphasis on dietary and life style modifications. The main stay of therapy is weight loss that leads to reversal of several mechanisms that sustain hypertension in obese.[9,10]

Since last few decades, there has been progressive urbanization in developing countries leading to dietary and life style changes. There is rising trend of intake of fast food, snacks, soft drinks and diet drinks with lack of fresh fruits, vegetables and fiber containing food. Use of television, mobile phones and computers is contributing to excessive screen time in younger generation.

Sedentary behavior and lack of physical activity are responsible for rising prevalence of non-communicable diseases like diabetes mellitus, hypertension, ischemic heart disease, obesity and malignancies i.e. leading cause of death and disability all over the world.[11] In Pakistan by the year 2025, 3.87 million premature deaths are expected from non-communicable diseases among people from 30 to 69 years that will have serious economic implications.[12]

We conducted this study to determine the frequency of obesity and hypertension among our female students. We also aimed to determine the possible risk factors and anthropometric predictors of obesity and hypertension among our students. Identifying those at risk and providing them timely intervention may help to minimize the non-communicable diseases including obesity and hypertension in our population.

SUBJECTS AND METHODS

Total 307 female medical students of specified institution (MBBS and BDS courses) were included after ethical approval by Institution and informed consent. Students having known systemic illness, diabetes mellitus,taking corticosteroids or other long term medications were excluded. Demographic details(name, age and address)were documented.

Anthropometric measurements were obtained by trained personnel. Height was measured by Leicester height measurement scale and weight by digital scale (rounded to nearest 0.1 kg).Students were advised to remove shoes and extra clothing before measurements.Body mass index (BMI) was calculated by formula weight(kg) / height(m^2). Students were classified as underweight, normal, at risk, obesity grade I and obesity grade II as per criteria of WHO **(fig I)**.

Blood pressure was measured manually by mercury sphygmomanometer. Student had to rest for 5 minutes and blood pressure was recorded in both arms in sitting position. In case of abnormal reading, second measurement was recorded after 5 minutes and average of two measurements calculated.[13] Hypertensionwas labeled at blood pressure $\geq$ 140/90 mmHgas per recommendations of Eighth report of Joint National Committee (JNC VIII).[14]

Family history of diabetes mellitus, hypertension, ischemic heart disease and obesity in at least one first degree relative was considered as positive. Outdoor activity, screen time, studying/reading time, dietary preferences and sleep hours were documented. Students having more than three servings per week were considered as high consumers of fast food, soft drinks, or snacks. All the information was documented on a specially designed proforma.

Data was analyzed using SPSS version 17. Mean and standard deviation calculated for quantitative data (height, weight, BMI, waist circumference). Categorical data presented as frequencies and percentages. Outcome of obesity was labeled as present or absent at BMI cut-off point of $\geq$ 25 kg/m^2. Chi-square test was applied to determine association of hypertension with obesity, and their association with daily screen time, sedentary behavior, family history and dietaryhabits.P-value<0.05 was considered as statistically significant.

RESULTS

Total 307 female medical students were included. Mean age was 22 $\pm$ 1.36 (19-28) years. Mean weight was 57.16 $\pm$ 11.59 (30-101) kg, mean height 157 $\pm$ 7.17 (137-186) cm, mean BMI 23.31 $\pm$ 4.66(12-42)kg/$m^2$and mean waist circumference 30.66 $\pm$3.94(23-42) inches.Higher Waist circumference (> 31.5 inches) was present in 39%.

The obesity was present in 105 (34%) students. As per BMI categories, 47 (15%) students were underweight, 93 (30%) normal weight, 62 (20%) at risk of obesity, 78 (25.4%) having obesity grade I and 27 (8.8%) obesity grade II **(fig I).** Obesity was found to be associated with high consumption of chocolates, soft drinks, diet drinks, meat and dairy products (p< 0.05) **(table I)**. Daily screen time of $\geq$ 2 hours was found to be associated with obesity (p = 0.008). Oversleep on weekends was also associated with obesity (p = 0.019). Obesity was significantly associated with family history of obesity, hypertension and ischemic heart disease (p< 0.05) **(table II).**

Mean systolic blood pressure was recorded as 113.91 $\pm$ 9.45 (90-180)mmHg and mean diastolic blood pressure 74.36 $\pm$ 8.49(50-115) mmHg. Hypertension was found in15 (4.88 %) students **(fig II).** Hypertension was

FIG I: BAR GRAPH REPRESENTATION OF VARIOUS BMI CATEGORIES OBSERVED IN STUDENTS (n = 307)

	BMI (kg/m^2)	n (%)
Underweight	< 18.5	47(15%)
Normal Weight	18.5 - 22	93(30%)
At risk	23 – 24.9	62(20%)
Obesity I	25 – 29.9	78(25.4%)
Obesity II	≥ 30	27(8.8)

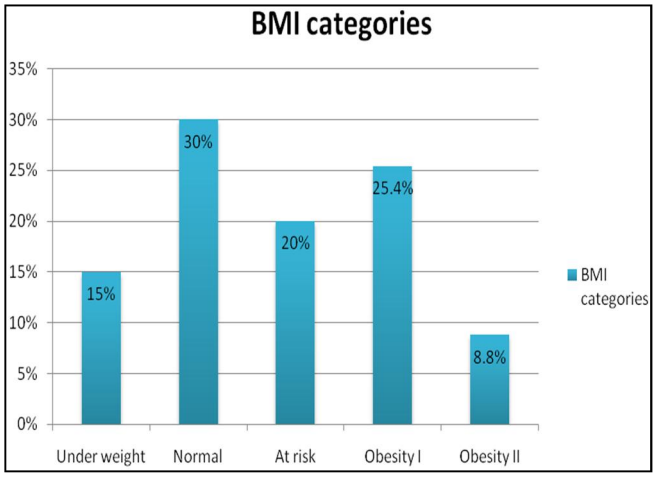

FIG II: PIE CHART REPRESENTATION OF HYPERTENSION AND MEAN SYSTOLIC AND DIASTOLIC BLOOD PRESSURES OBSERVED IN STUDENTS (n=307)

Blood Pressure	mean ± SD	range
Systolic Blood Pressure (mmHg)	113.91 ± 9.45	90-180
Diastolic Blood pressure (mmHg)	74.36 ± 8.49	50-115

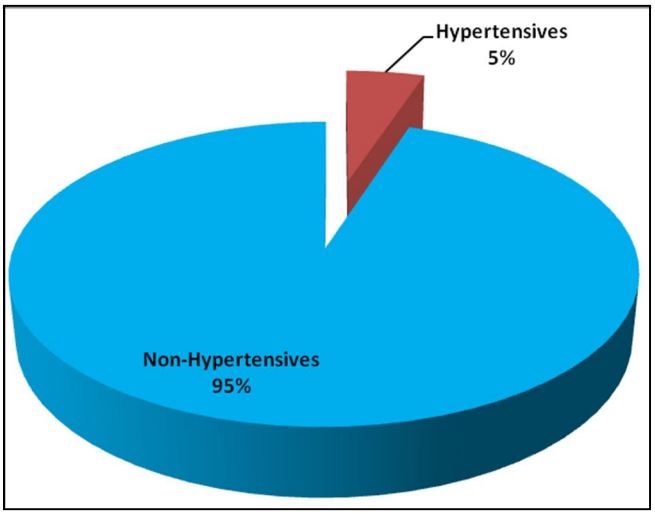

TABLE I: DIETARY PREFERENCES OF STUDENTS AND ASSOCIATION WITH OBESITY AND HYPERTENSION (n = 307)

		Daily n(%)	4-6 times/ week n(%)	1-3 times/wk n(%)	Never n(%)	Relation to Obesity	Relation to hypertension
Dietary pattern	Chocolates	46(15%)	54(18%)	143(47%)	64(21%)	0.016*	0.047*
	Soft drinks	74(24%)	64(21%)	117(38%)	50(17%)	0.022*	0.009*
	Diet drinks	21(7%)	44(14%)	80(26%)	162(53%)	0.039*	0.126
	Eggs	100(33%)	79(26%)	94(31%)	34(11%)	0.478	0.558
	Fast food	58(19%)	66(21.5%)	147(48%)	36(12%)	0.234	0.737
	Fruits	119(39%)	66(21.5%)	92(30%)	30(10%)	0.585	0.421
	Dairy products	97(32%)	68(22%)	78(25%)	64(21%)	0.025*	0.335
	Meat products	46(15%)	117(38%)	116(38%)	28(9%)	0.166	<0.0001*
	Snacks	132 (43%)	54 (17.5%)	81 (26.4%)	40 (13%)	0.126	0.951
	Vegetables	101(33%)	106(34.5%)	86(28%)	14(4.5%)	0.009	0.106

*P< 0.05 is significant; test of significance is Chi-square test.

found to be associated with excessive use of chocolates, soft drinks and meat products (p< 0.05), oversleep on weekends (p< 0.0001) and family history of ischemic heart disease (p< 0.0001).Waist circumference > 31.5 inches was found to be associated with hypertension (p = 0.001).

Among the students with hypertension; 11 (12 %) students were obese as compared to 4 (1.9 %) non-obese. Significant association was found between hypertension and obesity (p< 0.0001) **(table III).**

Almost 60 % students used canteen snacks, 53 % meat products, 45 % soft drinks, 41 % fast food, 33 % chocolates and 21 % diet drinks > 3 times a week. Use of vegetables > 3 times a week was observed in 67 %, fruits in 60 % and dairy products in 54 % students (table I).

Under-sleep (< 6 hours) was seen in 18.5 % students on weekdays and in 0.6 % on weekends. However over-sleep (> 10 hours) was seen in 2.6 % students on week days and 14.6 % on weekends. Daily screen time ≥ 2hours seen among 76 % students. Weekly physical activity time < 2.5 hours was seen in 66.7 % students. Daily sedentary time of ≥ 3 hours was seen in 73 % students. Family history of diabetes mellitus, hypertension, ischemic heart disease and obesity was present in 44 %, 45 %, 19.5% and 19 % students respectively (table II).

TABLE II: PHYSICAL ACTIVITY, SLEEPING HABITS AND FAMILY HISTORY OBSERVED IN STUDENTS IN ASSOCIATION WITH OBESITY AND HYPERTENSION (n = 307)

Risk factor				Relation to Obesity	Relation to Hypertension
Sleep hours	Sleep hours /day (on week days)	Mean ± SD Range < 6 hours 6-10 hours >10 hours	6.73 ± 1.77 2-12 57 (18.5) 242 (78.8%) 8(2.6%)	0.312	0.446
	Sleep hours /day (on holiday)	Mean ± SD Range < 6 hours 6-10 hours >10 hours	9.05 ± 2.16 1-18 2 (0.6%) 238 (77.5%) 45 (14.6%)	0.019*	<0.0001*
Physical activity	Screen time / day	Mean ± SD Range ≥2 hours < 2 hours	2.56 ± 1.42 0-8 233 (76%) 74 (24%)	0.008*	0.140
	Outdoor games & exercise /week	Mean ± SD Range <2.5 hours >2.5 hours	2.42 ± 2.95 0-14 205 (66.7%) 102 (33%)	0.639	0.993
	Sitting time/day (sitting and reading)	Mean ± SD Range ≥3 hours < 3hours	3.99 ± 1.96 0-10 224 (73%) 83 (27%)	0.652	0.573
Family history	Diabetes	n (%)	135 (44%)	0.210	0.751
	Hypertension	n (%)	147 (45%)	0.018*	0.335
	Ischemic heart disease	n (%)	60 (19.5%)	< 0.0001*	<0.0001*
	Obesity	n (%)	58 (19%)	0.005*	0.573

*P<0.05 is significant; test of significance is Chi-square test.

TABLE III: COMPARISON BETWEEN OBESE AND NON-OBESE HYPERTENSIVE STUDENTS (n = 307).

	Obese n = 91	Non-Obese n = 216	P-value
Hypertensive	11 (12%)	4 (1.9%)	< 0.0001*
Non- hypertensive	80 (88%)	212 (98%)	

*P<0.05 is significant; test of significance is Chi-square test.

DISCUSSION

Obesity has emerged as a global epidemic during last few decades. With the changing life style, dietary pattern and urbanization; developing countries are also facing this problem.[15] The prevalence of worldwide

obesity has almost doubled since 1980. There were more than 1.4 billion obese adults all over the world in year 2008.The prevalence of obesity in the United States in 2010 was 35.7% i.e. almost 2/3rd of its population.

This study was conducted on medical students that represent our younger generation. We found prevalence of obesity to be 34 % i.e. comparable to the figureof 36 % in a developed country like United States reported by Flegal et al.[2] A regional study conducted by Nanan et al shows prevalence of obesity in rural area to be 9 % (men) and 14 %(women). Higher prevalence was observed in urban men (22%) and urban women (37%).[4] Jaffer et al observed prevalence of 25 % in Indo-Asian population.[16]Our study represents the urban younger females and reflects the higher regional prevalence of obesity.

We used the criteria of WHO for Asians that recommends the BMI cut-off point of $\geq$25 kg/m^{2}for obesity in Asians **(fig I)**. The underlying reason beingthe evidence of higher prevalence of type 2 diabetes mellitus and cardiovascular risk factors in certain regions of Asia where average BMI is < 25 kg/m^2. Another reason being the variation in the association between BMI, body fat percentage and distribution of body fat, between Asians and non-Asians.,[17,18]

Tayemetal found obesity in 4 % of Palestinian female students.[19]Ramchandran et al compared obesity in Asian countries Vs. United States of America in 2002 and found prevalence of 2.2 % in India as compared to 30.2 % in USA.[3] Jafar et al concluded that quarter of Pakistani population is obese as per Asian criteria for obesity.[12]Comparatively higher figure of 34 % in our students reflects the rising burden of obesity in Asia. Public awareness programs are required at national level to facilitate healthy life style that is key to reduce burden of the obesity and obesity-related disorders.

The National Institute of Health reports increased waist circumference to be associated with increased risk of type 2 diabetes mellitus, dyslipidemia, hypertension and cardiovascular disease for individuals with BMI of 25 to 34.9 kg/m^2. Sniderman et al in his adipose tissue overflow hypothesis suggested the substantial differences in the primary adipose tissue compartment between South Asians and white people.[20]Lim et al suggested that Asian women have greater abdominal and visceral fat than Caucasian women with similar overall adiposity. Among our students, 39% had waist circumference more than recommended figure of 31.5 inches. This may contribute to the elevated metabolic risk for obesity related diseases. This study found significant association between increased waist circumference and hypertension. In view of this authors suggest that waist circumference should also be used in addition to BMI to predict the risk of metabolic and cardiovascular morbidity in Asians.

The physical activity and sedentary behavior of students was also assessed. 76 % of our students spent $\geq$ 2 hours daily on various screens (mobile phones, tablets, television and computer). This is more than the recommended screen time of < 2 hours for adults. Stamatakis et al concluded that spending $\geq$ 2 hours a day in front of a screen during leisure time, particularly watching television, almost doubles the risk of cardiovascular events over four years.[22] Higher screen time in our students is a contributing factor to obesity and hypertension. Awareness should be created to limit screen time to < 2 hours per day.

We found that 73 % of our students spent $\geq$ 3 hours sedentary time daily. Healy et al stated that the total sedentary time (i.e. absence of whole-body movement) has been associated with obesity, abnormal glucose metabolism and metabolic syndrome.[23] Though our students had higher sedentary time, yet it wasn't found to be associated with obesity or hypertension.

American Heart Association and Center for Disease Control and Prevention recommends 150 minutes of exercise or physical activity per week.[24]66.7 % of our students had weekly physical activity time less than the recommended. Thus indicating the need to increase physical activity, reducing the sedentary time and taking breaks in between sedentary time. Replacing the sedentary time with physical activity can reduce the risk of cardiovascular events.

Beccuti et al found insufficient sleep to be associated with endocrine alterations, i.e. impaired glucose tolerance, decreased insulin sensitivity, raised evening cortisol levels, increased ghrelin, decreased leptins and increased hunger and appetite.[25]Ruiz et al concluded that sleep deficit on weekdays leads to sleep debit, being compensated by oversleep at weekends i.e. associated with obesity.[26] The pattern of sleep in our students with under sleep on working days and over sleep on weekends was found to be associated with obesity and hypertension. Appropriate sleep hours are suggested to avoid sleep debit and improve mental and physical wellbeing.

With the progressive westernization in developing countries, Aziz et al found that in Karachi, most of the food provided to children and adolescents by their families is not according to food pyramid and lacks fresh vegetables and fruits.[27] Boggs et al concluded that excessive use of fast food and soft drinks leads to obesity in younger women.[28] In our study, excessive use of soft drinks and chocolates was found to be associated with obesity as well as hypertension.

As per criteria of JNC VIII guidelines, 4.88% of our students were found to be hypertensive that is comparable to western developed countries. As per figures

provided by CDC, prevalence of hypertension in US adults increases with age, i.e. from 7.3% (18–39 years), to 32.4% (40–59 years), to 65.0% (> 60 years).[29]Hussain et al in his study conducted in southern Punjab reports the prevalence of 5.7 % in younger Pakistani population.[30]However,Tayem et al reports a lower figure of 0.4-3.3 % in the West Bank University Palestine.[19] Our results are higher than this figure. This indicates need to screen high risk at younger age.

Wakabayashi et al reported adiposity to be strongly associated with hypertension.[31]A study conducted by Khan et al in Peshawar proves significantly more hypertension in obese patients than in non-obese with coronary artery disease.[32]Re RN et al concluded that obesity predisposes to hypertension and alters the course of hypertensive cardiovascular disease.[8]

Family history of obesity was present in 19%. Yucel et al reported that family history of obesity in parents and siblings is a significant risk factor for raised BMI.[33]Thus, pointing to need for screening and intervention in those with positive family history of obesity, hypertension and ischemic heart disease.

There are fewer studies conducted on Pakistani younger population regarding risk factors for hypertension and obesity. We applied the criteria specific for Asian population that includes lower cut-off value for BMI as compared to the criteria for non-Asians. The results of this study should be interpreted carefully in view of certain limitations of this study. Being an institute of female students, we were unable to include males and suggest further regional studies that include both the genders. Also comparison with age matched controls is suggested in further regional studies.

CONCLUSION

Screening programs for obesity and hypertension should be offered to younger people along with implementation of life style modification, dietary advice and pharmacological intervention.

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