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Original Article

The Use of Obesity Indicators for the Prediction of Hypertension Risk among Youth in the United Arab Emirates

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Abstract

Background: Obesity is a significant risk factor for metabolic disorders including increase in blood pressure. Body mass index (BMI), waist circumference (WC) and Waist/Hip ratio (WHR) are simple and effective indicators of obesity. The objectives of this study were to examine the relationships between obesity anthropometric indicators and hypertension and to identify the best anthropometric indicator/s that can predict hypertension risk among youth in the UAE.

Methods: A 110 first year students in a Medical University in Ajman, UAE, during the year 2009-2010 were included in a cross-sectional study. The height, weight, WC, hip circumference and blood pressure were measured and the BMI and WHR were calculated for each student and used in the analyses.

Results: The mean values for BMI, WC, hip circumference and WHR, were significantly higher in the Pre/Hypertensive group compared to normal blood pressure group. The risk of Pre/ hypertension was significantly increased by 4.3 times for participants who had general obesity (BMI≥ 30) or abdominal obesity (identified from high WC). Highly significant correlations were noticed between systolic and diastolic blood pressure and all anthropometric indicators except that for Hip circumference and systolic blood pressure. Step-wise linear regression model showed that when all obesity indicators were studied together, the waist circumference was the only indicator which showed significant relationship with both systolic and diastolic blood pressure.

Conclusion: Waist circumference is the best anthropometric indicator that can predict hypertension risk among youth in the UAE.

Keywords: *Hypertension, Youth, Obesity indicators*

Introduction

Overweight and obesity are well-known risk factors for a wide range of chronic non-communicable diseases, debilitating conditions, and psychosocial problems (1) The prevalence of overweight and obesity in youth is increasing rapidly worldwide (2) and is a serious concern for public health. Several studies suggest that overweight early in life is associated with increased cardiovascular risks in adulthood (3, 4).

Abdominal obesity has emerged as an important predictor for adverse health effects; it has been linked to the metabolic syndrome, type 2 diabetes (5-7) and increased cardiovascular and metabolic risks in both adult men and women (8-10)

The Body mass index (BMI) is recommended by the World Health Organization (WHO) as the most useful epidemiological measure of obesity (5). Nevertheless, it is a crude index that does not take into account the distribution of body fat, resulting in variability in different individuals and populations (2).

The BMI is used as an indicator of overall adiposity, whereas waist circumference (WC) has been

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advocated as an indicator of abdominal obesity because it is a good predictor of abdominal fat (11,12) and is related to the development of cardiovascular diseases, type 2 diabetes mellitus, and premature death(13-16).

The BMI and WC have been used for the prediction of risk factor clustering among children and adolescents in the USA (17). Reported data showed a strong gradient between higher BMI and increased risk of hypertension among all ages in Nigeria (18). Both BMI percentile and WC were significantly ($P< .05$) associated with daytime and nighttime systolic and diastolic BP (19).

Little is known about these relationships among youth in the United Arab Emirate. The present study was therefore undertaken to examine the relationships between obesity anthropometric indicators and hypertension among the Emiratis youth and to identify the best anthropometric indicator/s that can predict hypertension risk among the studied population.

Materials and Methods

A cross-sectional study was conducted among first year students in the Gulf Medical University of Ajman, UAE. Students enrolled in Medicine, Dental Medicine, and Allied (Pharmacy and Physical Therapy) academic programmes during the year 2009-2010 were included in the study. The study was approved by the Ethics Committee of the Gulf Medical University. Verbal consent was taken from the participants before enrollment in the study. The height was measured on a vertical scale with heels, buttocks, and occiput against the wall and head in Frankfurt plane, to the nearest 0.5 cm. Weight was measured on a weighing scale with standard minimum clothing to the nearest 0.5 kg. Waist circumference (WC) was measured midway between the lowest rib and the superior border of the iliac crest, with a flexible tape. Hip circumference was measured at the level of greater trochanters with the subject in standing position and both feet together. For the previous measurements, two consecutive recordings were made for each student and the average of the two readings was used in all analyses. The Waist/Hip ratio (WHR) was obtained by dividing Waist circumference by hip circumference (20). Abdominal obesity is identified when the participant has high WHR or high WC. The cut-off values used to identify High WHR among males and females were ≥0.95 and ≥ 0.85 respectively, while those used to identify high WC were 102 cm and 88 cm respectively (21).

The BMI was calculated using the formula- weight (in kg.) divided by height^2 (in mtr.). Categorization of BMI was done based on the WHO criteria (2) into three categories: normal (BMI= 18.5-24.9 kg m^{-2}), overweight (BMI= 25-29.9 kg m^{-2}) and obese (BMI≥ 30 kg m^{-2}). For blood pressure (BP) measurement a mercury sphygmomanometer with an appropriate sized cuff was used to obtain an accurate measurement. The onset of the first tapping sound was taken to indicate the systolic blood pressure, while the point of complete disappearance of the sound (Korotkoff V) was taken to indicate diastolic blood pressure. The BP was measured two times for each student by same team on the right arm of participants in a seated relaxed position. The means of the two BP measurements were used in all analyses and interpreted as per the BP guidelines, issued in 2003 by the National Heart, Lung, and Blood Institute (NHLBI) as shown in Table 1 (22).

Table 1: Classification of blood pressure for adults (22)

Category	Systolic Blood Pressure mm of Hg	Diastolic Blood Pressure in mm of Hg
Normal	less than 120	less than 80
*Prehypertension	120-139	80-89
stage Hypertension1	140-159	90-99
Hypertension stage2	more than 160	more than 100

Prehypertension: A group of individuals whose systolic and diastolic BP are120-140 and 80-90 mm Hg.repectively22

Descriptive statistics such as means, standard deviation were used to summarize the quantitative variables. Proportions and percentages were used to summarize categorical variables. Chi-square test examined the association between variables. The significance of difference between mean values was tested by using independent *t*-test. The correlation between variables was tested by simple correlation coefficient. Multiple linear regression with stepwise method, to eliminate the variables with smallest significance, was used to find the factor/s, which should be included in the final model. A $P \leq 0.05$ was considered for statistical significance.

Results

The study include 110 students, 84(76%) of them are females. Distribution of the studied participants by gender, program, BMI, Waist circumference, Waist/Hip ratio and blood pressure categories is shown in Table 2. It can be seen that only 69 participants (62.7%) have normal BP. Significant association is noticed between BP and gender, BMI and Waist circumference. The frequency of Pre/ Hypertension is significantly higher among males compared to females (61.5% Vs 29.8%), among obese compared to non-obese group (66.7% Vs 31.5%) and among participants who have abdominal obesity (identified from high waist circumference) compared to those who do not have abdominal obesity (66.7% Vs 31.5%). The prevalence of both general obesity (BMI≥ 30) and abdominal obesity (high WC) is 16.4% (in both cases, 18/110). Table 3 shows the mean (±standard deviation) values of BMI, waist circumference, hip circumference, waist/hip ratio in Pre/Hypertensive and Normal Blood Pressure groups.

Significantly higher mean values of all indicators are noticed in the Pre/Hypertensive group compared to the Normal Blood Pressure group.

The mean and standard deviation values for systolic and diastolic BP among the normal and Pre/Hypertensive males and females are shown in Table 4. The mean systolic and diastolic BP values are significantly higher among the Pre/Hypertensive males and females compared to their counterpart in the normal BP groups.

Table 5 shows the risk (Odds Ratio) of Pre/ hypertension among the studied youth. It can be seen that the risk of Pre/hypertension is significantly increased by 4.3 times for participants who have general obesity or abdominal obesity (identified from high WC). Participants with high WHR also have an increase in the risk of Pre/ hypertension by 1.8 times but this increase in risk is not significant.

The correlations between anthropometric indicators used and systolic and diastolic BP are shown in Table 6 and 7 respectively. Highly significant correlations are noticed between systolic and diastolic BP and all anthropometric indicators used except that between Hip circumference and systolic BP. To eliminate the variables with smallest significance and to find the factors, which should be included in the final model, Step-wise linear regression models, were fitted for systolic and diastolic BP as dependent variables and anthropometric indicators as independent variables. Waist circumference was the only anthropometric indicator which showed significant relationship with both systolic BP (beta 0.334, SE 0.095, $P< 0.001$) and diastolic BP (beta 0.526, SE 0.074, $P< 0.001$).

Table 2: Distribution of the studied participants by blood Pressure and different variables

Variables	Group	Blood Pressure				Total	Significance
		Normal		Pre/Hypertension			
		n.	%	n.	%		
Gender	Female	59	70.2	25	29.8	84	<0.05
	Male	10	38.5	16	61.5	26	
Programme	MBBS	28	54.9	23	45.1	51	NS
	Allied	24	77.4	7	22.6	31	
	DMD	17	60.7	11	39.3	28	
BMI (kg m^{-2})	<30	63	68.5	29	31.5	92	<0.005

Table 2: Continued…

	≥ 30	6	33.3	12	66.7	18	
Waist/Hip ratio	Normal	61	64.9	33	35.1	94	NS
	*High	8	50.0	8	50.0	16	
Waist	Normal	63	68.5	29	31.5	92	<0.005
circumference	**High	6	33.3	12	66.7	18	

Note: χ^2-test was used to test the association between variables
* ≥0.95 and ≥ 0.85 for males and females respectively
**≥102 cm and ≥88 cm for males and females respectively

Table 3: The mean (± standard deviation) values for BMI, waist circumference, hip circumference, waist/hip ratio, systolic and diastolic blood pressure in Pre/Hypertensive and Normal Blood Pressure groups

Anthropometric indicators	Normal (No=69) Mean (±SD)	Pre/Hypertensive (No=41) Mean (±SD)	*P*
BMI	23.3 (4.6)	27.6 (6.5)	<0.001
Waist circumference (cm)	74.6 (9.6)	86.0 (14.3)	<0.05
Hip circumference (cm)	96.4 (9.6)	102.7 (13.9)	<0.001
WH Ratio	0.78 (0.09)	0.84 (0.11)	<0.001
Systolic BP	107.4 (9.5)	121.2 (14.7)	<0.005
Diastolic BP	68.4 (7.1)	84.1 (10.9)	<0.005

Note: The significance of difference between mean values was tested by using independent t-test

Table 4: The mean and standard deviation values for systolic and diastolic blood pressure among the normal and Pre/Hypertensive males and females

Gender	Blood Pressure	Normal		Pre/Hypertensive		*P*-value
		Mean	SD	Mean	SD	
Males	Systolic BP	113.8	10.8	125.7	12.2	<0.05
	Diastolic BP	68.6	10.9	84.6	14.0	<0.005
Females	Systolic BP	106.3	8.9	118.4	15.6	<0.001
	Diastolic BP	68.4	6.4	83.9	8.7	<0.01

Note: The significance of difference between mean values was tested by using independent t-test

Table 5: The risk (Odds Ratio) of Pre/ hypertension among the participants in different anthropometric indicators categories

Anthropometric measurement		Odds ratio	Confidence Interval (Lower-Upper)	*P* value
BMI (kg m^{-2})	< 30	**Comparative Group**		
	≥ 30	4.345	1.484-12.720	0.007
Waist circumference (cm)	Normal	**Comparative Group**		
	High*	4.345	1.484-12.720	0.007
Waist/Hip ratio	Normal	**Comparative Group**		
	High**	1.848	0.636-5.377	0.259

*≥102 cm and ≥88 cm for males and females respectively
** ≥0.95 and ≥ 0.85 for males and females respectively

Table 6: Simple correlation coefficient (r) between Systolic Blood Pressure and obesity anthropometric indicators

Variables	Simple correlation coefficient	*P*- value
BMI	0.307	< 0.001
Waist circumference	0.338	< 0.001
Hip circumference	0.176	.066
Waist/Hip ratio	0.261	.006

Note: The correlation between variables was tested by simple correlation coefficient.

Table 7: Simple correlation coefficient (r) between Diastolic Blood Pressure and obesity anthropometric indicators

Variables	Simple correlation coefficient	*P*- value
BMI	0.474	< 0.001
Waist circumference	0.526	<0.001
Hip circumference	0.384	<0.001
Waist/Hip ratio	0.305	.001

Note: The correlation between variables was tested by simple correlation coefficient.

Discussion

The WHO Report, 2002 "Reducing Risks, Promoting Healthy Life" has identified obesity as one of the ten leading risk factors, globally (5).

The prevalence of obesity found in the current study (16.4%) is higher than that reported in previous two studies done on Emiratis youth in Al-Ain, UAE with a reported prevalence of 7.5% (23) and 9.8% (24). Our data is also higher than other study done on University students in Jordan (25), with a reported prevalence of 11.9 %.

In the population studied, the prevalence of Pre/ Hypertension is 37.3%. Significantly higher prevalence of Pre/Hypertension is noticed among males compared to females. This is in agreement with another study done in Addis Ababa, Ethiopia, in which the prevalence of hypertension among males Vs females was 31.5% Vs 28.9% (26).

In the present study, higher mean systolic and diastolic BP values are noticed in males compared to females in both the normal and pre/Hypertension group. This is in accordance with another study done in India (27), in which the mean systolic and diastolic BP values in males versus females were 120.20±15.59 Vs 118.35±15.70 mm Hg and 77.63±10.65 Vs 76.06±10.53 mm Hg respectively. Other investigators (28) in Al-Ain city, UAE, found that the mean diastolic BP in the normotensive and incident hypertensive groups were significantly higher in males compared with females (77.4±5.6 Vs 77.2±5.5 and 91.4±7.2 Vs 89.8±6 respectively), while it was not significant for the self reported hypertensive group (89.8 ±10.5 Vs 89.6±10.5).

In the current study, significantly higher prevalence of Pre/hypertension was observed among participant who have general obesity and abdominal obesity. The association between obesity and hypertension was reported by many investigators using cross-sectional study (27) and longitudinal study (29) designs. Being obese in this study is associated with more than fourfold increase in the risk of developing Pre/Hypertension and this increase in the risk was statistically significant. This emphasize what had been reported by other investigators that being overweight is associated with two- to six fold increase in the risk of developing hypertension. An increase of 2-3 mmHg in systolic and 1-3 mmHg in diastolic blood pressure has been shown for each 10 kg increase in weight in

western population (30). Another study done in Brazil (31), showed that the odds ratio (OR) for arterial hypertension for overweight and obese individuals were 2.04 (95% CI: 1.65-2.54) and 4.08 (95% CI: 3.30-5.08), respectively. Studies in urban Indian population also showed strong relationship between different anthropometric indicators and BP levels (32, 33). In another study (34), subjects with central obesity had significantly higher frequency of hypertension ($P< 0.0025$) and higher mean values for BMI, systolic and diastolic BP values compared to their counterpart in the non-central obesity group.

In the present study significant positive correlations are noticed between all anthropometric indicators and systolic and diastolic BP except that between hip circumference and systolic BP. Similar findings were reported by other researchers (35). Many investigators have earlier reported significant positive correlation of BMI with systolic and diastolic BP (36). A study done on Australian adults showed that BMI, WC and WHR were equally related with hypertension (37). A study from Pakistan, reported significant positive correlations between BMI with systolic (r= 0.592, $P< 0.0001$) and diastolic BP (r= 0.199, $P< 0.0001$), similarly, positive correlation was found between WHR with systolic (Males r= 0.356, $P< 0.0001$, Females r= 0.346) and diastolic BP (Males r= 0.396, $P< 0.0001$, Females r =0.412) in both males and females (38).

The current data suggest that WC is superior to other obesity indicators to predict both systolic and diastolic BP among youth in the UAE, and this emphasize data from the Obesity in Asia Collaboration which indicate that measures of central obesity, in particular WC, are better discriminators of diabetes and hypertension in Asians and Caucasians, compared with BMI (39). A study on Chinese population showed that the WC is the best predictor of metabolic risk factors including hypertension (40). Findings of clinical studies suggest that the WC rather than the WHR should be used as index of abdominal visceral adipose tissue and related cardiovascular risk in men and women (11). In conclusion, the waist circumference is the best anthropometric measures to be used for screening of hypertension among youth. From evidence of this study, we recommend that the WC should be used to screen youth in the UAE for the risk of hypertension. The WHO report (2) suggest that individual can be identified as being at increased risk of obesity-related illness by using waist circumference alone, even though the risks seems to vary in different populations.

Ethical Considerations

Ethical issues including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc. have been completely observed by the authors.

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