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Waist Circumference: An Important Marker for Hypertension

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ABSTRACT

Introduction: High blood pressure indirectly identified through anthropometric indicators may be an efficient strategy for detection and control, mainly because these measures can be implemented without specialized technical apparatus. The study was done with the objective of evaluating waist circumference as marker for hypertension.

Methods: Blood pressure, height, weight and waist circumference was measured using standard procedures for all participants in the cross sectional study. t test and ANOVA test was used to compare mean values of waist circumference among different groups.

Results: There was a statistically significant difference in waist circumference between age groups (F = 4.388, p=0.013); education groups (F = 11.037, p=0.000) and BMI groups (F = 57.7, p=0.000). 63.5% of hypertensive had waist circumference more than the gender specific cutoff point. Both mean systolic and diastolic blood pressure was higher in the individuals with waist circumference more than the gender specific cutoff for all the categories of BMI in both the genders. The proportion of hypertensive was 45.5% in normal weight and 57.4% in overweight group with waist circumference more than gender specific cutoff (p<0.05).

Conclusion: The study emphasizes the need for using simple anthropometric tool like waist circumference for assessing risk of hypertension in communities.

Key words: Waist circumference, Systolic blood pressure, Overweight, Diastolic blood pressure

INTRODUCTION

Hypertension is a non-communicable disease that affects more than 25% of the global adult population, including Oman.[1] It is projected that by 2025, hypertension will increase by 24% to over 80% in developed and developing countries, respectively. This has the potential to overwhelm health care systems with increasing demands and related costs for treatment.[2,3]The presence of morbidities, hypertension and obesity; can affect the health status of individuals and communities adversely and may have serious social and economic implications.

High blood pressure indirectly identified through anthropometric indicators may be an efficient strategy for the detection and control, mainly because these measures can be implemented without specialized technical apparatus.[4] This strategy allows screening adults with anthropometric indicators and for discriminating high blood pressure; subjects can be screened at all health care facilities, particularly in primary health care settings.

The Jackson Heart Study showed a strong association between visceral fat as measured by waist circumference (WC) and cardio metabolic risk factors in adult African Americans even after accounting for body mass index (BMI).[5] Lorenzo et al also found that the waist circumference was associated with higher blood pressure.[6]Després argued that because there is a wide range of waist circumference for every BMI value, it will be simplistic to think that WC is a better measure of cardiovascular disease risk over BMI especially given that WC may be influenced by subcutaneous or visceral fat.[7] Lee et al showed that WC and waist height ratio was more closely associated with metabolic risk factors than other indices of general adiposity. These authors also demonstrated the fact that there was a weak relationship between waist hip ratio and blood pressure in females. This observation could be explained by the fact that the effect of WC is often masked by the increase in HC which generally accompanies a big WC.[8] Indeed several studies have shown that WC may be a more sensitive predictor of CVD risk than the other measures of obesity.[9,10]

Measurement of WC alone as a proxy of abdominal fat mass has been suggested as a simple clinical alternative to BMI for detecting adults with possible health risks due to obesity. Moreover the Oman health survey in 2008 showed that the mean WC of Omani males and females were 89.7 cm and 88.7 cm, respectively. The percentage of the Omani population classified to have central obesity was high; overall more than one third of the Omani population had excess abdominal fat (i.e. centrally obese); 19.7% males and 53.5% females were centrally obese.[11] With this background the present study was conducted to evaluate waist circumference as an important marker for hypertension.

METHODS

A cross sectional study was conducted in South Batinah governorate polyclinic. Inclusion criteria of participants in the study was people of Omani nationality visiting the clinic, age more than 18 years who gave consent to participate in the study. The visitors less than 18 years of age and those who did not give consent and expatriates were excluded from the study. The estimated sample size was 469, considering the prevalence of hypertension in Omani adults as 45%, with 10% variability in the estimated prevalence. Thus a total of 500 participants more than 18 years of age formed the study population. Information on age, gender, education and occupation was collected from all the participants after taking informed consent. The study was approved by the Ministry of health research and ethics committee. Height, weight, waist circumference and blood pressure were measured for all. All participants were requested to remove footwear; weight was measured to the nearest 0.1kg on Detecto scale. Height was measured while the participant was standing with heels together with the body held in a maximally erect position and hands placed on hips and head held in the Frankfurt plane. Height was measured to the nearest 0.1 cm. Waist circumference was measured in centimeter midway between the lower costal margin and iliac crest in a horizontal plane during the end expiratory phase. Blood pressure was measured with mercury sphygmomanometer. The standard definition of hypertension was considered as systolic blood pressure (SBP) of ≥ 140 mm Hg and/or diastolic blood pressure (DBP) ≥ 90 mm Hg.[12] The body mass index (BMI) was calculated by dividing weight by square of height in (kg/m^2). BMI less than 18.5 was considered underweight, 18.5 to 29.9 as normal weight and ≥ 25 as overweight.[13] To define overweight, waist circumference cut offs were taken as ≥ 94 for males and ≥ 80for females.[14,15]

Data was analyzed in SPSS. Mean and standard error of anthropometric measurements was calculated for comparison in different socio-demographic groups. Similarly mean and standard error of mean systolic and diastolic blood pressure values was calculated for comparison in different BMI and waist circumference groups. The chi-square test was used to test variation in frequency. The t test was used to assess differences in the means of continuous variables. ANOVA test was used to compare waist circumference among different age, education and BMI groups. Homogeneity of variance was tested by F test. A post hoc comparison to evaluate pair wise differences among group means was conducted with use of Tukey HSD tests. Statistical significance was set at $p < 0.05$.

RESULTS

A one-way analysis of variance was used for comparison of waist circumference among age, education and BMI groups (Table 1). The assumption of normality was evaluated by histograms and found tenable for all the groups. There was a statistically significant difference in waist circumference between age groups as determined by one-way ANOVA (F=4.388, p=0.013). A post hoc comparison tests revealed significant pair wise differences between the mean score of participants in age group < 30 years and > 50 years, p=0.010. Participants in the age group 31-50 years did not statistically differ from the other two groups, p>0.05. Similarly there was statistically significant difference between education groups, one-way ANOVA (F=11.037, p=0.000). Post hoc comparisons showed significant differences between mean score in higher secondary group and secondary (p= 0.008); between higher secondary and primary group (p= 0.000). Participants with secondary education did not differ statistically from primary group, p>0.05. Different BMI groups also had statistically significant difference in mean waist circumference values, one-way ANOVA (F=57.7, p=0.000). Post hoc comparisons showed significant differences between mean score in overweight and underweight group (p= 0.000); between overweight and normal group (p= 0.000). Participants with normal weight did not differ statistically from underweight group, p>0.05. Waist circumference did not differ significantly between gender and occupation groups in the hypothesis testing done using t test.

157 (77.3%) of hypertensive population had high BMI; whereas 129 (63.5%) of hypertensive had waist circumference more than the gender specific cutoff point (80 for females and 94 for males).

Out of the underweight population, 25% of hypertensive had waist circumference more than the gender specific cutoff. The proportion of hypertensive increased with increase in BMI. It was 45.5% in normal weight and 57.4% in overweight group (Table 2). The difference was statistically significant in the normal and overweight group (p<0.05).

The mean systolic blood pressure was statistically significantly higher in the individuals with waist circumference more than the gender specific cutoff in the normal weight (p= 0.004) and overweight (p= 0.001) categories of BMI (Table 3).

Table 1: Distribution of waist circumference according to socio-demographic characteristics

Variable	Mean ± S.E	p value
Age (years)		
<30	88.0 ± 1.22	0.013
31-50	90.5 ± 1.49	
>50	94.0 ± 1.55	
Gender		
Male	91.0 ± 0.92	0.922
Female	90.8 ±1.81	
Education		
Higher secondary	85.9 ± 1.18	0.000
Secondary	92.6 ± 1.65	
Primary	94.4 ± 1.43	
Occupation		
Physical activity	89.7 ± 1.04	0.108
Sedentary	92.4 ± 1.33	
BMI		
Underweight	79.9 ± 4.18	0.000
Normal	79.9 ± 0.97	
Overweight	96.7 ± 1.03	

Table 2: Population classified by waist circumference and BMI

Variable	Hypertensive(%)	Non Hypertensive(%)	Total (%)	p value
Underweight BMI (n=24)				
W.C < cutoff	5 (31.3)	11 (68.7)	16 (66.7)	0.572
W.C ≥ cutoff	2 (25.0)	6 (75.0)	8 (33.3)	
Normal weight BMI (n= 152)				
W.C < cutoff	29 (22.3)	101 (77.7)	130 (85.5)	0.022
W.C ≥ cutoff	10 (45.5)	12 (54.5)	22 (14.5)	
Overweight BMI(n=324)				
W.C < cutoff	40 (33.3)	80 (66.7)	120 (37)	0.000
W.C ≥ cutoff	117 (57.4)	87 (42.6)	204 (63)	

Table 3: Blood pressure values by waist circumference and BMI

Variable	Total	Systolic blood pressure		Diastolic blood pressure	
		Mean ± S.E	p value	Mean ± S.E	p value
Underweight BMI					
W.C < cutoff	16	131.3 ± 3.12	0.652	83.8 ± 2.11	0.690
W.C ≥ cutoff	8	128.4 ± 5.55		81.8 ± 5.52	
Normal weight BMI					
W.C < cutoff	130	125.1 ± 1.10	0.004	82.1 ± 0.72	0.047
W.C ≥ cutoff	22	133.5 ± 2.57		85.7 ± 1.26	
Overweight BMI					
W.C < cutoff	120	129.8 ± 1.11	0.001	86.8 ± 2.61	0.848
W.C ≥ cutoff	204	135.0 ± 0.96		87.2 ± 2.61	

Table 4: Gender-wise systolic Blood pressure values by waist circumference and BMI

Variable	Total	Males		Total	Females	
		Mean ± S.E	p value		Mean ± S.E	p value
Underweight BMI						
W.C < cutoff	11	134.7 ± 3.44	0.888	5	123.8 ± 5.70	0.963
W.C ≥ cutoff	5	136.0 ± 5.00		3	123.3 ± 7.88	
Normal weight BMI						
W.C < cutoff	105	125.6 ± 1.19	0.002	25	123.1 ± 2.82	0.093
W.C ≥ cutoff	6	141.9 ± 4.48		16	130.3 ± 2.78	
Overweight BMI						
W.C < cutoff	103	129.4 ± 1.12	0.000	17	132.2 ± 3.96	0.685
W.C ≥ cutoff	123	135.8 ± 1.20		81	133.8 ± 1.60	

Table 5: Gender-wise diastolic blood pressure values by waist circumference and BMI

Variable	Total	Males		Total	Females	
		Mean ± S.E	p value		Mean ± S.E	p value
Underweight BMI						
W.C < cutoff	11	85.2 ± 2.74	0.485	5	80.6 ± 2.93	0.566
W.C ≥ cutoff	5	90.0 ± 0.00		3	76.3 ± 8.01	
Normal weight BMI						
W.C < cutoff	105	82.3 ± 0.75	0.015	25	80.9 ± 2.05	0.274
W.C ≥ cutoff	6	90.2 ± 1.96		16	84.1 ± 1.39	
Overweight BMI						
W.C < cutoff	103	87.3 ± 3.03	0.736	17	83.9 ± 1.98	0.534
W.C ≥ cutoff	123	88.2 ± 0.88		81	85.6 ± 1.19	

The mean diastolic blood pressure was also high for normal weight and overweight category of BMI in the individuals with waist circumference more than the gender specific cutoff but the difference was statistically significant only for the normal weight category of BMI (p= 0.047).

In gender stratification, it was found that men with waist circumference more than the cutoff had significantly higher mean systolic blood pressure values than the individuals with waist circumference less than the cutoff value in the overweight (p= 0.000) and normal weight categories of BMI (p=0.002). Even though similar findings were present for females, the difference was not statistically significant for them (Table 4). The difference in mean diastolic blood pressure was more profound in men than women for all categories of BMI in the individuals with waist circumference more than the cut off; however it was significant only for normal weight BMI group, p=0.015 (Table 5).

DISCUSSION

In the present study, mean systolic blood pressure was higher in individuals with waist circumference more than the gender specific cut off value in overweight and normal weight group classified by BMI. Different studies reported that increased WC and BMI increased the risk of high systolic and diastolic blood pressure.[16-18] Guagnano et al reported that among males with WC more than normal, the odds ratio for hypertension was three times that of males with normal WC; females with WC more than normal had a risk for hypertension twice that of females with normal WC.[19] It has also been reported that clustering rate of high blood pressure significantly increased with rising of BMI and waist circumference.[20] Janssen et al reported waist circumference and not BMI explains obesity related health risk including hypertension.[21] Central obesity is an important risk factor for the development of metabolic syndrome and for diseases like hypertension and diabetes. BMI though measures overall obesity with good relationship with fat content; neglects body fat distribution; waist circumference catches the central obesity.[22]This is important especially in Omani population who are more fatty; so that an individual who has been misclassified by BMI; may benefit from measurement of body composition.[23]

In the present study, even in the normal BMI weight group, 45.5% individuals with more than normal WC were hypertensive; this proportion increased to 57.4% in the overweight BMI group. This is in agreement with studies which showed an important relationship between WC and the probability of emerging cardiovascular events.[24]Sarno et al reported that in men, the fraction of hypertension attributable to BMI exceeded the fraction attributable to waist circumference based on the usual cut-off points for the indicators (56% vs. 48%, respectively); in women, the fraction of hypertension attributable to waist circumference was slightly higher than the fraction attributable to BMI based on the usual cut off points for both indicators (44% vs. 41%).[25] Liu et al showed a strong association between WC and cardio metabolic risk in African Americans irrespective of BMI.[5] High WC is associated with an increased risk of hypertension, stroke, coronary heart disease, diabetes mellitus, and cardiovascular-related death, independent of body mass index.[26, 27] Recognizing these important cardiovascular risks, the National Institutes of Health recommends screening for high WC in persons who are overweight (BMI 25–29.9) or obese class I (BMI 30–34.9) and to consider screening for high WC in persons with normal weight (BMI 18.5–24.9).[28]

CONCLUSION

There was a statistically significant difference in waist circumference between age groups, education groups and BMI groups. The proportion of hypertensive was significantly higher in individuals with waist circumference more than normal. Mean systolic blood pressure was significantly higher in the individuals with waist circumference more than normal for overweight and normal categories of BMI. The study emphasizes the need for using simple anthropometric tool like waist circumference for assessing the risk of hypertension in communities both in overweight and normal people according to BMI criteria. There is a growing common opinion that WC should be seen as a vital sign and recorded in the same manner as weight and height in the medical chart of every patient. Along with helping to detect obesity and hypertension, this will encourage people to watch their waist circumference regularly by themselves which will have positive long term effects.

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REFERENCES

1. Perkovic V, Huxley R, Wu Y, Prabhakaran D, MacMahon S. The burden of blood pressure-related disease: a neglected priority for global health. Hypertension. 2007;50:991-7.
2. Al-Nozha M, Abdullah M, Arafah M, Khalil M, Khan N, AlMazrouY, et al. Hypertension in Saudi Arabia. Saudi Med J.2007;28:77-84.
3. Furberg C, Wright Jr J, Davis B, Cutler J, Alderman M, Black H, Cushman W, et al. Major outcomes in high-risk hypertensive patients randomized to angiotensin converting enzyme inhibitor or calcium channel blocker vs diuretic: the Antihypertensive and Lipid Lowering Treatment to Prevent Heart Attack Trial (ALLHAT). JAMA. 2002;288:2981–97.
4. Carmem Cristina Beck, Adair da Silva Lopes, Francisco José GondimPitanga. Anthropometric indicators as predictors of high blood pressure in adolescents. Arq Bras Cardiol. 2011; 96(2): 126-133.
5. Lui J, Fox CS, Hickson DA, May WD, Hairstoen KG, Taylor HA. Impact of abdominal visceral and subcutaneous adipose tissue on cardio metabolic risk factors: the Jackson Heart Study. J ClinEndocrinol Metab.2010;95: 5419-5426.
6. Lorenzo C, Serrano-Rio M, Martinez-LarradMT,Gabriel R, William K, Gomez-Gerique JA, Stem MP, Haffner SM. Central adiposity determines prevalence, differences of the metabolic syndrome. Obes Res. 2003;11; 1480-1487.
7. Desprès JP. Body fat distribution and risk of cardiovascular disease.Circulation.2012; 126:1301-1313.
8. Lee K, Song YM, Sung J. Which obesity indicators are better predictors of metabolic risk? Healthy twin study. Obesity. 2008; 16: 834-840.
9. Czernichow S, Kengne AP, Stamatakis E, HamerM, Batty GD. Body mass index, waist circumference and waist-hip ratio: which is the better discriminator of cardiovascular disease mortality risk? Evidence from an individual-participant meta-analysis of 82 864 participants from nine cohortstudies.ObesRev.2011;12:680-687.
10. Klein S, Allison DB, Heynsfield SB, Kelly De, Leibel RL, Nonas C et al. Waist circumference and cardio metabolic risk:a consensus from shaping America's Health: Association for weight management and obesity prevention:NAASO. Am J ClinNutri. 2007;85:1197-1202.
11. Asya AR, Mahmoud AAE, Magdi M, Hilal AK, Waleed AS, Sanjay J. Oman World Health Survey: Part 1 - Methodology, Sociodemographic Profile and Epidemiology of Non-Communicable Diseases in Oman. Oman Med J. 2012; 27(5):425-443.
12. Meier P, Messerli F, Baumbach A, Lansky AJ.Pre-hypertension: another "pseudodisease"? BMC Medicine 2013; 11: 211-213.
13. Al-Riyami AA, Afifi M. Distribution and correlates of total impaired fasting glucose in Oman. Eastern Mediterranean Health Journal. 2003;9:377-389
14. Alberti KG, Eckel RH, Grundy SM, et al. Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; and International Association for the Study of Obesity. Circulation. 2009;120(16):1640-1645.
15. Lean MEJ, Han TS, Morrison CE. Waist circumference as a measure for indicating need for weight management. BMJ.1995;311:158-61.
16. Deshmukh PR, Gupta SS, Bharambe MS, Dongre AR, Maliye C, Kaur S, Garg BS. Relationship of obesity indicators with blood pressure levels in rural Wardha. Indian Journal of Medical Research. 2006; 123(5): 657-64.
17. Wilsgaard T, Schirmer H, Arnesen E. Impact of body weight on blood pressure with a focus on sex differences: the Tromso Study, 1986-1995. Arch Intern Med. 2000; 160(18): 2847-53.
18. Gryglewska B, Grodzicki T, Kocemba J. Obesity and blood pressure in the elderly free-living population. J Hum Hypertens. 1998;12(9):645-7.
19. Guagnano MT, Ballone E, Colagrande V, Della Vecchia R, Manigrasso MR, Merlitti D, Riccioni G, Sensi S. Large waist circumference and risk of hypertension. Int J Obes Relat MetabDisord. 2001;25(9):1360-4.
20. Zhao LC, Wu YF, Zhou BF, Li Y, Yang J. Mean level of blood pressure and rate of hypertension among people with different levels of body mass index and waist circumference. Zhonghua Liu Xing Bing XueZaZhi. 2003; 24(6):471-5.
21. Janssen I, Katzmarzyk PT, Ross R. Body mass index, waist circumference, and health risk: evidence in support of current National Institutes of Health guidelines. Arch Intern Med. 2002;162(18):2074-9.
22. Webb GP. Nutrition: A health promotion approach. 2nd ed. London: Arnold; 2002. p.186.
23. Svendsen OL. Should measurement of body composition influence therapy for obesity? ActaDiabetol. 2003;40(1):250-3.
24. Feldstein CA, Akopian M, Olivieri AO, Kramer AP, NasiM,Garrido D. A comparison of body mass index and waist-to hip ratio as indicators of hypertension risk in urban Argentine population: a hospital-based study. Nutr Metab Cardiovasc Dis. 2005;15(4):310–5.
25. FlávioSarno, Carlos A Monteiro. Relative importance of body mass index and waist circumference for hypertension in adults. Rev. SaúdePública 2007;41(5).
26. Folsom AR, Prineas RJ, Kaye SA, Munger RG. Incidence of hypertension and stroke in relation to body fat distribution and other risk factors in older women. Stroke. 1990;21:701-706.
27. Harris MM, Stevens J, Thomas N, Schreiner P, Folsom AR. Associations of fat distribution and obesity with hypertension in a bi-ethnic population: the ARIC study. Atherosclerosis Risk in Communities Study. Obes Res. 2000;8:516-524.
28. Zhu S, Wang Z, Heshka S, Heo M, Faith MS, Heymsfield SB. Waist circumference and obesity-associated risk factors among whites in the third National Health and Nutrition Examination Survey: clinical action thresholds. Am J ClinNutr. 2002;76:743-749.