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Original Article

Waist height ratio and waist circumference in relation to hypertension, Framingham risk score in hospitalized elderly Egyptians ☆

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ABSTRACT

Background: Hypertension is a public health problem and obesity is becoming an epidemic, increasing the risk of hypertension. Both are risk factors for cardiovascular diseases (CVD).
Methods: A case control study recruiting 102 patients aged ≥60 years, divided into 55 cases with hypertension and 47 controls without. Body mass index (BMI), waist circumference (WC) and waist to height ratio (WHtR) were measured as well as lipid profile then Framingham risk score (FRS) was calculated.
Results: Odds ratio (OR) for hypertension and medium to high risk cardiovascular events was the same in female patients using WC and WHtR. In male patients, only WHtR increased the risk for hypertension and for cardiovascular events, OR significantly increased with higher WHtR compared to WC.
Conclusion: WHtR and WC are strong risk factors for hypertension and cardiovascular events in Egyptian elderly female patients. WHtR is the best anthropometric predictor for hypertension and cardiovascular events in male patients.

1. Introduction

Hypertension prevalence in increasing, constituting a major public health problem. It is considered one of the most common chronic medical conditions in the United States, affecting about one third of the population.[1] It is a major risk factor for cardiovascular and cerebrovascular diseases, increasing morbidity and mortality. Therefore, prevention of hypertension is a public health challenge.[2] In Egypt, according to Egyptian National Hypertension Project (ENHP) 1991-1993, about 26.3% of adult Egyptians had high blood pressure, and more than 50% of people older than 60 years suffered from hypertension.[3] Obesity and dyslipidemia are associated with hypertension, and visceral adiposity accounts for 65% to 75% of the risk for essential hypertension. All are major risk factors for coronary artery disease (CAD).[4,5] Egyptians have one of the highest mortality rates worldwide attributed to CAD, further complicating this problem.[6] Both generalized and abdominal obesity are associated with increased risk of morbidity and mortality. BMI was traditionally the chosen indicator measuring body composition. However, alternative measures that reflect visceral adiposity, such as waist circumference and waist–hip ratio (WHR), have been suggested to be superior in predicting CVD risk, because increased visceral adipose tissue is associated with metabolic abnormalities and inflammation.[5,7] WHtR is considered in some studies now a proxy for central adipose tissue, and has recently been described as a marker of 'early health risk'.[8] The Framingham coronary heart disease (CHD) risk assessment tool has been validated and used widely to determine the 10 year risk of cardiovascular events.[9] Population-based research focuses on the relationship between hypertension and obesity and abdominal obesity, but gender-specific approaches are less common[10] and mostly no studies were done in Egypt approaching this issue.

2. Aim of the work

To study the relation between anthropometric measures (waist height ratio and waist circumference) and both the risk hypertension and Framingham risk score for cardiovascular diseases in male and female elderly Egyptians.

3. Study design

A case control study performed in Ain-Shams University hospital during the period between June and September 2016 after taking informed consent from patients to participate in the study.

☆ The protocol for the research project has been approved by Ethics Committee of the Faculty of Medicine, Ain-Shams University.
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4. Participants

One hundred and two patients aged 60 years and more were recruited. Patients were divided into 55 cases and 47 controls according to the presence or absence of hypertension. Patients were considered to have hypertension if systolic blood pressure was ≥140 mmHg or diastolic blood pressure was ≥90 mmHg or both on two different occasions after complete physical or mental rest, or patients previously informed they have hypertension or on treatment for hypertension.

5. Exclusion criteria

Patients known to have diabetes mellitus, ischemic heart disease either on anti-ischemic treatment or experienced previous cardiac events were excluded from the study.

6. Methods and assessment

Resting blood pressure was measured in a sitting position after a 5-min of mental and physical rest using a mercury sphygmomanometer and according to standard procedures.[11]

The first objective: to study the relation between anthropometric measures, lipid profile and hypertension. Anthropometric measurements were taken by a trained staff, in the morning, according to the world health organization (WHO) recommendations.[12] Weight was measured to the nearest 0.5 kg, height was measured with the patient barefoot in the standing position to the nearest 0.5 cm. BMI was calculated by dividing weight per kilograms by height per meter square (kg/m^2).WC was measured to the nearest centimeter, midway between lowest rib margin and iliac crest with the patient standing and breathing normally. It was used as a surrogate for central obesity. WC was categorized into high-risk (≥94 cm and ≥80 cm for males and females, respectively) and low-risk if below these cutoffs as established standards by WHO and International diabetes federation (IDF) for patients living the Middle East; including Egypt.[13] WHtR was calculated as WC (in cm) divided by height (in cm). A ratio of (0.5) was considered a cutoff point for WHtR; according to a systematic review done in 2010, which stated that this cutoff can be used for men and women across different ethnic groups.[14]

Blood samples were obtained for lipid profile from patients by venipuncture after 12 h of fasting. Blood samples were assayed within 24 h.

The second objective: FRS for cardiovascular events[9] was calculated; to study its relation to WC, BMI, WHtR. It takes into consideration the following factors: age; gender; systolic blood pressure value; whether or not the patient takes anti-hypertensive medications; the presence or absence of diabetes mellitus; smoking; high-density lipoproteins cholesterol (HDL-c) and total cholesterol values. Patients are considered to have low 10 year risk for cardiovascular events if FRS is less than 10%, intermediate-risk if between 10–20%, and high risk if 20% or more.[15] Patients were classified in the study into two groups, a group with low risk (FRS <10%) and a group with intermediate to high risk (FRS ≥ 10%) and OR was calculated accordingly.

7. Statistical analysis

Age, BMI, WC and Lipid profile were studied in relation to cases and controls by Paired sample t test. Odds ratio regarding BMI, WHtR and WC were calculated using Chi square test. Values for P less than 0.05 were considered significant and values less than 0.001 were considered highly significant.

8. Results

A total of 102 patients divided into 55 cases (patients already having hypertension) and 47 controls (patients with normal blood pressure) as shown in Table 1. The study included 70 male (about

Table 1
Demography of the study population.

		Hypertension				X^2	P
		No controls number = 47		Yes cases number = 55			
		Count	N%	Count	N%		
Sex	Male N = 70	35	74.5%	35	63.6%	1.101	.294
	Female N = 32	12	25.5%	20	36.4%		
Smoking	No	25	53%	37	67%	4.453	.056
	Yes	22	47%	18	33%		

Table 2
Comparison between cases and controls regarding age, anthropometric measures and lipid profile.

	Controls/cases	N	Mean	Std. Deviation	*t* test	p
Age	**Controls**	47	67.94	6.664	0.682	.497
	Cases	55	67.11	5.490		
BMI	**Controls**	47	29.60	3.048	−2.376	**.019**
	Cases	55	31.37	4.257		
WC	**Controls**	47	93.40	8.9838	−2.140	**.036**
	Cases	55	98.05	13.3256		
Total Cholesterol	**Controls**	47	131.26	44.647	−2.327	**.022**
	Cases	55	154.72	56.565		
TG	**Controls**	47	114.79	38.483	−2.810	**.006**
	Cases	55	141.02	54.814		
HDL	**Controls**	47	45.00	5.469	2.251	**.027**
	Cases	55	42.50	5.649		
LDL	**Controls**	47	91.00	19.123	−2.332	**.022**
	Cases	55	100.59	21.829		

BMI = body mass index WC = waist circumference TG = triglycerides.
LDL = low density lipoproteins HDL = high density lipoproteins.

Table 3
Correlation between blood pressure measurements, anthropometric measures in cases.

	Pearson correlation r	P value
WC and systolic blood pressure	0.299	**.027**
WC and diastolic blood pressure	0.343	**.010**
BMI and systolic blood pressure	0.257	.058
BMI and diastolic blood pressure	0.293	**.030**

two thirds), and 32 female patients. Half of male patients and 62.5% of female patients had hypertension. More smokers were found in the control group, and all smokers were of male gender. Regarding educational level of the study population, all of them were illiterate. Mean age of the study population was around 67 or 68 in cases and controls respectively. The first objective was studied in Tables 2–4. Table 2 showed that the prevalence of obesity is more in cases; BMI and WC were significantly higher (p 0.019, 0.036) respectively, as well as lipid profile parameters. The mean total cholesterol, triglycerides (TG) and low density lipoprotein (LDL) levels were higher in cases 154.72, 141.02 and 100.59 (P 0.022, 0.006, 0.022) respectively while HDL levels were lower (P 0.027). When correlating WC and BMI with blood pressure measurement in Table 3, WC correlated with both systolic and diastolic blood pressure, however BMI correlated only with diastolic blood pressure indicating that greater degrees of central adiposity are stronger indicator of blood pressure severity. When we classified male and female patients according to high and low WC, high and low WHtR, and obese and not obese in Table 4, OR for hypertension was significantly high in male group with high WHtR (OR 2.53, p 0.001) but was not significant using either WC or BMI classification. In female group OR for hypertension was exactly the same regarding WC and WHtR in contrast to BMI which is not significant. The second objective in Table 4, WHtR greatly increase FRS to intermediate to severe cardiovascular disease events (OR 7, p 0.005) than WC (OR 2.41, p < .0001) in male patients.

9. Discussion

According to centers for disease control and prevention (CDC), ischemic heart disease is on the top of ten causes of death in Egypt in 2013, followed by cerebrovascular strokes.[16] While some studies report that the risk of developing hypertension was greater with increased BMI, compared to WC[17], others suggest that visceral adiposity is generally a stronger predictor of hypertension than BMI-based measures.[18] Visceral adiposity is not only a predictor of hypertension, but also correlates with the severity of the disease. In this study WC rather than BMI increased the severity of hypertension. This finding is consistent with study done on Mexican American population.[19] Greater central obesity can be associated with systemic inflammation which directly contributes to CVD risk.[20]

The WHtR was described as a useful tool for assessing abdominal adiposity.[21] Like other studies, the study found that WHtR is superior to WC and BMI in association with hypertension[22,23] in the male group. In a meta-analysis done, WHtR was found to be significantly better than WC for hypertension, CVD and all outcomes in both men and women.[24] Our findings agree with this for both hypertension and CVD in male patients, however in the female group WHtR has the same risk as WC.

Patients having hypertension had higher serum total cholesterol, TG and LDL levels and lower serum HDL levels. This is consistent with others[25,26], indicating that patients with hypertension are more likely to have dyslipidemia.

10. Conclusions

WHtR and WC are strong risk factors for hypertension and cardiovascular events in Egyptian elderly female patients. However WHtR is the strongest and the best anthropometric predictor for hypertension and cardiovascular events in male patients and BMI is the worst for both groups. Patients with hypertension are more likely to exhibit dyslipidemia than patients without.

11. Limitation of the study

Sample size is small, so results can't be generalized on all Egyptians and we need further evaluations to explain variation in results between men and women. This study didn't include WHR, which we need in further studies in Egyptians.

Table 4
Odds ratio for hypertension and Framingham risk score.

	Odds ratio (OR) risk of hypertension	x^2 Chi square	P value	Confidence interval (CI)95%
Male WC ≥ 94 WC< 94	1.41	0.125	.106	0.453–2.980
Female WC ≥ 80 WC< 80	1.8	5.333	**.002**	0.157–10.614
Male BMI ≥ 30 < 30	1.78	0.133	.099	0.498–3.317
Female BMI ≥ 30 < 30	3	0.091	.157	0.353–7.355
Male WHtR ≥ 0.5 WHtR < 0.5	2.53	5.143	**.001**	0.532–4.212
Female WHtR ≥ 0.5 WHtR < 0.5	1.8	5.333	**.002**	0.157–10.614
	OR For FRS ≥ 10%(intermediate to high CVD risk)	x^2 Chi square	P value	Confidence interval (CI)95%
Male WC ≥ 94 WC< 94	2.414	23.516	**<.0001**	0.250–8.585
Female WC ≥ 80 WC<80	2.25	13.235	**<.0001**	0.131–15.425
Male WHtR ≥ 0.5 WHtR < 0.5	7	2.273	**.005**	0.399–13.580
Female WHtR ≥ 0.5 WHtR < 0.5	2.25	13.235	**<.0001**	0.131–15.425

FRS = Framingham risk score WC = waist circumference BMI = body mass index WHtR = waist height ratio CVD = cardiovascular disease.

Conflict of interest

No conflict of interest, no financial resources or support.

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The author contributed to the study work and approved the final manuscript.

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