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# Relationship Between Hypertension and Obesity Anthropometric Indices in Adults of Mashhad City

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**Abstract:** *Objective*: To assess the association of obesity related indices with hypertension among adults in Mashhad, Iran. *Materials and Methods*: It was a descriptive, observational study. Participants were 126 healthy inactive individuals which referred to the cardiovascular department of Imam Reza hospital for the normal checkup. The examination included blood pressure and anthropometric measurements (height, weight, body mass index, waist to hip ratio, waist to thigh ratio, waist to height ratio and circumferences of hip, waist, neck and thigh). *Results*: Significant differences were observed for anthropometric indices between male and female individuals and males were taller anda heavier than females. Any significant relationship between anthropometric indices and blood pressure was not observed in the female group. There was a significant direct relationship between waist to hip ratio, waist to thigh ratio, waist to height ratio and systolic blood pressure, diastolic blood pressure and mean arterial pressure. *Conclusion*: waist to hip ratio, waist to thigh ratio and waist to height ratio were good predictors for hypertension. We recommend that waist to height ratio should be used to detect persons at high risk of hypertension.

**Key words:** Hypertension · Obesity · Anthropometric indices

## INTRODUCTION

The prevalence of obesity is increasing widely in developed and developing countries [1]. Hypertension (typically obesity related) is a risk factor for cardiovascular disease [2]. Obesity is defined by different anthropometric measurements and indices. Body mass index (BMI), waist circumference (WC), waist to hip ratio (WHR), waist to thigh ratio, subscapularis to triceps skinfold ratio, neck circumference (NC) and waist to height ratio (WHtR) are among anthropometric indices that are used widely [3].

Hypertension is defined with systolic blood pressure greater than 139 mm Hg and diastolic blood pressure greater than 89 mmHg [4]. Esmaillzadeh *et al*., (2004) used WHR as an index for predicting of cardiovascular disease risk [1]. Kaur *et al*., (2008) reported that BMI and WC were good predictors for hypertension in male individual population; they also recommended that WHR should be routinely used in addition to BMI to detect persons at high risk of hypertension [5]. Fuchs *et al*., (2005) made a correction of the circumference of waist for stature and reported that the correction improves its performance in the prediction of incidence of hypertension [6].

The aim of this study was to assess the relationship between hypertension and anthropometric indices among adults in Mashhad, Iran.

## MATERIALS AND METHODS

This was a descriptive, observational study. Participants were 126 healthy and inactive individuals living in Mashhad, who referred to the cardiovascular department of Imam Reza hospital for a normal checkup under supervision of a heart surgeon, who confirmed that they had no clinical evidence of cardiovascular disease.

Individuals were weighted with precision of 100 g in an orthostatic position, with the arms stretched along the

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body without shoes and wearing light clothes. A tape was used for measuring circumferences of neck, hip, thigh and waist. WHR, waist to thigh ratio, WHtR and BMI were calculated too. To measuring WC, at the minimum respiration, the tape was applied below the lowest rib and above the iliac crest, at the narrowest part of trunk, For determining the hip circumference, the tape was used at the widest point of buttocks, NC was measured at the mid neck height, thigh circumference was measured at the mid distance between the groin fold and above the patella [7, 8].

Morning fasting blood samples were taken and kept for subsequent assay. Serum concentrations of glucose, TC, HDL, LDL and TG were evaluated. Systolic blood pressure, diastolic blood pressure and mean arterial pressure were determined by a heart surgeon using a sphygmomanometer.

All data obtained were analyzed using a statistical package for social science (SPSS version 16.0) PC program. A P-value less than 0.05 was considered as statistically significant. To determine the relationship between anthropometric indices with systolic blood pressure, diastolic blood pressure, mean arterial pressure, serum glucose and serum lipids, Pearson's correlation coefficient was used. Independent samples T test was used for comparison of blood pressure and blood lipoproteins with anthropometric indices.

## RESULTS

A summary of the characteristics of each variable is shown in the Table 1 and Table 2. Significant differences were observed for anthropometric indices (weight, height, neck circumference and BMI) between male and female individuals and males were taller and heavier than females, but the amount of BMI in female was significantly greater than males.

Table 3 shows blood test parameters according to sex and the results of the Pearson correlation coefficient analysis is shown in Table 4. In women, none of the anthropometric indices was related to systolic blood pressure, diastolic blood pressure and mean arterial pressure ($P<0.05$).

In men WHR, waist to thigh ratio and WHtR were significantly correlated to systolic blood pressure, diastolic blood pressure and mean arterial pressure ($P<0.05$). In women, significant correlations were observed between BMI with TC/HDL and TG/HDL, NC with TG, TC/HDL and TG/HDL, WC with glucose and TG, WHR with glucose and LDL/HDL, waist to thigh ratio with glucose and WHtR with glucose, TG and TG/HDL ($P<0.05$). In women, significant correlations were observed between NC with LDL, TC, TG, TC/HDL and TG/HDL, WC with LDL, TC, TG, LDL/HDL, TC/HDL and TG/HDL, hip circumference with LDL, TC and TG, WHR with HDL, waist to thigh ratio with HDL and WHtR with HDL ($P<0.05$).

Table 1: Averages and standard deviations of descriptive variables according to sex

| | Sex | |
|---|---|---|
| Variable | Male | Female |
| Age | 48.59 ± 11.4 | 48.82 ± 8.7 |
| Height (cm)* | 168.3 ± 8 | 153.6 ± 5.6 |
| Weight (kg)* | 75.21 ± 13 | 69.49 ± 14.9 |
| SBP (mm Hg)• | 145.61 ± 21.14 | 150.4 ± 27.28 |
| DBP (mm Hg)• | 92.27 ± 12.48 | 94.46 ± 11.9 |
| MAP (mm Hg)• | 110.34 ± 14.15 | 113.11 ± 16.23 |

* Significant differences between sexes at $P<0.05$, • SBP = systolic blood pressure, DBP = diastolic blood pressure, MAP = mean arterial pressure.

Table 2: Averages and standard deviations of anthropometric indices according to sex

| | Sex | |
|---|---|---|
| Variable | Male | Female |
| BMI ($kg/m^2$)* | 26.76 ± 4 | 29.32 ± 5.5 |
| NC (cm)* | 39.29 ± 3.42 | 34.46 ± 2.54 |
| WC (cm) | 95.07 ± 12.78 | 94.68 ± 16.61 |
| HC (cm)• | 99.69 ± 12.26 | 102.16 ± 13.47 |
| WHR | 1.06 ± 0.96 | 0.93 ± 0.13 |
| WTR | 1.97 ± 1.61 | 1.72 ± 0.33 |
| WHtR | 0.6 ± 0.47 | 0.61 ± 0.1 |

* Significant differences between sexes at $P<0.05$; • HC = hip circumference.

Table 3: Averages and standard deviations of blood test parameters according to sex

| | Sex | |
|---|---|---|
| Variable | Male | Female |
| LDL (mg/dl) | 115.76 ± 34.2 | 108.05 ± 26.66 |
| HDL (mg/dl) | 44.59 ± 9.34 | 42.96 ± 5.96 |
| TC (mg/dl) | 190.87 ± 37.27 | 201.93 ± 41.89 |
| TG (mg/dl) | 158.62 ± 74.2 | 165.06 ± 71.97 |
| LDL/HDL | 2.68 ± 0.85 | 2.59 ± 0.87 |
| TC/HDL | 4.44 ± 1.03 | 4.78 ± 1.22 |
| TG/HDL | 3.8 ± 2.2 | 3.79 ± 1.64 |
| Glucose (mg/dl) | 116.42 ± 57.45 | 103.12 ± 35.52 |

Table 4: Correlation coefficients of anthropometric indices and cardiovascular risk factors

| Indices | NC | | WC | | WTR | | BMI | | WHR | | WHtR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Variables* | *M* | *F* | *M* | *F* | *M* | *F* | *M* | *F* | *M* | *F* | *M* | *F* |
| *HDL* | 0.1 | -0.29 | 0.02 | -0.02 | -0.26* | -0.1 | 0.11 | -0.2 | -0.23* | 0.15 | -0.3* | -0.01 |
| *LDL* | 0.23* | 0.03 | 0.36* | -0.1 | -0.01 | -0.17 | 0.13 | 0.14 | 0.00 | -0.21 | -0.01 | -0.1 |
| *LDL/HDL* | 0.12 | 0.22 | 0.23* | -0.04 | 0.17 | -0.06 | 0.00 | 0.27 | 0.12 | -0.33* | 0.2 | -0.05 |
| *TC* | 0.35• | 0.12 | 0.37• | 0.04 | -0.06 | -0.05 | 0.15 | 0.2 | -0.1 | -0.15 | -0.05 | 0.1 |
| *TC/HDL* | 0.24* | 0.36* | 0.3* | 0.07 | 0.11 | 0.04 | -0.02 | 0.35* | 0.05 | -0.26 | 0.2 | 0.1 |
| *TG* | 0.36• | 0.34* | 0.36• | 0.3* | -0.01 | 0.27 | 0.18 | 0.27 | 0.00 | 0.12 | -0.02 | 0.36* |
| *TG/HDL* | 0.35• | 0.43• | 0.37• | 0.26 | 0.08 | 0.23 | 0.1 | 0.31* | 0.08 | 0.01 | 0.08 | 0.3* |
| *Glucose* | 0.04 | 0.28 | 0.21 | 0.35* | -0.1 | 0.5• | 0.1 | 0.2 | -0.1 | 0.41* | -0.1 | 0.42* |

M = male, F = female; * Significant at P<0.05; • Significant at P<0.01

## DISCUSSION

Results of this study showed that no significant relation was found between BMI with systolic blood pressure, diastolic blood pressure and mean arterial pressure, that was not in agreement with Zafar *et al*., (2007), Gupta *et al*., (2007), Ben-Noun and Laor (2004), Hu *et al*., (2007), Jung *et al*., (2009) and Ng *et al.,* (2007) [9, 10, 11, 12, 13, 14]. A significant relation between neck circumference and systolic and diastolic blood pressure was not found, but Ben-Noun and Laor (2006) reported that neck circumference was a valid index of obesity and had a direct significant relation with systolic and diastolic blood pressure [3].

Analysis of our findings revealed that WHtR had a direct and significant relation with systolic blood pressure, diastolic blood pressure and mean arterial pressure and in comparing to WHR, waist to thigh ratio and BMI, was a stronger index. These findings were in agreement with Hara *et al*., (2002), Gelber *et al*., (2008) and Park *et al*., (2009) [15, 16, 17]. Hara *et al*., (2002) reported that WHtR in comparing to BMI, fat percent, waist circumference and WHR, had a stronger relation with cardiovascular risk factors such as LDL, HDL, TG, systolic blood pressure and diastolic blood pressure [15]. Freedman *et al*., (2007) also reported that WHtR in comparing to BMI had a stronger relation with cardiovascular risk factors and its measurement is easier [18].

Results of this research showed that there was a direct relationship between WHR and systolic blood pressure, diastolic blood pressure and mean arterial pressure that is in agreement with findings of Ben-Noun and Laor (2004), Widgern *et al*., (1992), Zafar *et al*., (2007) and Gupta *et al*., (2007) [9, 10, 11, 19]. Our results also showed that waist to thigh ratio in the male group had a direct significant relation with systolic blood pressure, diastolic blood pressure and mean arterial pressure. Ashton *et al*., (2001) also reported that fat at hip and thigh region in comparing to fat of waist are less active and are not hazardous for health [20].

WHR, WHtR and waist to thigh ratio had a direct significant relation with systolic blood pressure, diastolic blood pressure and mean arterial pressure. These anthropometric indices are valid indices of obesity. Obese individuals have more blood and use more oxygen in comparing to normal individuals that will lead to over load and according to Frank Starling mechanism, stroke volume and heart output will increase, this will result in hypertension. Furthermore, in obese individuals peripheral resistance may be elevated that lead to elevation of blood pressure. Obese persons tend to have less physical activity and eat more salt and food; these risky daily habits are responsible for more blood pressure in these individuals. Impaired glucose tolerance in obese individuals activates the response of the rennin-angiotensin-aldosterone system. This process increase blood pressure. Obesity induces hypoxy leads to elevation of red blood cells and blood volume [2].

## CONCLUSION

In general, our results revealed that WHtR was the best predictor for hypertension and can be used widely and easily for predicting obesity and hypertension in clinical situations. Mechanisms of such associations and effects of exercise on these mechanisms should be studied.

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