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The Relationship between Hypertension and Anthropometric Indices in a Jordanian Population

Abdul-Monim Batiha[1] *, Manar AlAzzam[2], Mohammed ALBashtawy[2], Loai Tawalbeh[2], Ahmad Tubaishat[2] and Fadwa N. Alhalaiqa[1]

[1]Philadelphia University, Faculty of Nursing, Jordan
*Corresponding author

[2]Al-AlBayt University, Faculty of Nursing, Jordan

Abstract

Background: High blood pressure is correlated with overweight and obesity which can be assessed by anthropometric indices (hip circumference, waist circumference, height, weight, waist-to-hip ratio, and a body shape index).
Objectives: To investigate the correlation between anthropometric indices and age relating to hypertension; additionally to find which one of these variables are most strongly correlated with high blood pressure in the research Jordanian population.
Methods: A quantitative approach utilizing a descriptive correlation cross-sectional design was used among students and workers of universities in Jordan
Results: 622 participants were included in study; 34.7% were overweight, 15.4% were obese and hypertension was detected among 22.2% of the participants. The linear correlation was significant among all anthropometric indices and hypertension at the $p<0.01$ level, whereas body shape index and diastolic blood pressure were significant at the $p< 0.05$ level. Stepwise multiple linear regression research showed that waist circumference and age were the independent predictors of hypertension.
Conclusions: Waist circumference and age were the independent predictors of hypertension. Assessing these predictors should be taken into inconsideration when screening members of the Jordanian population who are at risk of hypertension. Further research is required to understand other factors which may affect the issue

of hypertension and to design interventions based on these predictors in order to prevent the condition's occurrence or re-occurrence.

Keywords: Anthropometric indices, blood pressure, cross-sectional study, hypertension, Jordan

1. Introduction

Hypertension is defined as systolic and/or diastolic blood pressure of 140/90 mm Hg or more, and/or medication use for decreasing hypertension (Lebeau et al. 2014, Alhalaiqa et al.2014). The World Health Organization (WHO) categorizes high blood pressure (BP) as the top risk factor for death rate, accounting for 13% of fatalities globally. Also, hypertension, or the 'silent killer' as it is also known, has been recognized as an important risk factor for cardiac arrest, stroke, kidney disease, and increased mortality rates in adults (WHO 2014).

In 2014, WHO announced that 39% (two billion) of the world's adults were overweight and 13% (or 600 million) were obese (WHO 2014). The main modifiable risk factors for high BP are being overweight and obese (Badaruddoza et al. 2011). The conditions of overweight and obesity are connected to more fatalities globally than being underweight. Also, most of the earth's population live in places where being overweight and obese kills more people than those who are underweight (this contains all high-income and most middle-income nations) (WHO 2014).

Many studies have offered clear evidence that decreasing weight, via a healthy diet and exercise, can help individuals with high blood pressure (Campbell & Meckling 2012, Fuglestad et al. 2012, Tawalbeh et al. 2013, Batiha 2014). Although there are many anthropometric indices that have been used to measure obesity, there is a debate about which of these anthropometric indices best defines obesity and contributes to the highest risk for causing hypertension (Nahar et al. 2012). The early detection of hypertension, and identifying risk factors relating to high blood pressure, would be an important preventive measure in the population. In Jordan there are many studies that discuss obesity and hypertension (Jaddou et al. 2000, Shakhatreh et al. 2008, Jaddou et al. 2011, Bashayreh et al. 2013, Khader et al. 2014, ALBashtawy et al. 2014). But this study is the first to investigate the correlation between anthropometric indices and age with hypertension. In addition this research will attempt to find which one, anthropometric indices or age, was the most strongly correlated with high blood pressure in Jordanian research population.

2. Methods

2.1. Design

A cross-sectional design was adopted in this study.

2.2. Study population and sampling technique:

Jordan consists of three provinces (North, Middle, and South). One university was randomly selected from each province to provide a representative sample of Jordanian universities (Jordan University of Science and Technology, Philadelphia University, and the Al-Hussein Bin Talal University). The participants were recruited by a convenience sampling technique. The inclusion criteria were: (a) aged above 18 years, (b) agree to participate.
An appropriate sample size was identified by using G* power software (Faul, Erdfelder, Lang, & Buchner, 2007). On the foundation of G* power, the minimal sample size was 334. To allow for more generalization, and to compensate of dropout, a total of 790 students and workers from selected universities were invited to participate in the current study: finally 622 participants were included. The acceptance rate to the invitation was 78.7% (n=622/790); the study was carried out between September -November 2014.

2.3. Data collection measurements

2.3.1. Anthropometric measurement

Anthropometric indices were taken from all participants by trained nurses in a private room in each college, according to standardized equipment and methods. During data collection for the anthropometrical indices, all participants wore light clothes. All measurements were taken two times and the mean was recorded: if values differed by greater than 10%, a third value was taken and the average value used for analysis (Nahar et al. 2012). Height and weight measurements were utilized to determine BMI by using weight (kg) divided by height squared (m^2) expressed as kg/m^2 (Nahar et al. 2012). Calculating bodyweight was done to the nearby 0.5 kg; via reliable scales which were calibrated by using a 50 kg weight on each day of data collection. The height measurement for participants was done in a standing posture using a portable stadiometer; the participant being without shoes. An overweight condition was recognized with BMI results $\geq$25-29.9 kg/m^2; obesity was evident with a body mass index $\geq 30 kg/m^2$ (Cassani 2009; WHO 2014).

To measure WC, metric tape over light clothing was used at the level of umbilicus. WC measurements were taken twice by a non-stretchable tape with no pressure on the skin. The mean of the two sets of values was recorded. The cutoff value of WC for men was 91.5 cm and for women was 85.5cm (Esteghamati et al. 2008). Hip circumference was measured at maximum width of the buttocks in a standing position with the participants feet together (Fu et al. 2014). Central obesity was also calculated and defined on the basis of WHR. Recognition of an ABSI was based on the formula: $ABSI = WC/ (BMI^{2/3})*(height^{1/2})$ (Krakauer & Krakauer 2012).

2.3.2. Blood pressure measurement

BP was measured on the right arm by the use of a standardized and validated digital monitor machine (Model HEM-711). Before measuring BP, each individual was asked to rest comfortably for at least five minutes, while sitting with the sphygmomanometer at the level of the participant's heart (Ozturk et al. 2014). For more accuracy each participant received another measurement, using a different BP monitor and then the average reading was recorded. When the differences between measurements exceeded five mmHg, another senior staff would measure it using a validating mercury sphygmomanometer. The sphygmomanometer's cuff size was chosen according to arm circumference. Participants with BPs above 140/ 90 mmHg, or who were being treated for hypertension, were classified as having an elevated BP.

2.3.3. Interview questionnaire

The interview questionnaire was developed by the researchers, and was informed by other studies (Deshmukh et al. 2006; Nahar et al. 2012).To improve the face and content validity of the interview questionnaire, three educational specialists in nursing research examined the format of the questions and equipment to be employed for data collection.

A pilot study was conducted with 25 students and workers to try out and assess the framework, content, reliability, and time allowance needed for the questionnaire. No changes were required with the equipment. However, based on the feedback from the pilot study's population some questions were adjusted, and others removed. Item homogeneity (internal stability reliability) was calculated using Cronbach's alpha coefficient. The complete stability for all items within each subscale was good (0.83) (table 1).

The designed set of questions consisted of the following:

1. History of chronic illnesses (diabetic mellitus, hypertension, endocrine, renal, etc.)
2. Family medical history (hypertension; diabetic mellitus, obesity….etc.).
3. Drug history, especially antihypertensive medication.
4. Smoking history.
5. Life style history including: eating habit, salt intake, fat intake and exercise.

2.4. Data analysis

Data analysis was performed by using Statistical Package for the Social Sciences (SPSS) (Version 17). Significance was set at $p<.05$. In this analysis, descriptive data for anthropometric features, systolic and diastolic BP were expressed as mean ± SD. A partial correlation coefficient was used to evaluate the connection between independent variables (BMI, WC, HC, WHR, ABSI) and dependent variables (systolic and diastolic BP). A logistic regression model was used to assess different anthropometric indices with high BP, including age.

2.5. Ethical considerations

Approval of the research protocol was taken from the ethical committee of the three universities involved in the study. Before data collection, each participant was informed that this interview and anthropometric measurements would be totally voluntary, there was no need for identification, and there was no risk from participation in this study.

3. Results

Data was collected from 622 participants; the mean of their age was 30.3 years. The majority of the participants were nonsmoker (67.8%). Regarding anthropometric indices: the mean of height was 1.7m and weight was 73.9kg. Their BMI mean was 25.4. Nearly half of the participant are overweight (34.7%) or obese (15.4%). Their waist circumference mean was 89.5 cm, with a hip circumference mean 102.7cm. Meanwhile the mean of waist-to-hip ratio was 0.87cm and the BSI was 7.9. The means of systolic and diastolic BP reflect normality (124 mmHg, 77.5 mmHg respectively) with around half (54%) actually having normal BP. Therefore, the majority of participants (93.6%) did not take any antihypertensive drugs. However, around one third (37.7%) were categorized as pre-hypertensive patients (see Table 1).

Table 1: | Characteristics of participants

Characteristics	Number of participants	Per cent	Mean ± SD
Participants	622	100%	
Age (years)			30±12.4
Height (cm)			1.7±.09
Weight (kg)			74.7±26.5
Body mass index (kg/m2)			25.4±4.9
Body mass index group			
Underweight (<18.5)	43	6.9%	
Normal (18.5–24.9)	269	43.2%	
Overweight (25.0–29.9)	216	34.7%	
Obese class I (30- 34.9)	72	11.6%	
Obese class II (35- 39.9)	18	2.9%	
Obese class III (≥ 40.0)	4	0.6%	
Waist circumference (cm)			89.5 ± 14.9
Hip circumference (cm)			102.7 ± 11.3
Waist-to-hip ratio			0.87 ± 0.11
Body shape index			7.9 ± 0.86
Systolic blood pressure (mmHg)			124 ± 17.5
Diastolic blood pressure (mmHg)			77.5 ± 10.5

Table 1: (Continued): | Characteristics of participants

% Hypertension category		
Normal	336	54%
Prehypertension	172	27.7%
Stage 1 hypertension*	85	13.7%
Stage 2 hypertension	29	4.7%
Smokers' category		
Never	422	67.8 %
Former	30	4.8 %
Current	170	27.3%

*Systolic BP ≥140 mmHg and/or diastolic blood pressure (mmHg) BP ≥120 or if the participant was on antihypertensive medication.

Table 2 shows that the linear correlation was significant among all anthropometric indices and systolic and diastolic blood pressure for ($p<0.01$), except for ABSI and diastolic BP, whose readings were significant at $p< 0.05$. This means that increased BP is associated with an increase of all anthropometric measurements.

Table 2:| Correlation between anthropometric indices and blood pressure

Anthropometric measurement	**Systolic blood pressure**	**Diastolic blood pressure**
Body mass index	.387**	.212**
Hip circumference (cm)	.351**	.197**
Waist-to-hip ratio	.271**	.177**
A body shape index (ABSI)	.159**	.101*
Waist circumference (WC) (cm)	.452**	.268**

**Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed)

Hypertension was detected among 138 (22.2%) of the participants. Table 3 summarizes the independent sample t-test that compares the age and anthropometric indices for hypertensive and normotensive contributors. A significant difference in age and anthropometric measurements for hypertensive and normotensive participants was detected.

Table 3: | Variances in the mean of age, normotensive, hypertensive and anthropometric indices among participants according to the presence of hypertension

	Normotensive (*n* = 484)	**Hypertensive (*n* = 138)**	***P***
Age (years)	28.7 ±10.8	36±15.46	0.000
Body mass index	24.68±4.8	27.9±4.2	0.000
Waist circumference (WC) (cm)	86.66±14.5	99.3±11.9	0.000
Hip circumference (cm)	101±11.5	108±8.4	0.000
Waist-to-hip ratio	.86±.12	.91±.066	0.000
A body shape index (ABSI)	7.9±.9	8±.46	0.000

Stepwise multiple linear regression analysis was conducted to assess the effect of age and anthropometric measurements; the only independent predictors of hypertension were WC and age (see Table 4).

Table 4: |Stepwise multiple linear regression

	Odds ratio	**95% CI**	**P**
Age (years)	1.02	(1.02–1.03)	<0.01
Body mass index	1.04	(0.91–1.19)	0.21
Waist circumference	1.08	(1.05–1.13)	<0.001
Hip circumference	1.03	(0.96–1.03)	0.31
Waist-to-hip ratio	1.01	(0.94–1.00)	0.62
A body shape index	1.03	(0.93–1.01)	.012

4. Discussion

The major findings of this study were that WC and age were the independent predictors of hypertension. Also, all the anthropometric indices confirmed a positive relationship with high BP. Our results are comparable to those revealed by others (Rahimi et al. 2012; Carba et al. 2013)

An important discovery of this research was that nearly half of the participants were overweight (34.7%) and obese (15.4%); a situation likely to be due to the intake of carbohydrates and fats by Jordanians. This intake can be explained by the increased adoption by the population of a westernized diet containing oily, hot, high sodium and low fibers material. Low physical activity, due to a lack of sufficient exercising, and limited walking, together with environmental factors (presence of housemaids, private cars, television, and advanced household appliances, change in employment structure, travel systems and enjoyment recreation and activities). The findings of this research agree with previous studies that had been conducted in different countries, in terms of a significant relation between anthropometric measures and increased systolic and diastolic BP (Peymani et al 2012, Moser et al. 2013). These results should motivate the health care providers in Jordan to carry out appropriate anthropometric assessment for hypertensive patients in order to control BP.

Our study results found that there was a difference between normotensive and hypertensive patients in terms of age and anthropometric measures, data which supported other studies conducted in this field (Batiha et al. 2013, Lie and Kim 2014; Wang et al 2015). However, these studies used rib circumference and body shape scores in addition to WC, BMI, HC and WHR data.

The findings of this study can be considered as both valuable and relevant. However, there were some limiting issues in inferring changes over time, between the variables included and the conclusions reached when using a cross-sectional research design (Polit & Beck 2010). Second, only Jordanian universities' students and workers are included in the present study. One of the strong points of this study is that the data collection was done by well trained nurses, and the sample was representative of all Jordanian universities.

4.1. Conclusions and recommendations

The WC and age were the independent anthropometric predictors of hypertension, showing that this easy statistic may be an important indicator of hypertension in the Jordanian population. Assessing these predictors should be considered when screening people at risk for hypertension in the Jordanian population. Regular BP measurements are essential for health monitoring purposes and for informing the choice of a treatment plan. It is recommended that a healthy way of life, such as maintaining a healthy diet and exercising, should be implemented to reduce obesity. It is thus vital to use life style changes to achieve weight-loss (keeping BMI from between 18.5 to 24.9 kg/m2), such as reducing the intake of dietary salt and increasing exercise.

The high prevalence of overweight people in the population of this study is a warning sign; strong evidence (from previous studies in addition to our study) showing a close relationship between obesity and serious chronic diseases (e.g. hypertension, coronary artery disease, diabetes mellitus). Therefore, the health policy makers should plan practical solutions to increase the public's understanding and awareness of these important health issues by designing appropriate and effective programs to encourage people to modify their life style to decrease the negative consequences.

Further research is required to understand other factors which may affect the hypertension and to facilitate the design of intervention based on these predictors, in order to prevent the occurrence of hypertension, by using a larger and more representative sample.

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