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Anthropometric and Body Composition Indices as Predictors of Hypertension Risk among Older Adults

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Abstract

Introduction: Older adults are at particular risk of high blood pressure and associated morbidity and mortality, as aging is associated with physiological changes, including alterations in body composition and a decline in overall health. Changes in body composition occur throughout life. **Objectives:** This paper aims to investigate the anthropometric and body composition indices and their effects on hypertension in older adults living in the West Bank of Palestine. **Methods:** A cross sectional study was conducted with anthropometric measurements, including height, waist and hip circumference, body mass index, and total body fat were assessed. A body composition analyzer measured body weight, fat mass, and fat-free mass. Systolic and diastolic blood pressure were measured using an automated sphygmomanometer. Statistical tests t-test and regression were used for analysis. **Results:** Data were collected from 79 older adult participants. Their mean age was 68.28 ± 5.76 years. Nearly half of the participants were obese (49.4%) or overweight (27.8%). Hypertensive participants had significantly higher anthropometric measurements compared to normotensive participants. Statistical significance was set at ($p < 0.01$) for all anthropometric indices, systolic and diastolic blood pressure, while waist-hip ratio and systolic blood pressure were significant at $p < 0.05$. **Conclusions:** Hypertension and obesity were strongly linked. Patients with hypertension tend to have higher obesity indices. For older adults with hypertension, adopting healthy eating habits and engaging in regular physical exercise can help manage hypertension, fight obesity and reduce the risk of complications.

Keywords

Anthropometry, Body Composition, Hypertension, Older Adults, Palestinian

1. Introduction

Hypertension is a major global health challenge, contributing significantly to morbidity, mortality, and disability [1] [2]. According to the World Health Organization, 1.28 billion adults are currently living with hypertension worldwide and projected to reach 1.6 billion by the end of 2025 [3] [4]. Of them, two-thirds live in low- and middle-income countries (LMIC). Hypertension prevalence continues to rise in the Middle East and Asia, with significant implications for public health in Palestine [1] [5]. Over the past three decades, hypertension has contributed to nearly a one-fifth increase in mortality, primarily due to coronary heart disease and stroke, particularly in LMICs, with deaths primarily resulting from coronary heart disease or stroke occurring in LMIC [5] [6].

Literature Review

It is imperative to recognize that lifestyle choices, such as diet, physical activity, and body weight, are significant contributors to hypertension risk factors [1] [7] [8]. Aging is a key risk factor for hypertension, increasing susceptibility to elevated blood pressure over time. However, screening based on age alone to identify those at high risk for hypertension and other cardiovascular diseases was found by Wald & Morris to return high false-positive rates [9]. Thus, understanding these factors is crucial for effective prevention and treatment of hypertension, especially considering the worldwide epidemic of obesity [4] [10] [11]. Such effective hypertension prevention and treatment require age- and context-specific strategies based on risk stratification data. In resource-limited contexts, non-laboratory, less expensive methods are favored [12]. Although not without limitations, anthropometric and body composition measures remain widely used to assess obesity, metabolic risks, and hypertension associations, as well as to assess metabolic risks and the association between obesity and hypertension [13]-[15].

In Palestine, hypertension prevalence (27.6%) has risen alongside increased rates of overweight (57.8%) and obesity (26.8%) [16] [17]. Alarmingly, nearly two-thirds of treated hypertensive patients remain uncontrolled [18], highlighting the need for better management strategies. This study investigates the relationship between anthropometric and body composition indices and their effects on hypertension in older adults living in the West Bank of Palestine.

2. Methods

2.1. Design

A cross-sectional study was conducted from February to May 2024.

2.2. Research Question

"Is there a correlation between anthropometric variation and body composition indices with hypertension among older adults in the West Bank of Palestine?"

2.3. Population and Setting

The study recruited a convenience sampling of Palestinian adults from major public health centers in Nablus, Ramallah, and Hebron, representing the northern, central, and southern regions of the West Bank.

2.4. Inclusion/Exclusion Criteria

Participants were eligible if they were adults aged 60 years or older, did not use anticonvulsants, had no physical disorders affecting body measurements, and provided informed consent. Additionally, participants needed to stand independently on the body composition analyzer without mobility limitations. Moreover, participants with underlying conditions such as diabetes, chronic kidney disease, or cardiovascular diseases (conditions that can independently affect blood pressure) were excluded. Furthermore, Potential confounders such as diet, physical activity, and medication use were controlled.

2.5. Body Composition Measurements

A body composition analyzer (TANITA BC-418MA®) was used to measure body weight (kg), fat mass (kg), percentage of fat mass (%), and fat-free mass (kg) to the nearest 0.1 kg. This was done twice when participants were dressed in light clothing without shoes. All measurements were taken in the morning while participants were fasting, had emptied their bladder, and were wearing light clothing and no shoes. After entering the basic information (sex, age, height) of the participant, choose an appropriate model for ordinary people or athletes, and then the test begins.

Body measurements, including Height and Weight, Waist circumference (WC), and Hip circumference (HC) were measured. Trained technicians made all these measurements following the procedures established by the ISAK [19]. Barefoot height was measured using a wall-mounted stadiometer to the nearest 0.1 cm. WC measured with a tape measure at the midpoint between the last floating rib and the highest crest of the iliac. Hip circumference was measured at the widest part of the buttocks using a flexible tape measure. WHR ratio was calculated as a WC (cm) divided by HC (cm).

The increasing obesity rates in Palestine have been assessed through various national health surveys and studies employing standardized anthropometric measurements. A key method involves calculating the Body Mass Index (BMI), which is derived from an individual's weight and height. According to the World Health Organization (WHO), a BMI of 25 or above classifies an individual as overweight, while a BMI of 30 or above indicates obesity.

2.6. Blood Pressure

Blood pressure was measured in the morning by trained clinical staff in a controlled clinic setting. The automated sphygmomanometer followed the recommendations of the European Heart Society (on the right arm in a semi-flexed po-

sition at heart level, with participants in a supine position and after 10 min of rest). Hypertension was defined according to the American Heart Association as systolic blood pressure (SBP) ≥ 130 mmHg and diastolic blood pressure (DBP) ≥ 80 mmHg, while normotension was defined as SBP < 120 mmHg and DBP < 80 mmHg [20].

2.7. Data Analysis

For all the analyses, descriptive statistics were done by (SPSS version 26. Chicago. IL, USA). P values < 0.05 were considered to be statistically significant. A partial correlation coefficient was used to evaluate the connection between anthropometric indices (BMI, WC, HC, and WHR) and systolic diastolic BP. A logistic regression model was used to assess the association between anthropometric indices and hypertension, adjusting for potential confounders such as age and sex. Comparisons of body composition variables across blood pressure categories (normal vs. hypertensive) were performed using t-test. Obesity levels were grouped into five body mass index categories (BMI < 18.50: underweight, BMI 18.50 - 24.9: normal weight, BMI 25.00 - 29.9: overweight, BMI ≥ 30: obese [4].

Ethical Consideration

All participants were informed orally and voluntarily agreed to participate in the research. Approval of the research protocol was taken from the Palestine Ahliya University. Before data collection, each participant was informed that this interview and anthropometric measurements would be completely voluntary. No personally identifiable information was collected to maintain participant confidentiality, and there was no risk of participating in this study. Permission has been obtained from the Ministry of Health in Palestine.

3. Results

3.1. Sample Characteristics

Data were collected from 79 older adult participants. Their mean age was 68.28 ± 5.76 years. For anthropometric indicators, the mean height was 167.81 ± 9.83 m and weight 84.10 ± 16.79 kg. Their mean B.M.I. was 29.86 ± 5.56 kg/m^2. Nearly half of the participants were obese (49.4%) or overweight (27.8%). The mean waist circumference was 94.27 ± 10.04 cm, with a hip circumference being 95.96 ± 12.35 cm. Meanwhile, the mean waist-to-hip ratio was 0.99 ± 0.06. Systolic and diastolic blood pressure means hypertensive (135.46 ± 15.89 mmHg, 84.19 ± 7.47 mmHg, respectively), with almost a third (25.3%) having normal blood pressure (**Table 1**).

3.2. Research Questions Results

All anthropometric measurements showed significant correlations with systolic and diastolic blood pressure ($p < 0.01$), except for the Waist-Hip Ratio (WHR) and systolic blood pressure, which exhibited a significant correlation at $p < 0.05$. These findings suggest that increased blood pressure is associated with increased anthropometric measurements (**Table 2**).

Table 1. Characteristics of participants (n = 79).

Characteristics		N (%)	M (SD)
Age (years)			68.28 (5.76)
Height (cm)			167.81 (9.83)
Weight (kg)			84.10 (6.79)
BMI (kg/m^2)			29.86 (5.56)
BMI Group	Normal weight	18 (22.8)	
	Overweight	22 (27.8)	
	Obese	39 (49.4)	
WC (cm)			94.27 (10.04)
HC(cm)			95.96 (12.35)
W.H.R.			0.99 (0.06)
SBP (mmHg)			135.46 (15.89)
DBP (mmHg)			84.19 (7.47)
Hypertension category	Normotensive	20 (25.3)	
	Hypertensive	59 (74.7)	

WC = waist circumference; HC = hip circumference; BMI = body mass index; WHR = waist-to-hip ratio; SBP = systolic blood pressure; DBP = diastolic blood pressure. Hypertensive is where SBP ≥ 130 mmHg and DBP ≥ 80 mmHg; Normotensive is where SBP < 120 mmHg and DBP < 80 mmHg [20].

Table 2. Correlation between anthropometric indices and blood pressure.

Anthropometric measurement	Systolic blood pressure	Diastolic blood pressure
BMI (kg/m^2)	0.602**	0.576**
WC (cm)	0.729**	0.668**
HC (cm)	0.741**	0.711**
WHR	−0.281*	−0.332**

WC = waist circumference; HC = hip circumference; BMI = body mass index; WHR = waist-to-hip ratio. ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

An independent sample t-tests were conducted to compare anthropometric indices between hypertensive and normotensive participants. Significant differences were observed in all anthropometric measurements for hypertensive and normotensive participants. Hypertensive participants exhibited significantly higher values for BMI, waist circumference, and hip circumference compared to normotensive subjects ($p < 0.001$ for all comparisons), as seen in **Table 3**.

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

Anthropometric measurement	Normotensive (n = 20)	Hypertensive (n = 59)	p value
BMI (kg/m^2)	25.41 ± 3.45	31.37 ± 5.34	0.001
WC (cm)	85.35 ± 7.86	97.29 ± 8.88	0.001
HC (cm)	84.05 ± 7.61	100.00 ± 10.98	0.001
WHR	1.02 ± 0.05	0.98 ± 0.06	0.001

WC = waist circumference; HC = hip circumference; BMI = body mass index; WHR = waist-to-hip ratio.

Logistic regression analysis was conducted to assess the effect of anthropometric measurements; there were no independent predictors of hypertension. The lack of significant predictors in the logistic regression analysis may be due to small sample size (Table 4).

Table 4. Binary logistic regression.

Anthropometric measurement	Odds ratio	95%CI	p value
BMI (kg/m^2)	1.076	0.843 - 1.49	0.587
WC (cm)	0.247	0.026 - 3.00	0.292
HC (cm)	5.557	0.418 - 62.55	0.215
WHR	2.634	0.00 - 2.96	0.265

WC = waist circumference; HC = hip circumference; BMI = body mass index; WHR = waist-t hip ratio.

4. Discussion

Although several anthropometric indices were significantly correlated with hypertension, our study found no independent predictors of hypertension. "This finding contrasts with other research that has identified such predictors, and may be attributed to factors such as sample size, measurement variations, or the unique characteristics of the Palestinian population." Our results are comparable to those of those who studied similar ethnic/racial groups and found a significant association between anthropometric indices and hypertension [21]-[23]. Moreover, our findings echo other studies that revealed a positive relationship between indicators of obesity like WC, BMI and hypertension [24] [25]. However, the crucial finding of this research was that nearly half of the participants were obese (49.4%) and overweight (27.8%), a situation highlighted by Turk-Adawi *et al.* and Assaf *et al.* to be due to poor diet and limited physical activity [5] [16]. Concerning eating habits, although there was no strict dietary pattern identifiable among the participants. Participants' diets were found to be inadequate, with a tendency toward

high salt intake and saturated fats, both of which are known to contribute to elevated blood pressure. In accordance with several studies, it has been suggested that general obesity demonstrates a stronger association with elevated blood pressure in both men and women [26]-[29]. Also, an earlier study found an increased risk of developing high blood pressure among obese people [30]. Obesity indicators are closely related to the risk of high blood pressure across gender and age, with BMI having the highest relative strength [31]. The argument was further debated until a systematic review and meta-analysis of 38 hits confirmed a correlation between BMI, WHR, WHtR, and WC and hypertension, with BMI carrying the highest predictability rates [32].

The findings are consistent with the international literature, demonstrating a substantive correlation between anthropometric measures and heightened systolic and diastolic blood pressure [31]. Consistently, the waist-to-hip ratio (WHR) exhibits a positive association with augmented systolic blood pressure values, accentuating the imperative role of healthcare practitioners in Palestine to conduct comprehensive anthropometric assessments for efficacious blood pressure management among hypertensive cohorts [33].

Furthermore, this investigation illuminates distinctions in anthropometric measures between normotensive and hypertensive cohorts, agreeing with previously published literature [23] [34]. Remarkably, indices of obesity, encompassing BMI, WC, hip circumference (HC), WHR, and waist-to-height ratio (WHtR), manifest statistically significant elevation within the hypertensive stratum, mirroring outcomes observed in a cohort from Taiwan region [31]. These discernments underscore the pertinence of integrating anthropometric indicators into the evaluative paradigm for blood pressure management among hypertensive individuals.

Recommendations

Based on these findings, public health initiatives should focus on targeted obesity prevention and hypertension screening programs. Implementing community-based lifestyle interventions, such as promoting physical activity, improving dietary habits through nutrition education, and reducing salt intake, could help address risk factors. Additionally, early screening for hypertension in high-risk groups, integrating anthropometric assessments in routine health check-ups, and increasing public awareness about obesity-related health risks would enhance prevention efforts. Furthermore, replication the study with large sample size of population and analyze whether the relationship between obesity and hypertension varies across different age groups and gender within the elderly population.

5. Conclusion

Obesity indices, including BMI, WC, HC, and WHR, are significantly higher in hypertensive people. The evaluation of these predictors should be taken into account when examining those at risk of hypertension in the Palestinian population. Given the significant relationship between obesity indicators and hypertension in

this population, healthcare providers in Palestine should prioritize the assessment of these indicators as part of routine hypertension management. Additionally, interventions aimed at improving diet and promoting physical activity should be implemented at the community level to reduce obesity rates and mitigate the risk of hypertension.

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Conflicts of Interest

The author declares no conflict of interest with any organization regarding the materials discussed in this paper.

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