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Original Article

Comparison of Hand Grip Strength in Hypertensive and Non-Hypertensive Middle-Aged People

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ABSTRACT

Background: Hypertension is a leading risk factor for cardiovascular diseases, affecting millions globally. Previous studies have suggested an inverse relationship between hand grip strength (HGS) and hypertension, indicating the potential of HGS as a non-invasive marker for cardiovascular health. However, research exploring this relationship within the middle-aged population of Pakistan remains limited.

Objective: This study aims to compare hand grip strength between hypertensive and non-hypertensive middle-aged individuals and to assess the potential of HGS as a predictive marker for hypertension.

Methods: A comparative cross-sectional study was conducted over six months, from August 2022 to February 2023, involving 220 participants (110 hypertensive and 110 non-hypertensive), aged 35-45 years, at PSRD and Jinnah Hospitals in Lahore, Pakistan. Hand grip strength was measured using a CAMRY digital dynamometer, and blood pressure was assessed with a Certeza sphygmomanometer. Participants were excluded if they had wrist joint problems, neurological disorders, a history of frozen shoulders, limb fractures, cognitive impairments, diabetes, or were pregnant. Data were analyzed using SPSS version 25, employing independent sample t-tests with a significance level set at $p<0.05$.

Results: The mean age of participants was 39.81±3.16 years. Hypertensive individuals showed significantly lower hand grip strength compared to non-hypertensive individuals, with mean dominant HGS at 34.10±8.75 kg for hypertensives and 39.40±7.37 kg for non-hypertensives. Non-dominant HGS followed a similar pattern, with hypertensives at 31.87±8.75 kg and non-hypertensives at 36.97±7.57 kg. Additionally, a higher proportion of males was observed in the hypertensive group compared to the non-hypertensive group.

Conclusion: The study found a significant association between lower hand grip strength and hypertension among middle-aged individuals, supporting the potential of HGS as a screening tool for hypertension risk. This finding underscores the importance of incorporating hand grip strength assessment into routine health evaluations to identify individuals at higher risk of hypertension.

Keywords: Hand Grip Strength, Hypertension, Middle-aged, Pakistan, Cardiovascular Health, Non-invasive Marker.

INTRODUCTION

Hypertension, characterized by a sustained increase in systemic arterial pressure beyond a certain threshold, is a significant public health concern due to its close association with cardiovascular anomalies, which in turn affect vital organs and can lead to premature mortality(1). Blood pressure, delineated by systolic blood pressure (SBP) and diastolic blood pressure (DBP), is deemed normal when SBP is less than 120 mm Hg and DBP is less than 80 mm Hg(1). The condition escalates from pre-hypertension, defined as an SBP of 120-129 mm Hg and a DBP of less than 80 mm Hg, to stage 1 hypertension with SBP and DBP ranging from 130-139 mm Hg and 80-89 mm Hg respectively, culminating in stage 2 hypertension where SBP is 140 mm Hg or higher and DBP is 90 mm Hg or higher(2). The severity of hypertension and its implications are underscored by findings from the Asia Pacific Cohort Study Collaboration, which revealed that Asian patients with hypertension are at a 4.5-fold greater risk of cardiovascular diseases compared to those with normal blood pressure(3). Furthermore, the World Health Organization's estimates indicate that hypertension afflicts 38.7 million

people in Pakistan, with a mere 2.7 million managing to control the condition, a situation that is anticipated to exacerbate over time, thereby increasing the burden on the country's healthcare infrastructure(4).

The regulation of blood pressure involves a complex interplay between the hormonal and nervous systems, along with intracellular feedback loops, all of which are influenced by a variety of genetic and environmental factors as one ages. Notably, sympathetic overactivity has been identified as having the strongest correlation with hypertension, possibly due to cortical influences affecting the basal sympathetic tone originating from the hypothalamus(5). Hand grip strength (HGS), a measure of the muscular strength generated by the forearm and wrist muscles, is determined by the amount of static force that the hand can exert against a dynamometer. Its relevance extends beyond a simple measure of strength, as it has been posited to serve as a viable screening tool for middle-aged adults due to its predictive performance and straightforward application(6). The average HGS values for men and women stand at 42.4 kg and 40.6 kg for the right and left hands, respectively, for men, and 27.1 kg and 25.9 kg for women(7). The process of regulating skeletal muscle blood flow encompasses a myriad of mechanisms and substances, where a balance between vasoconstrictor and vasodilator signals ensures muscular blood flow. In individuals with normal circulatory systems, the requisite increase in muscle blood flow for oxygen delivery during physical activity is achieved through a significant rise in the production of vasodilators like Nitric oxide (NO) and prostacyclin, predominantly mediated by endothelial cells. However, in the context of hypertension, endothelial dysfunction leads to impaired vascular tone control, increased peripheral vascular resistance (PVR), and inadequate oxygen supply regulation to skeletal muscles, potentially affecting muscle function. This is further compounded by alterations in prostacyclin production, NO bioavailability, and an uptick in vasoconstrictors and reactive oxygen species production(8). Given the limited research on the relationship between hand grip strength and hypertension within the middle-aged population in Pakistan, this study aims to fill that gap by providing insights that could inform strategies for enhancing hand grip strength, thereby potentially mitigating hypertension risk in this demographic.

MATERIAL AND METHODS

This comparative cross-sectional study was conducted at the Pakistan Society for the Rehabilitation of the Disabled (PSRD) Hospital and Jinnah Hospital Lahore, spanning a period of six months from 1 August 2022 to 1 February 2023. Utilizing a non-probability convenient sampling technique, a sample size of 220 participants was determined using Raosoft software, with a 95% confidence interval and a 5% margin of error(9). Participants were divided into two groups of 110 each: Group 1 comprised individuals diagnosed with hypertension, confirmed through medical examination, and Group 2 consisted of non-hypertensive individuals with no history of hypertension. Inclusion criteria were strictly adhered to, selecting males and females aged 35-45 years. Consent forms, available in both English and Urdu, were provided to ensure participants were fully informed about the study's nature and purpose. Participants were required to sign these forms to confirm their understanding and agreement to participate.

Exclusion criteria were rigorously applied to maintain the study's integrity, excluding individuals outside the specified age range, those with wrist joint issues, neurological disorders, a history of frozen shoulders, recent or prior limb fractures, cognitive impairments, diabetes, or pregnant females. The exclusion of pregnant females was due to potential variances in blood pressure and hand grip strength that pregnancy may induce.

Measurements were taken using a CAMRY digital dynamometer (Model: EH01) for hand grip strength and a Certeza sphygmomanometer (Model: CR-1002) for blood pressure. Participants were seated comfortably during the measurement process. Initial demographic data, including names, ages, heights, and weights, were collected. Participants were then inquired about their dominant hand and hypertension history, including the duration of hypertension where applicable. Blood pressure measurements were taken from the right arm, recording both systolic and diastolic pressures. Hand grip strength was measured in both the dominant and non-dominant hands using the dynamometer, with settings adjusted for age and a holding time of 5 seconds. Three consecutive measurements were taken, and the average of these measurements was utilized in the analysis.

Data analysis was performed using SPSS software version 25, employing an independent sample t-test with a significance level set at $p<0.05$. Ethical clearance for the study was granted by the ethical board (Reference no. PSRD/CRS/MKS/REC/letter39), with additional permissions obtained from the PSRD College of Rehabilitation Sciences and Jinnah Hospital Lahore. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki, ensuring that all participants were fully informed of the study's purpose and procedures and that their participation was voluntary, with confidentiality and anonymity maintained throughout.

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RESULTS

In this comparative cross-sectional study, demographic characteristics and hand grip strength were meticulously analyzed among hypertensive and non-hypertensive middle-aged participants. The study encompassed a total of 220 individuals, evenly divided into two groups based on their hypertension status, with each group consisting of 110 participants.

The age distribution among the participants was closely matched, with the mean age for the hypertensive group reported at 39.85 years (SD = 3.21), while the non-hypertensive group had a slightly lower mean age of 39.77 years (SD = 3.12), indicating a homogeneous age distribution across both groups (Table 1). A noticeable difference was observed in the physical stature of participants; the hypertensive group presented with a mean height of 169.26 cm (SD = 8.48), in contrast to the non-hypertensive group, which had a slightly higher mean height of 172.80 cm (SD = 8.60). This variance in height was paralleled by differences in weight, with the hypertensive group having a mean weight of 66.30 kg (SD = 7.27) compared to the non-hypertensive group's mean weight of 69.30 kg (SD = 8.71). Despite these differences in height and weight, the Body Mass Index (BMI) remained remarkably consistent across groups, with hypertensive individuals displaying a mean BMI of 23.19 (SD = 2.32) and non-hypertensive individuals a mean BMI of 23.16 (SD = 2.48), showcasing minimal variation in body composition between the two cohorts.

Gender distribution within the study population also revealed notable distinctions; the hypertensive group comprised 73.63% males and 26.36% females, whereas the non-hypertensive group had a higher proportion of males at 87.27% and a lower proportion of females at 12.72%. This disparity underscores the potential influence of gender on hypertension prevalence or participation rates in the study. Dominant hand preference exhibited a slight variation, with 93.63% of the hypertensive group and 90.9% of the non-hypertensive group reporting right-hand dominance. Left-hand dominance was reported by 6.36% of hypertensive and 9.09% of non-hypertensive participants, suggesting a consistent preference for the right hand across populations (Table 1).

Table 1 Demographic Characteristics of Participants by Hypertension Status

Demographic Variables	Hypertensive (n=110)	Non-Hypertensive (n=110)
Age (years), mean ± SD	39.85 ± 3.21	39.77 ± 3.12
Height (cm), mean ± SD	169.26 ± 8.48	172.80 ± 8.60
Weight (Kg), mean ± SD	66.30 ± 7.27	69.30 ± 8.71
BMI (Kg/m^2), mean ± SD	23.19 ± 2.32	23.16 ± 2.48
Gender, n (%)		
Male	81 (73.63%)	96 (87.27%)
Female	29 (26.36%)	14 (12.72%)
Dominant Hand, n (%)		
Right	103 (93.63%)	100 (90.9%)
Left	7 (6.36%)	10 (9.09%)

Table 2 Hand Grip Strength (HGS) Comparison Between Hypertensive and Non-Hypertensive Participants

Hand Grip Strength (HGS)	Non-Hypertensive Mean ± SD (Kg)	Hypertensive Mean ± SD (Kg)
Dominant HGS	39.40 ± 7.37	34.10 ± 8.75
Non-Dominant HGS	36.97 ± 7.57	31.87 ± 8.75

Hand grip strength (HGS), a focal measure of this study, demonstrated significant differences between hypertensive and non-hypertensive participants. The mean dominant HGS for non-hypertensive individuals was recorded at 39.40 kg (SD = 7.37), markedly higher than the 34.10 kg (SD = 8.75) observed in their hypertensive counterparts. This trend was consistent in non-dominant HGS measurements, where non-hypertensive participants showed a mean strength of 36.97 kg (SD = 7.57) compared to 31.87 kg (SD = 8.75) for hypertensive individuals, indicating a clear association between hypertension and reduced grip strength (Table 2).

These findings, derived from detailed assessments and analyses, underline the intricate interplay between demographic factors and hand grip strength in relation to hypertension status. The highlighted differences not only contribute to the understanding of hypertension's impact on physical capabilities but also emphasize the importance of considering a broad range of demographic variables in health-related research.

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DISCUSSION

This study aimed to elucidate the relationship between hand grip strength and hypertension among a cohort of 220 participants, predominantly male. The findings revealed a discernible difference in hand grip strength between hypertensive and non-hypertensive individuals, with the latter group exhibiting higher strength levels. This inverse relationship aligns with previous research by Mainous in 2015, which also identified a link between diminished hand grip strength and hypertension across a diverse sample population, highlighting the potential influence of age on this association(10). Notably, a study conducted in Southern China unearthed a significant correlation between hand grip strength and hypertension among elderly females, yet no similar association was found within the male demographic(9). This contrast with our findings, which indicated a broad applicability of the hand grip strength and hypertension relationship across both genders, suggests that demographic variables may play a crucial role in this context.

Further complicating the relationship between hand grip strength and hypertension, the study by Chao Ji and Zheng posited that overweight and obese individuals with stronger hand grip strength might still be at an increased risk of hypertension(11). In our study, 68 participants were classified as obese, with a gender distribution of 51 males and 17 females. The connection between a mere 5% increase in body weight and a subsequent 20% to 30% rise in hypertension risk underscores the critical role of Body Mass Index (BMI) as a determinant, with obesity increasing the risk of hypertension fivefold compared to individuals with normal BMI(12). These findings are corroborated by evidence suggesting that modest weight loss can significantly mitigate hypertension risk, with a reduction of 4.5 kilograms over 30 months leading to a 65% decrease in hypertension likelihood(12).

The primary emphasis on lifestyle modifications for hypertensive patients reflects the consensus that prevention is preferable to cure(13). Adhering to Asian guidelines, non-pharmacological interventions such as dietary sodium reduction, weight management, and increased physical activity are advocated(14). The deleterious effects of excessive salt intake on blood vessel elasticity and systolic blood pressure further highlight the importance of dietary management in hypertension control, with a recommended salt intake of no more than 5.0g per day(15).

Despite the Pakistani government's efforts to enhance hypertension management through increased healthcare staffing, challenges remain due to underutilization of healthcare facilities, infrastructural deficits, and accessibility issues(16). The importance of patient and healthcare provider education on hypertension management cannot be overstated, emphasizing the need for affordable medication and proactive patient involvement in health maintenance.

The study also sheds light on the impact of stress and lifestyle factors on hypertension, advocating for the integration of exercise as a pivotal component of hypertension management(17). The recommendation for isometric hand grip exercises, shown to moderately reduce hypertension, underscores the potential of non-pharmacological interventions(19). Furthermore, the benefits of regular physical activity in enhancing endothelial function and reducing resting blood pressure levels highlight the multifaceted approach required for effective hypertension management(20).

The study's strengths lie in its comprehensive analysis of the relationship between hand grip strength and hypertension, contributing valuable insights to the existing body of research. However, limitations include the study's short duration and the gender imbalance among participants. Future research should consider employing 24-hour ambulatory blood pressure monitoring for more accurate hypertension diagnosis and prioritizing a balanced gender representation to deepen the understanding of the relationship between hand grip strength and hypertension.

CONCLUSION

In conclusion, this study corroborates the notion that non-hypertensive individuals possess stronger hand grip strength compared to their hypertensive counterparts, reinforcing the connection between hand grip strength and hypertension risk. This underscores the potential of hand grip strength as a practical metric for cardiovascular health assessment and the importance of incorporating strength training and lifestyle modifications into hypertension management strategies. Further research is warranted to explore this relationship in greater depth, particularly among diverse demographic groups and using longitudinal study designs.

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