



## Original Research Article

# CORRELATION OF HAND GRIP STRENGTH WITH CARDIOVASCULAR PARAMETERS IN HEALTHY INDIVIDUALS: A PROSPECTIVE STUDY

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## ABSTRACT

**Background:** Hand grip strength (HGS) is an established indicator of overall muscle strength and functional status. Recent evidence suggests its association with cardiovascular health, including blood pressure, heart rate, and vascular resistance. However, data in young healthy populations, particularly in the Indian context, remain limited. **Aim:** To evaluate the correlation between hand grip strength and cardiovascular parameters in healthy individuals.

**Materials and Methods:** This prospective study was conducted over a period of 3 months in the Department of Physiology, PMCH, Patna. A total of 100 healthy participants, including undergraduate (UG) and postgraduate (PG) students and staff, were enrolled. Hand grip strength was measured using a calibrated dynamometer. Cardiovascular parameters assessed included systolic blood pressure (SBP), diastolic blood pressure (DBP), pulse rate, and mean arterial pressure (MAP). Statistical analysis was performed using Pearson's correlation coefficient, with  $p < 0.05$  considered statistically significant.

**Results:** Hand grip strength showed a statistically significant positive correlation with systolic blood pressure and mean arterial pressure, while a weak correlation was observed with diastolic blood pressure. An inverse relationship was noted with resting pulse rate. These findings indicate that higher muscle strength may be associated with better cardiovascular efficiency.

**Conclusion:** Hand grip strength can serve as a simple, non-invasive surrogate marker of cardiovascular health in healthy individuals. It may be useful for early screening and preventive strategies in clinical practice.

**Keywords:** Hand grip strength, cardiovascular parameters, blood pressure, pulse rate, muscle strength, correlation study.

## INTRODUCTION

Hand grip strength (HGS) is widely recognized as a reliable and simple measure of overall muscular strength and functional capacity. It is frequently used in both clinical and research settings due to its non-invasive nature, ease of measurement, and reproducibility. Over the past decade, HGS has gained prominence not only as an indicator of musculoskeletal health but also as a predictor of cardiovascular morbidity and mortality.<sup>[1,2]</sup>

Cardiovascular diseases (CVDs) remain the leading cause of mortality worldwide, accounting for a significant burden in both developed and developing countries, including India.<sup>[3]</sup> Early identification of

individuals at risk is crucial for timely intervention and prevention. Traditional risk factors such as hypertension, obesity, and dyslipidemia are well established; however, there is increasing interest in identifying additional simple markers that can aid in early detection.<sup>[4]</sup>

Emerging evidence suggests that muscle strength, particularly hand grip strength, is inversely associated with cardiovascular risk factors and adverse outcomes.<sup>[5]</sup> Lower HGS has been linked to higher incidence of hypertension, metabolic syndrome, and increased arterial stiffness.<sup>[6,7]</sup> Conversely, individuals with higher muscle strength

tend to exhibit better vascular compliance and autonomic balance.<sup>[8]</sup> These associations may be explained by shared physiological pathways involving inflammation, insulin resistance, and endothelial dysfunction.<sup>[9]</sup>

Hand grip strength is also closely related to physical activity levels, which play a crucial role in maintaining cardiovascular health. Regular physical activity improves cardiac output, reduces peripheral resistance, and enhances autonomic regulation, thereby contributing to lower resting heart rate and optimal blood pressure.<sup>[10]</sup> Therefore, HGS may indirectly reflect cardiovascular fitness and overall health status.

Several studies conducted in Western populations have demonstrated significant correlations between HGS and cardiovascular parameters such as systolic and diastolic blood pressure, pulse rate, and mean arterial pressure.<sup>[11,12]</sup> However, findings are not entirely consistent, particularly in younger and apparently healthy populations. Moreover, there is a paucity of data from Indian settings, where lifestyle, genetic predisposition, and environmental factors may influence these associations.<sup>[13]</sup>

In young adults, especially students and working professionals, sedentary lifestyle and stress are increasingly common, potentially affecting both muscular strength and cardiovascular health. Despite being apparently healthy, this population may harbor early subclinical changes that could predispose them to future cardiovascular diseases.<sup>[14]</sup> Therefore, assessing the relationship between HGS and cardiovascular parameters in this group is of considerable importance.

A better understanding of this correlation may help establish HGS as a cost-effective screening tool in routine clinical practice and community health programs. It may also encourage incorporation of strength assessment in preventive health strategies.<sup>[15]</sup>

Hence, the present study was undertaken to evaluate the correlation between hand grip strength and cardiovascular parameters among healthy individuals in a tertiary care teaching institution in Bihar.

## MATERIALS AND METHODS

**Study Design:** This was a **prospective observational study**.

**Study Duration:** The study was conducted over a period of **3 months**.

**Study Location:** The study was carried out in the **Department of Physiology, Patna Medical College and Hospital (PMCH), Patna**.

**Study Population:** The study included **undergraduate (UG) students, postgraduate (PG) students, and staff members** of PMCH.

**Sampling Technique:**

A **convenience sampling technique** was employed to recruit participants. Individuals who were readily

available, met the eligibility criteria, and were willing to participate during the study period were included

**Sample Size:** A total of **100 healthy individuals** were included in the study.

### Inclusion Criteria

- Apparently healthy individuals aged 18–40 years
- Both males and females
- Willing to participate and provide informed consent

### Exclusion Criteria

- History of cardiovascular disease, hypertension, or diabetes
- Musculoskeletal disorders affecting upper limbs
- Chronic systemic illness
- Individuals on medications affecting cardiovascular parameters
- Smokers and alcoholics

### Data Collection Procedure

After obtaining institutional ethical clearance and informed consent, participants were enrolled in the study. A detailed history and general physical examination were conducted.

### Measurement of Hand Grip Strength

- Hand grip strength was measured using a **calibrated hand grip dynamometer**.
- Participants were instructed to sit comfortably with the elbow flexed at 90°
- The dynamometer was held in the dominant hand
- Three readings were taken with a rest interval of 1–2 minutes
- The **highest value (kg)** was recorded for analysis

### Measurement of Cardiovascular Parameters

#### 1. Blood Pressure (BP):

- Measured using a standard sphygmomanometer
- Participants rested for at least 5 minutes before measurement
- **Systolic BP (SBP)** and **Diastolic BP (DBP)** were recorded

#### 2. Pulse Rate:

- Measured manually at the radial artery for 60 seconds

#### 3. Mean Arterial Pressure (MAP):

- Calculated using the formula:  
[MAP = DBP +  $\frac{1}{3}$ (SBP - DBP)]

### Statistical Analysis

- Data were entered into Microsoft Excel and analyzed using statistical software
- Quantitative data were expressed as **mean ± standard deviation (SD)**
- **Pearson's correlation coefficient (r)** was used to assess the relationship between hand grip strength and cardiovascular parameters
- A **p-value < 0.05** was considered statistically significant.

## RESULTS

A total of 100 healthy individuals were included in the study, comprising undergraduate (UG) students, postgraduate (PG) students, and staff members. The

analysis focused on the correlation between hand grip strength (HGS) and cardiovascular parameters including systolic blood pressure (SBP), diastolic blood pressure (DBP), pulse rate, and mean arterial pressure (MAP).

**Table 1: Demographic and Baseline Characteristics (n = 100)**

Parameter	Mean ± SD / n (%)
Age (years)	24.8 ± 4.6
Males	58 (58%)
Females	42 (42%)
Hand Grip Strength (kg)	32.5 ± 8.4
SBP (mmHg)	118.6 ± 10.2
DBP (mmHg)	76.4 ± 7.8
Pulse Rate (beats/min)	74.2 ± 6.5
MAP (mmHg)	90.5 ± 8.3

The study population had a mean age of 24.8 years, indicating a predominantly young adult group. Males constituted 58%, while females accounted for 42%. The mean hand grip strength was 32.5 kg, with expected variability due to gender differences.

Cardiovascular parameters were within normal physiological limits, reflecting a healthy cohort. The relatively narrow standard deviations suggest homogeneity in the study population.

**Table 2: Correlation of Hand Grip Strength with Cardiovascular Parameters**

Parameter	Correlation Coefficient (r)	p-value
SBP	+0.42	<0.001
DBP	+0.28	0.004
Pulse Rate	-0.31	0.002
MAP	+0.39	<0.001

Hand grip strength showed a moderate positive correlation with systolic blood pressure ( $r = 0.42$ ) and mean arterial pressure ( $r = 0.39$ ), both of which were highly statistically significant ( $p < 0.001$ ). This indicates that individuals with higher muscle strength tend to have slightly higher but physiologically normal SBP and MAP.

A weak but significant positive correlation was observed with diastolic blood pressure ( $r = 0.28$ ,  $p = 0.004$ ), suggesting a modest relationship.

Interestingly, pulse rate demonstrated a negative correlation ( $r = -0.31$ ,  $p = 0.002$ ), indicating that individuals with higher hand grip strength tend to have lower resting heart rates, reflecting better cardiovascular efficiency and autonomic balance.

**Table 3: Comparison of Cardiovascular Parameters Based on Hand Grip Strength Categories**

Parameter	Low HGS (<25 kg) (n=30)	Moderate HGS (25–35 kg) (n=40)	High HGS (>35 kg) (n=30)	P-value
SBP (mmHg)	112.4 ± 8.6	118.9 ± 9.2	124.3 ± 10.5	<0.001
DBP (mmHg)	72.8 ± 6.4	76.7 ± 7.1	79.5 ± 8.2	0.003
Pulse Rate (bpm)	78.6 ± 6.2	74.3 ± 5.8	70.1 ± 5.3	<0.001
MAP (mmHg)	86.0 ± 6.9	90.8 ± 7.5	94.4 ± 8.1	<0.001

Participants with high hand grip strength (>35 kg) exhibited significantly higher SBP (124.3 mmHg) compared to those with low HGS (112.4 mmHg), showing an increase of approximately 10.6%. Similarly, MAP increased progressively across categories, with a 9.7% rise from low to high HGS groups ( $p < 0.001$ ).

DBP also showed a gradual increase (~9.2% higher in high HGS group), which was statistically significant ( $p = 0.003$ ).

In contrast, pulse rate decreased significantly with increasing HGS, with individuals in the high HGS group having a 10.8% lower pulse rate compared to the low HGS group ( $p < 0.001$ ), indicating improved cardiovascular fitness.

## DISCUSSION

The present study evaluated the correlation between hand grip strength and cardiovascular parameters among healthy individuals. The findings demonstrated a statistically significant association between HGS and key cardiovascular variables, supporting the hypothesis that muscular strength is closely linked to cardiovascular health.

In this study, a moderate positive correlation between HGS and systolic blood pressure ( $r = 0.42$ ) was observed. This finding is consistent with previous studies that reported a similar relationship between muscle strength and blood pressure levels.<sup>[1,2]</sup> The observed increase in SBP with higher HGS may reflect greater cardiac output and vascular tone in individuals with better muscular fitness. However, it is important to note that the SBP values remained

within physiological limits, indicating a normal adaptive response rather than pathological elevation. The positive correlation between HGS and mean arterial pressure ( $r = 0.39$ ) further reinforces this association. MAP is a key determinant of tissue perfusion, and its increase with higher muscle strength suggests improved hemodynamic efficiency.<sup>[3]</sup> Similar findings have been reported in studies where physically active individuals demonstrated higher MAP within normal ranges, attributed to enhanced vascular responsiveness.<sup>[4]</sup>

The relationship between HGS and diastolic blood pressure was weaker but still statistically significant ( $r = 0.28$ ). This is in agreement with studies that have shown inconsistent or modest associations between DBP and muscle strength.<sup>[5,6]</sup> DBP is primarily influenced by peripheral vascular resistance, and its weaker correlation with HGS may indicate that muscular strength has a more pronounced effect on systolic function rather than diastolic parameters.

One of the notable findings of this study was the inverse correlation between HGS and pulse rate ( $r = -0.31$ ). Individuals with higher grip strength exhibited lower resting heart rates, which is a well-established marker of good cardiovascular fitness and autonomic balance.<sup>[7]</sup> This finding aligns with studies demonstrating that physically fit individuals tend to have enhanced parasympathetic activity and reduced sympathetic tone, leading to lower resting heart rates.<sup>[8]</sup>

The subgroup analysis further supported these findings, showing a progressive increase in SBP, DBP, and MAP with increasing HGS, along with a corresponding decrease in pulse rate. This trend suggests that hand grip strength may reflect overall cardiovascular conditioning. Individuals with higher HGS likely engage in more physical activity, which improves cardiac efficiency and vascular health.<sup>[9]</sup>

The physiological mechanisms underlying these associations may involve multiple pathways. Increased muscle strength is associated with improved insulin sensitivity, reduced systemic inflammation, and enhanced endothelial function, all of which contribute to better cardiovascular health.<sup>[10,11]</sup> Additionally, regular physical activity leads to structural and functional adaptations in the cardiovascular system, including increased stroke volume and reduced resting heart rate.<sup>[12]</sup>

The findings of the present study are comparable to those reported in earlier research conducted in different populations. Few studies also demonstrated that lower hand grip strength was associated with higher cardiovascular risk and mortality.<sup>[13,14]</sup> Similarly, Celis-Morales et al. found that HGS is inversely related to cardiovascular events and all-cause mortality.<sup>[9]</sup> Although these studies were conducted in broader and older populations, the present study extends these observations to a younger, healthy cohort.

However, some studies have reported no significant correlation between HGS and certain cardiovascular parameters, particularly in homogeneous young

populations.<sup>[15]</sup> These discrepancies may be attributed to differences in sample size, demographic characteristics, and measurement techniques.

The present study has several strengths. It was conducted in a controlled environment with standardized measurement protocols, and it included a relatively homogeneous population, reducing confounding variables. However, certain limitations must be acknowledged. The sample size was limited to 100 participants, and the study duration was relatively short (3 months). Additionally, factors such as physical activity levels, dietary habits, and body composition were not assessed, which could have influenced both hand grip strength and cardiovascular parameters. The use of a convenience sampling technique may also introduce selection bias. Therefore, larger longitudinal studies incorporating a more diverse population and additional influencing variables are recommended to validate and expand upon these findings.

## CONCLUSION

The present prospective study conducted among 100 healthy individuals demonstrated a statistically significant correlation between hand grip strength (HGS) and cardiovascular parameters. A moderate positive relationship was observed between HGS and systolic blood pressure as well as mean arterial pressure, while a weaker yet significant association was noted with diastolic blood pressure. Additionally, an inverse correlation between hand grip strength and resting pulse rate highlighted improved cardiovascular efficiency in individuals with greater muscular strength.

These findings suggest that hand grip strength reflects not only musculoskeletal fitness but also cardiovascular functional status. Individuals with higher grip strength exhibited favorable cardiovascular profiles, particularly in terms of lower resting heart rate, indicating enhanced autonomic regulation and physical fitness.

However, the study is limited by its relatively small sample size and short duration. Future studies with larger, diverse populations and longitudinal follow-up are recommended to further validate these findings and explore causal relationships.

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