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Research Article

Grip Strength As A Marker Of Health: A Cross-Sectional Analysis In Working-Age Adults.

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Abstract

This cross-sectional study investigated the relationship between grip strength and physical and mental health indicators in working-age adults. While grip strength is a known predictor of frailty and cognitive decline in older populations, its role in younger adults remains underexplored. We hypothesized that grip strength could serve as an indicator of overall health and well-being in this demographic.

Eighty-eight participants from a local university were assessed using a Jamar Dynamometer for grip strength and the Short Physical Performance Battery for gait speed. They also completed questionnaires on demographics, health status, physical activity, perceived stress, and psychiatric history, including PHQ-2 for depression screening.

Grip strength was significantly associated with height, weight, physical activity, gender, medication use, and medical diagnosis, while gait speed showed no significant associations. Multivariate regression identified weight, gender, and physical activity as significant predictors of grip strength. Higher weight and male gender correlated with greater grip strength, whereas lower physical activity levels were linked to reduced grip strength. However, medical diagnoses, weight loss, and perceived stress were not significant predictors.

These findings suggest grip strength could be a useful screening tool for health assessment in younger adults. Its associations with multiple health parameters highlight its potential for early detection of health risks. However, the absence of a link between grip strength and gait speed, along with non-significant predictors, warrants further study. Integrating grip strength assessments into clinical practice may enhance preventive care and overall well-being.

INTRODUCTION

Frailty, characterized by weakness, fatigue, and reduced mobility, affects nearly 10% of community-dwelling Medicare beneficiaries aged 65 or older, contributing tens of billions of dollars annually to US healthcare cost. [1-5]. Frailty is associated with increased risks of hospitalization, disability, and mortality [6-7]. Early identification and prevention are critical to reducing impact, leading to development of tools such as grip strength measurement and Fried frailty criteria [6,8]. In particular, grip strength can be a robust marker of aging, with strong associations to cardiovascular health, mobility decline, or mortality [9-13].

Grip strength and frailty has been extensively studied in the geriatric population. Many studies such as Lim SH et al. and Shufan Li et al. have found a positive association between the two [14-15]. However, few studies look at different associations of grip and frailty related conditions in the younger population. This study aims to determine whether there is a correlation between grip strength and overall health and well-being in a group of working-age individuals, including age, gender, height, weight, grip strength, and gait speed, as well as medical history, medication use, and surgical history.

MATERIAL AND METHODS

Study design

This cross-sectional study, conducted from February 2023 to November 2023, utilized a convenience sampling method to investigate the correlations between grip strength and other physical performance indicators, particularly gait speed. The participants were adults associated with a local university, all capable of walking 4 meters and operating a dynamometer. Exclusion criteria included individuals under the age of 18, those unable to perform the gait or grip strength assessments, or those who could not fully complete the questionnaire. The study protocol commenced with the measurement of each participant's grip strength, followed by an assessment of their gait speed. After these physical assessments, participants

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completed a brief questionnaire designed to gather data on demographics, health status, and stress levels, among other factors (see Appendix 1 for full survey details).

Procedures

Protocol for measuring grip strength

Each participant's grip strength was measured using the Jamar Dynamometer (Model 670116-200) while following the protocol of the American Society of Hand Therapist [16]. The dynamometer was calibrated according to the manufacturer's recommendations. Each participant was seated with an adducted shoulder, and elbow at 90 degrees. The dynamometer was placed at the second handle level with peak grip strength measured for each participant in pounds.

Protocol for measuring gait speed

Gait speed was measured utilizing the "short physical performance battery" protocol [17]. Briefly, total distance was 4m with participants using a static start, with start and finish lines marked. Researchers explained that participants should start behind the line and walk across the opposite facing line at their normal walking pace. The researcher used a hand timer and began time when a participant initiated movement and ended time when a participant's foot crossed the line. This gait speed measurement was performed once. Assisted walking devices were allowed, however none of the participants in the study required one. Time was measured using an electronic stopwatch. Apple Inc. (2021). iPhone 13 [Device]. Cupertino, CA: Apple Inc

Outcomes of interest

The primary outcomes of interest were grip strength and gait speed. Physical health was determined through the Fried frailty criteria [18] and past medical history. Three of the components of the Fried frailty criteria, exercise, exhaustion and weight loss, were all self-reported through a questionnaire administered to participants. On the same questionnaire, participants listed their medical and surgical history.

Statistical Analysis

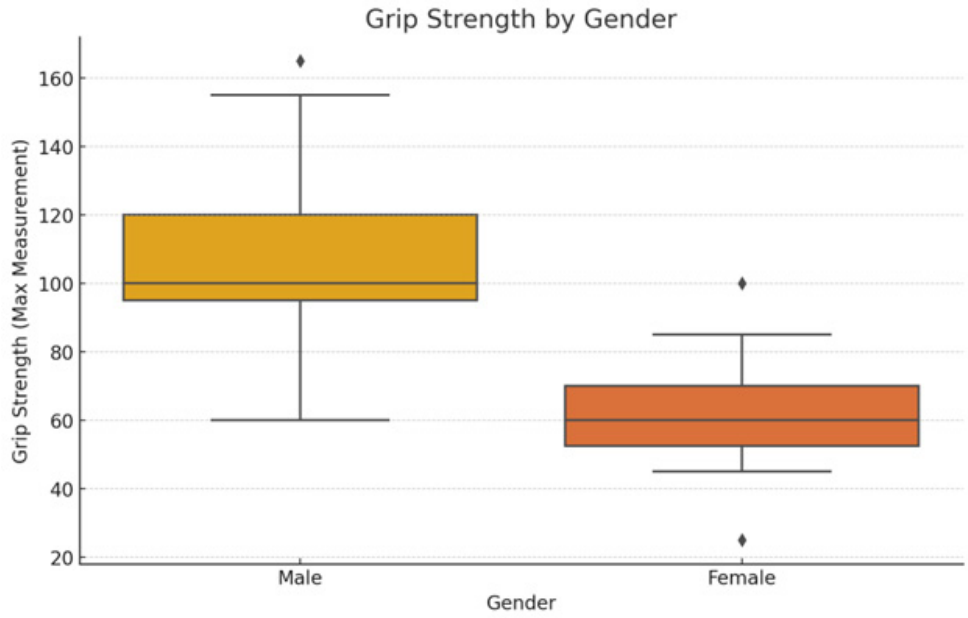
Descriptive statistics, including a correlation matrix, were initially conducted to summarize the data and explore relationships among variables. Linear regression analysis was then employed, with grip strength set as the dependent variable, to assess its associations with gait speed (measured to the nearest second) and participants' questionnaire responses. Questionnaire variables included the following: Age, height, weight, past medical history, Fried Frailty criteria, and PHQ-2. Variance Inflation factor was used to assess multicollinearity with any variable >=5 being removed from the regression model. The Shapiro-Wilk test was used to evaluate the normal distribution of the dataset. Statistical significance was established at a p-value of less than 0.05 for all tests. All analyses were conducted using Jamovi (Version 2.3). This study was completed within ethical standards and provided with following IRB approval: 2024-242-NSU.

RESULTS

Participant characteristics

The results of the study yielded 88 total responses. The median male (n=57) was 23 years old (range: 18-74), 69 inches (range: 57 - 75 inches), 175 lbs (range: 115 - 299 lbs), with no recorded health conditions (n=48, 84%), and a grip strength of 100lbs (range: 60-165). The median female (n= 31) was 25 years old (range: 17-50), 65 inches (range: 59 - 69 inches), 131lbs (range: 115 - 299 lbs), with a recorded health condition (n=16, 52%), and grip strength of 60lbs (range: 25-100). Both male and females had a median gait speed of 4 seconds (range: 2-5 seconds). **Figure 1**

Figure 1. Box plot demonstrating median strength by gender along with interquartile range.



Grip Strength and Gait Speed correlations

Simple linear correlation showed that grip strength was significantly associated with height (Pearson's r: 0.496 , P value: <0.001), weight (Pearson's r: 0.556, P value: <0.001), physical activity (Pearson's r: 0.344, P value = 0.001), gender (Pearson's r: -0.742, P value: <0.001), taking medications (Pearson's r: -0.323 , P value= 0.002), or having received a medical diagnosis (Pearson's r: -0.312 , P value: < 0.003). Gait speed was not significantly associated with any variable (all variables: P value >0.05). **Table 1**

Table 1. Median results of height, weight, grip strength, gait speed, and physical activity by gender.

Gender (n)	Characteristics				
	Height (IQR)	**Weight (IQR)**	**Grip Strength (IQR)**	**Gait speed (IQR)**	**Physical Activity**
Male (57)	69 inches (5)	175lbs (40)	100 (25)	4 sec (1)	1
Female (31)	65 inches (4)	131lbs (131)	60 (17.5)	4 sec (1)	2

Legend: Physical activity of 1 = "I am physically active 30 min physical activity, 5 or more days / week", physical activity of 2 = " I am physically active occasionally or in some seasons more than others"

Predictors of Grip Strength

A multivariate linear regression identified several significant predictors of grip strength. Weight was associated with an increased grip strength of 0.231 lb per pound of body weight ($p = 0.001$). Gender also played a significant role; being male was associated with an increased grip strength of 27.0 lbs ($p < 0.001$). Furthermore, physical activity levels showed that individuals who were only mildly active experienced a decrease in grip strength of 9.4 pounds compared to those who were more active ($p = 0.047$). In contrast, the presence of recent medical diagnoses ($p = 0.719$), recent weight loss ($p = 0.42$), and varying levels of perceived stress (p ranging from 0.694 to 0.987) were not significant predictors.

DISCUSSION

Our study examined 88 participants, focusing on their height, weight, grip strength, and gait speed. The characteristics of the male and female participants were consistent with what has been previously reported for U.S. adults in this age group [19]. Grip strength and height also aligned with existing data for similar populations, while gait speed fell within the expected range [14,20].

Our results show that being male was associated with higher grip strength, which appears to agree with Lim SH et al., who performed a retrospective study that found a similar finding between strength and gender [14]. Additionally, physical activity showed a positive correlation with grip strength. This aligns with a study by Shufan Li et al. [15], which demonstrated a significant positive correlation between grip strength and physical activity levels. The study further highlighted that higher levels of physical activity are consistently associated with stronger grip strength, emphasizing the importance of maintaining an active lifestyle. Interestingly, we found a negative correlation between grip strength and medication use, as well as recent medical diagnoses. This supports previous findings where certain medications, particularly cardiovascular and psychotropic drugs, may correlate to reduced muscle strength [21-22]. However, these studies often focus on older adults; our findings extend this relationship to a younger, generally healthier population.

We observed no significant correlation between grip strength and gait speed, which contrasts with findings in older populations where these measures are often positively associated [23-24]. However, this may be due to a limitation in our data collection, as gait speed was recorded to the nearest whole second, potentially obscuring subtle differences. While the lack of significance could reflect true differences in our younger cohort, it is also possible that more precise measurements might have revealed a significant relationship.

Our regression analysis identified weight, gender, and physical activity as significant predictors of grip strength. Specifically, weight positively influenced grip strength. Gender also played a significant role, with males exhibiting a 27.0 lbs higher grip strength than females. Physical activity levels further influenced grip strength, as participants with lower activity levels had reduced grip strength compared to their more active counterparts.

In contrast, recent medical diagnoses and perceived stress were not significant predictors of grip strength. This finding diverges from studies such as Lee et al. [25], whose cross-sectional study of 862 participants with a mean age of 73.6 years found perceived stress to be associated with frailty in older adults. The discrepancy may be attributed to differences in study populations; our cohort consisted of younger, healthier individuals with fewer chronic conditions, whereas prior research primarily involved older adults. Additionally, differences in study design, including sample size and statistical power, may have contributed to these contrasting results. For instance, our study may have been underpowered to detect more minor effects of stress and medical diagnoses on grip strength in a younger population.

Future Recommendations

Our study found significant correlations between grip strength and height, weight, physical activity, and gender, which may be helpful in some healthcare settings. With that in mind, we recommend further utilization and measurement

of grip strength in settings where relationships between grip strength and physical activity are carefully monitored.

Future studies should focus on further exploring the role of grip strength in younger populations, particularly across different health conditions. A broader range of variables, such as detailed dietary habits and longer-term health data, could provide more comprehensive insights. Longitudinal studies would also be valuable in determining whether changes in grip strength over time could serve as early indicators of declining health or frailty.

LIMITATIONS

This study has several limitations. First, the sample size was relatively small, which may limit the generalizability of our findings to broader populations. Additionally, our cohort was recruited from a single institution, which could introduce selection bias based on the demographic composition of the institution. For example, the population was predominantly young, likely college-affiliated, and potentially skewed toward specific ethnic or cultural groups, such as a high proportion of Spanish-speaking participants. These factors may limit the applicability of our results to more diverse populations.

Second, the reliance on self-reported data for physical activity and health conditions introduces the possibility of recall or response bias, as participants may underreport or overreport their activity levels and health status. This could affect the accuracy of the associations observed in our analysis.

Third, the measurement of gait speed to the nearest whole second may have been insufficiently precise to detect subtle differences or correlations with grip strength. Future studies should consider more accurate timing methods to address this limitation.

Additionally, the survey content, while comprehensive, did not include detailed information on factors such as dietary habits, socioeconomic status, or access to healthcare, which could influence both grip strength and overall health. Incorporating these variables in future research could provide a more nuanced understanding of the relationships we examined.

Lastly, while our analysis employed robust statistical methods, the possibility of residual confounding variables cannot be entirely excluded. For instance, we did not control for all potential influences, such as sleep patterns or mental health beyond the PHQ-2 assessment. Moreover, the cross-sectional nature of our study precludes establishing causal relationships between grip strength and the variables analyzed.

Despite these limitations, our findings contribute to the growing evidence that grip strength is a promising non-invasive measure of health. Further research with larger, more diverse populations and additional variables is warranted to validate these findings and explore their clinical utility.

CONCLUSION

This study assessed the link between grip strength and health in a working-age population, finding significant correlations with height, weight, physical activity, and gender. In contrast, grip strength was not associated with gait speed, recent medical diagnoses, weight loss, or stress levels. Medication use was identified as a negative predictor of grip strength. These findings help validate grip strength measurements as a tool that may help identify early health risks in younger, healthier populations.

Disclosure Statement

We, the authors of the manuscript titled “Grip Strength as a Marker of Health: A Cross-Sectional Analysis in Working-Age Adults,” confirm that all authors have made significant contributions to the research and manuscript preparation as outlined below:

Author Contributions

- **Study Conception & Design**
  - Adrian Alepuz
  - Gary Schwartz
  - Micah Ngatuvai
- **Data Collection**
  - Andy Suarez
  - Adrian Alepuz
  - Micah Ngatuvai
- **Data Analysis**
  - Micah Ngatuvai
- **Manuscript Writing**
  - Andy Suarez
  - Adrian Alepuz
  - Micah Ngatuvai
  - Christian Palacios
- **Manuscript Editing & Review**
  - Christian Palacios
  - Gary Schwartz

We confirm that all authors have reviewed and approved the final version of this manuscript and consent to its submission. Additionally, we declare that there are no conflicts of interest related to this work.

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