Vol 9 | Issue 1 | Pages 220-224
Archives of Family Medicine and General Practice
ISSN: 2578-6539

Research Article
DOI: 10.36959/577/511

Relevance of Grip Strength Measurement in Primary Care

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Abstract

Background: Grip strength (GS) has been shown to be an independent predictor of cardiovascular disease and all-cause mortality. Despite significant interest and vast literature, the role, if any, of routine GS measurement in a primary care setting remains uncertain.

Methods: GS was measured in an unselected group of adult patients presenting to a family medicine residency clinic. Results were correlated with age, sex, activity level, and clinical comorbidities as assessed by the Charlson Comorbidity Index (CCI).

Results: 254 patients were approached, and 212 agreed to participate. Informed consent was obtained. A negative correlation was identified between GS and age, and also between GS and clinical comorbidities. The age-related decline in HGS was more accelerated in males compared to females. A positive correlation was found between GS and activity level. Age, sex, comorbidities, and activity level were poor predictors of GS.

Conclusion: Our study results indicate that GS may be considered as a separate clinical variable that could be measured during routine office visits to help predict future morbidity and mortality. GS measurements are relatively simple to obtain, and the results may additionally help motivate individual patients to improve their adherence to healthier lifestyles.

Keywords

Hand-grip strength, Muscle strength, Health outcomes, Health risk-factors

Introduction

The clinical relevance of grip strength (GS) measurement in medical practice has generated significant interest over the past years [1]. We conducted a search in PubMed for Hand strength as a Medical Subject Heading and a search for “hand grip”, "hand grip strength" OR "handgrip strength" in the title or abstract. These yielded 79 publications about the topic from 1971 to 1980, and that number swelled to 11,883 from 2011 to 2020. Despite this attention and vast literature, the clinical role, if any, of measuring GS in a primary care setting remains uncertain [2]. GS has been shown to be an independent predictor of all-cause mortality and cardiovascular diseases. Additionally, low GS is associated with increased morbidity, risk of cerebrovascular disease, and hospitalization [2-5]. In this study, we aimed to investigate the correlation between

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Accepted: October 22, 2024

Published online: October 24, 2024

Citation: Lisa W, Roy M, Risha P, et al. (2024) Relevance of Grip Strength Measurement in Primary Care. Arch Fam Med Gen Pract 9(1):220-224

GS and various relevant clinical categories namely, age, sex, clinical comorbidities, and activity levels to further evaluate the potential use of GS measurement in a primary care setting. The aim is to determine whether measurement of GS can provide predictive value in estimating morbidity and mortality in addition to known prognostic factors such as age, sex, activity level, and clinical comorbidities.

Methods

In this study of GS, an unselected sample of patients presenting consecutively to a family medicine office was tested. The research project was previously approved by the organization's institutional review board. A sample of convenience was obtained in which 254 patients were approached and informed about the study methods and aims. Of these, 42 declined and 2123 agreed to participate. The sample size was based on the number of subjects needed to conduct linear and multiple regression analyses, as well as logarithmic and polynomial regression model analyses.

Using a spring-loaded Baseline Smedley dynamometer (Fabrication Enterprises Inc., White Plains, NY.), GS was measured twice in each hand and an overall average of both hands was calculated for every subject [5]. Measurements were obtained in the standing position. Patients were asked to squeeze the dynamometer with greatest effort for about 3 to 5 seconds. During this time, they were encouraged to exert their maximum strength and were asked to stop when the needle stopped rising [5]. Data on clinical comorbidities were extracted from the medical records. The Charlson Comorbidity Index (CCI) was used to obtain an overall estimation of comorbidities [6]. The activity level for each subject was estimated with the use of the Modifiable Activity Questionnaire [7].

Data analysis and correlation studies were conducted in Excel. A Pearson's correlation coefficient (r) was determined for linear regression analyses. The coefficient of determination r^2 was also calculated to estimate how well the regression model described the observed data. These analyses were performed to investigate the association between GS and age, sex, clinical comorbidities, and activity level. Additionally, multiple regression analysis, as well as logarithmic and polynomial regression models were tested to evaluate the combined effect of these independent variables.

Results

Of the 212 patients who agreed to participate, there were 80 men and 132 women. The ages range from 22 years to 87 years. The average age is 60.2 years with a standard deviation of 13.87 years. The median age is 62 years, indicating the absence of outliers in the data. Data on BMI and race or

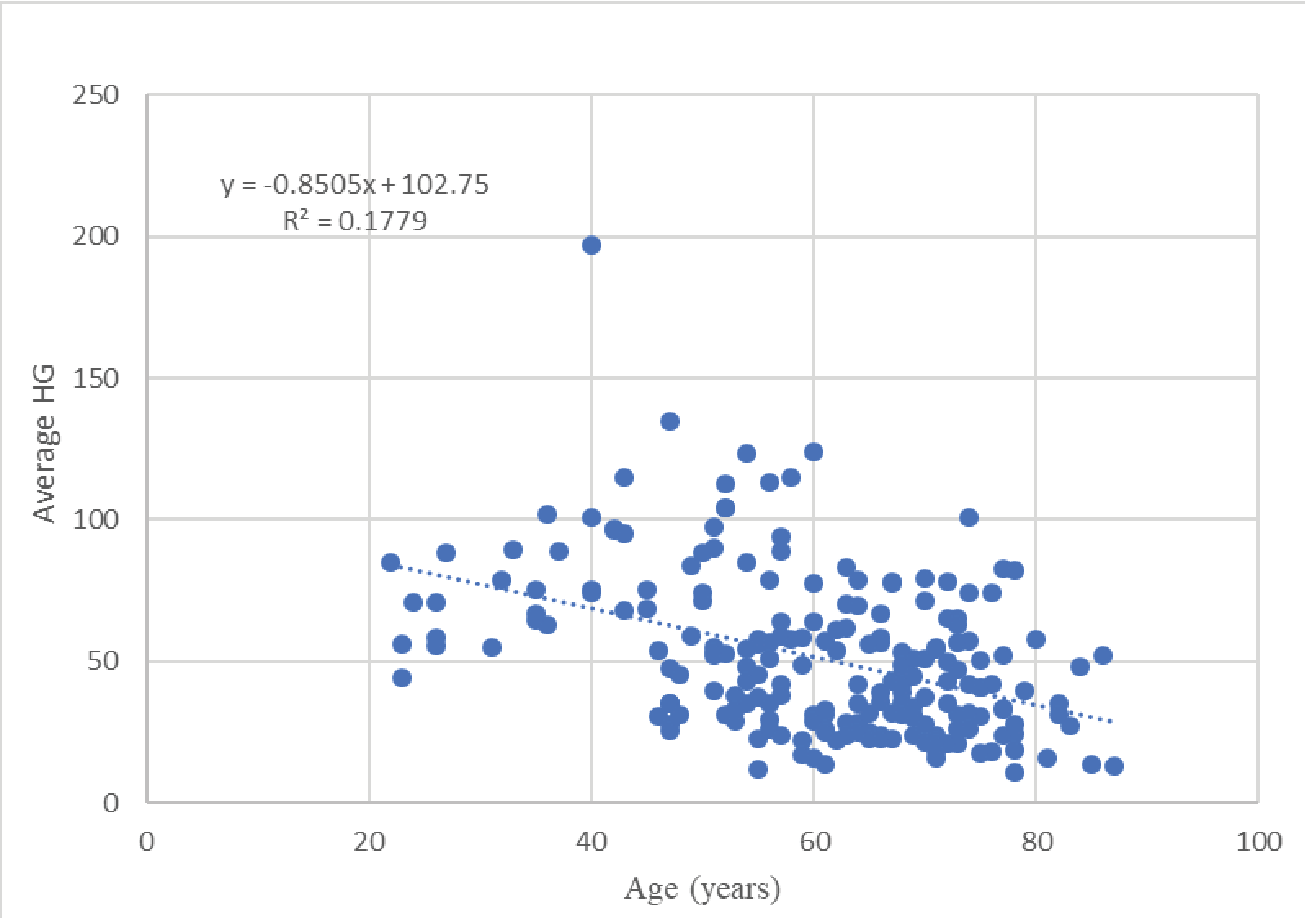

Figure 1: Average hand grip (HG) strength at various ages (years). The correlation coefficient r is -0.422 indicating a weak negative correlation. R^2 = 0.1779 indicating that only 18% of the variance in GS can be explained by age.

ethnicities are not reported as previous studies did not show them to be significantly associated with GS in a consistent manner [8,9]. The data indicate that GS declines with age (Figure 1). GS and age are negatively correlated (r = -0.422). This age-related decline in GS is observed in both females and males. However, only 18% of the variance in GS could be explained by age (r^2 = 0.18). In males, 30% of the variance in GS is explained by age and in females, only 16.5% of the variance is explained by age. The age-related rate of decline in GS is more accelerated in males compared to females. The calculated slope of the linear regression models in males and females is -1.29 and -0.52 respectively and the distribution of GS in males and females appears to overlap by age 70 years and above.

A negative correlation between GS and clinical comorbidities as assessed by the Charlson Comorbidity Index (CCI) is observed (r = -0.402). GS is a poor predictor of clinical morbidities as only 16% of the variance in CCI is explained by GS (Figure 2). There is a positive correlation between GS and physical activity level (r = 0.392). GS is a poor predictor of physical activity level as only 16% of the variance in activity level is explained by GS (Figure 3).

Discussion

Although GS appears to decline over time, our study findings suggest that age alone is a poor predictor of GS. Most of the variance in GS (82%) is not age-related, implying that several other 5 factors are essential contributors to GS. These other determinants of GS and of its decline with aging may be environmental, genetic, or other individual factors including overall health status, work-related activities, and exercise level.

A curvilinear relationship between age and GS has been previously described [10]. In our study however, when logarithmic and polynomial regression models were tested, a linear regression was found to be the best model to describe the association between age and GS. The rate of age-related decline is more accelerated in men compared to women. An unexpected and previously unreported finding of our study is that GS in men and women appear to overlap by age 70 and above. Similar findings were reported in another study although in that report, GS in men remained higher than in women in all age-groups [11]. Grip strength has been considered as a general indicator of sarcopenia and frailty [5]. The faster decline observed in men may be regarded as a clinical marker consistent with the generally shorter lifespan observed in the male population [12]. In one study, cell aging was evaluated by measuring the extent of DNA-methylation. Greater GS was inversely associated with DNA-methylation and age acceleration [13].

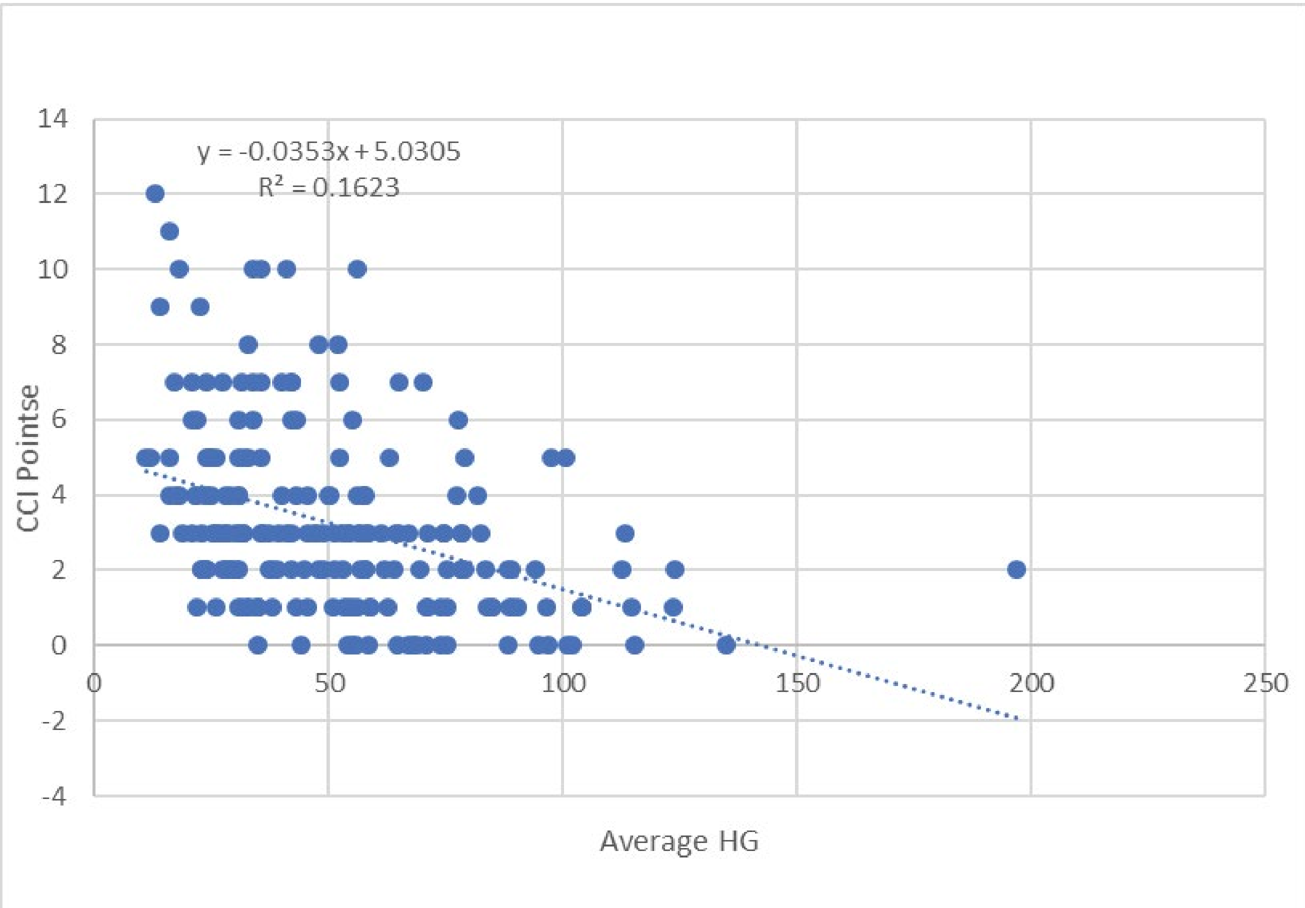

Figure 2: The clinical comorbidities index (CCI) and average hand grip (HG) strength. The correlation coefficient r = -0.402 indicating a weak negative correlation. R2 = 0.16 indicating that only 16% of the variance in GS can be explained by the CCI.

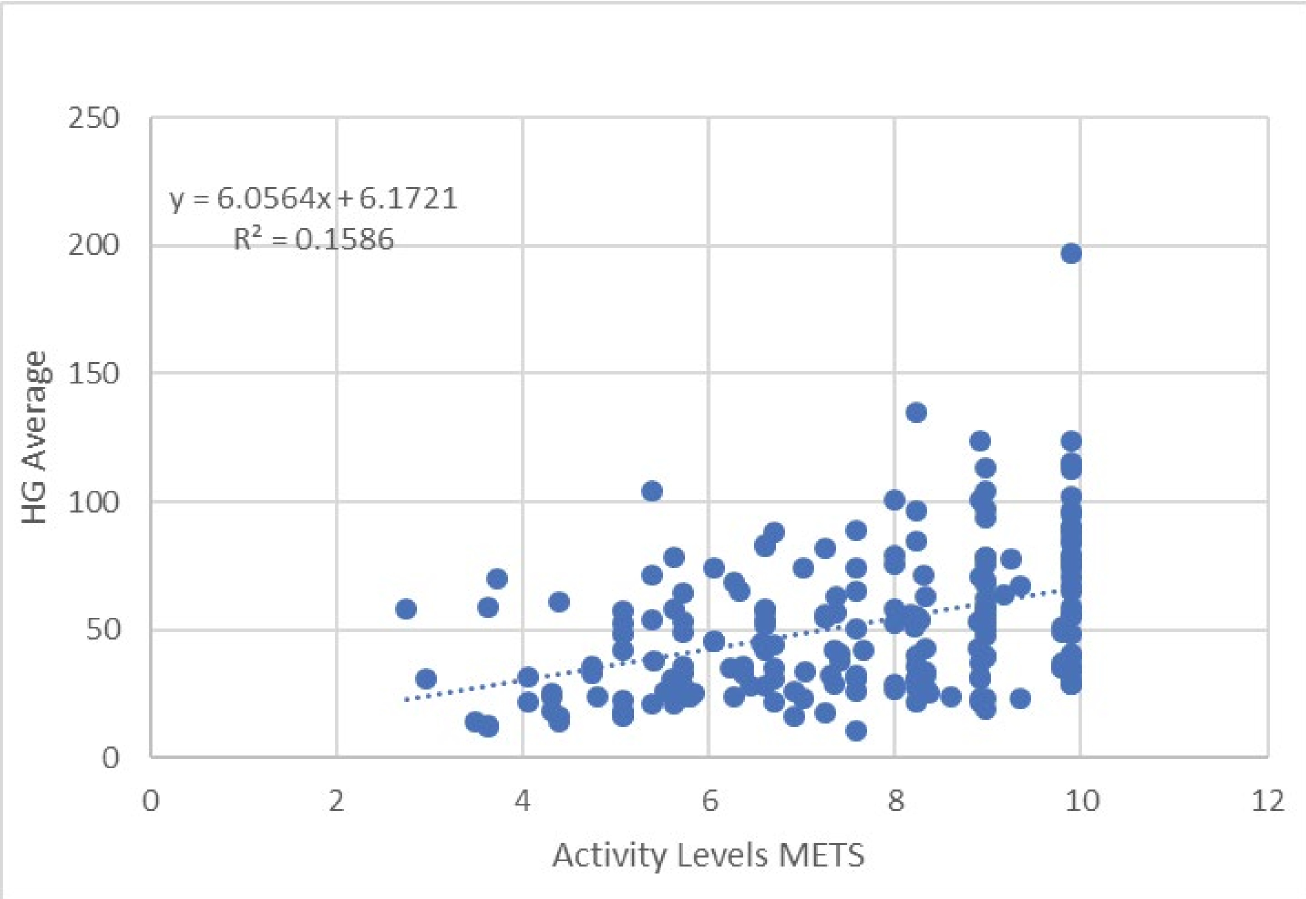

Figure 3: Hand grip (HG) strength average and various activity levels (Mets). There is a positive but weak correlation with a correlation coefficient r = 0.392 and R^2 = 0.158 indicating that only 16% of the variance in GS can be explained by the activity levels (METS).

Several studies have shown that GS is correlated with morbidity and all-cause mortality [2,3,14,15]. Low GS is a predictor of cardiovascular disease, hospital mortality, and length of stay [16,17]. It is also associated with declining cognition and predicted future disability as well as functional limitations [2]. Additionally, there is some evidence suggesting that GS may be a stronger predictor of all-cause and cardiovascular mortality than systolic blood pressure [15]. Since age, clinical comorbidities, and physical activity level are all relatively poor predictor of 6 GS, it may be important to include a measurement of GS as an additional element of the physical examination in a primary care setting to help predict future morbidity and mortality and also to improve patient care. Thus, GS measurements appear to provide valuable data in addition to patient age, sex, clinical comorbidities, and activity levels. Other researchers have also suggested that measurement of GS should be included in routine health assessments [18]. Moreover, GS results of individual patients may be compared with age and sex-specific normative data [19]. As the benefits of increased physical activity are well documented [20], results of individual GS can be compared to normal data. These may be shared with patients and used as a motivational tool to help increase their exercise participation level and also to improve overall medical compliance and adherence to healthier lifestyles.

A strength of this study is that the subjects we tested represent an unselected group presenting to a family medicine residency program. As such, the findings may also be applicable to patients in other family medicine residency programs and possibly in primary care practices as well. Furthermore, our office patients' demographics represent a mix of urban, suburban as well as rural populations, which is likely to improve the generalizability of the findings [21,22].

One limitation of the study involves the use of the Modifiable Activity Questionnaire (MAQ). Although the MAQ is a widely used self-reporting tool for assessing physical activity, it does allow for recall bias. Another limitation is the lack of objective measures of physical activity that could be provided by accelerometers and other methods. A third limitation is the absence of information regarding the association between GS and clinical outcomes which would have required long-term follow-up that was beyond the scope of this study.

Conclusion

In this clinical observational study, we found that GS was negatively associated with age and clinical comorbidity, and positively associated with activity level. The age-related rate of decline in GS was faster in males compared to females and GS levels in males and females begin to overlap by age 70.

Measuring GS is fast and straightforward, and the necessary equipment is inexpensive. If these results are confirmed, the implementation of routine measurement of GS in a primary care office setting should be encouraged as it may help improve patient care and clinical outcomes.

Conflicts of Interest

None.

Sources of Funding

None.

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DOI: 10.36959/577/511