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Handgrip strength among older American Indians: the Native Elder Care Study

SIR—Increased age is associated with declines in muscle strength and muscle mass, a condition referred to as sarcopenia [1]. Assessing handgrip strength is an easy test that can provide an approximation of total body muscle strength [2]. Research has found grip strength to be associated with functional disability [3, 4], chronic illnesses [5–8], hospitalisation and longer lengths of stay [9, 10] and mortality [2, 11]. Such studies have led to grip strength being considered a robust measure of frailty [8].

American Indians possess many of the risk factors for weaker grip. Notably they possess disproportionately high rates of functional disability [12] and chronic disease [13, 14]. Only one published study has examined hand strength in American Indians, measured by summing grip strength, two-point pinch and three-point pinch [15]. Given the limited information about grip strength in this population, coupled with their risk factors, we compared grip strength from a sample of American Indians to normative values and identified their correlates of weaker grip strength.

Methods

Data source

Data are from the Native Elder Care Study, a cross-sectional study of disability. Detailed methods have been described elsewhere [16]. The participating tribe was a federally recognised tribe in the USA. Trained interviewers administered surveys between July 2006 and August 2008. To be included in the study, participants had to be an enrolled tribal member, ≥55 years, non-institutionalised, cognitively intact and resided in the tribe’s service area. A random sample was collected using the tribal enrollment records. Equal numbers of respondents were sought for the age groups 55–64, 65–74 and ≥75 with a final sample of 505 (87% response rate). The tribe’s Institutional Review Board, Tribal Council, Tribal Elder Council and [West Virginia University] Institutional Review
Board approved the project. All study participants received a $20 gift card.

**Measures**

Assessment of grip strength of the dominant hand followed standardised testing procedures per the American Society of Hand Therapists [17] with the Jamar handheld dynamometer (Sammons Preston, Inc., Bolingbrook, IL, USA), which has been established as a reliable measure in community-dwelling older adults [18]. The average of three trials was recorded in pounds.

Demographic characteristics included sex, age, education, perceived income adequacy and marital status. Health-related behaviours included current smoking status, body mass index (BMI) and physical activity. Measured BMI was calculated as weight (kg)/height (m²). Physical activity was measured with, ‘During the past month, other than your regular job, did you participate in any physical activities or exercise such as running, swimming, aerobics, gardening, or walking for exercise?’ [19] Comorbidity was measured with a survey-based scale [14, 20] and scores range from 0 to 96 with higher scores indicating greater comorbidity. Functional disability measures included the short physical performance battery (SPPB) [21] and number of activities of daily living (ADL) and instrumental activities of daily living (IADL) limitations [22, 23]. The SPPB was administered per established protocol [24] and scores range from 0 to 12, with higher scores indicating better lower body function. For the eight ADL and eight IADL items, participants were categorised as having an ADL and/or an IADL limitation if they reported difficulty.

**Analyses**

The sample’s mean grip strength by sex was weighted with tribal enrollment data to account for the sampling stratification by age. Comparisons were made between the sample’s grip to published normative values by sex and age groups. The normative values were generated from a meta-analysis of 12 studies that obtained grip strength in accordance with the American Society of Hand Therapists recommendations [25].

Linear regression was used to examine the association between age and grip strength by sex. Ordinary least squares regression was used to investigate correlates of grip strength. The regression models included variables associated with grip strength at the bivariate level with a $P \leq 0.05$ level. The variance inflation factor was estimated to detect multicollinearity among the independent variables and none was detected. Everyone was able to perform the test to measure grip strength. Cases that did not have complete data on the independent variables were omitted resulting in an analytic sample of 372. All analyses used SAS software package version 9.1 (SAS Institute, Inc., Cary, NC, USA).

**Results**

The sample was primarily female (64.5%) with a mean age of 69.4 ± 8.8 years. Descriptive statistics of the independent variables are shown in Appendix 1 (available as Supplementary data at Age and Ageing online). The average grip strength was 81.0 lbs ±23.3 for men and 46.9 lbs ±15.3 for women. There was a significant inverse relationship between increased age and grip strength for both men and women.

Table 1 shows men had weaker grip compared with left and right hand normative values among those 55–59, 60–64 and 70–74 years. Men's grip strength for those 65–69 years fell within the left- and right-hand normative values range and those ≥75 years had stronger grip. Women had weaker grip compared with left- and right-hand normative values among those 55–59, 60–64, 65–69 and 70–74 years and stronger grip among those ≥75 years.

Significant unadjusted correlates of weaker grip strength for men were increased age, lower educational attainment, increased comorbidity, higher number of ADL and IADL limitations and poorer SPPB scores. Women had the same significant correlates of weaker grip plus physical inactivity. Table 2 reports significant correlates of weaker grip for men were increased age and a lower SPPB score. For women, significant correlates of weaker grip were increased age, lower levels of education and increased number of ADL limitations.

**Discussion**

Our results are consistent with previous research demonstrating stronger grip for men than women within the same age strata, and that grip diminishes with age [1]. Our sample had weaker grip in most age groups compared with normative values yet for both sexes, the oldest age group had stronger grip. This finding may be attributable to selective survival for those ≥75 years. Muscle mass and strength decrease with age leading to sarcopenia, which is associated

<table>
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<tr>
<th>Table 1. Mean grip strength comparison in pounds</th>
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<td>Men</td>
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with impaired functioning. Potential causal factors include age-related declines in anabolic steroid hormones and growth factors, decreased muscle protein synthesis, nervous system degeneration, as well as the pathological effects of poor nutrition, physical inactivity and chronic disease [26]. Since the average study participant was overweight, it is possible that a large portion had sarcopenic obesity. We did not measure muscle quality or muscle mass, although this is an important direction for future research in this population.

With respect to the association between educational level and grip among women, this finding is similar to what was found in an analysis of a European sample [27] with a lower level of educational attainment associated with weaker grip for women but not for men. Another study conducted in the UK also found an association with two social inequity indicators and weaker grip for both men and women [28]. Yet, overall there appears to be a lack of consensus of socioeconomic status indicators’ influence on grip given that some studies have adjusted for these variables [3, 7] while others have not [4–6]. Additional research is needed to improve understanding of the role of these variables on grip strength.

Other research has found an association between weaker grip with slower walking speed, inability to rise from a chair, and increased ADL and IADL limitations [3, 4]. While the exact physiological mechanism linking weaker grip strength with disability remains unclear, possible mechanisms include factors such as physical inactivity [2] as well as oxidative protein damage [29]. We did not find an association between physical activity and grip, which may be due to our somewhat crude measurement of physical activity, or self-report bias [30], or that they are simply not associated in this sample.

One other study has examined hand strength among American Indians measured by summing grip strength, two-point pinch and three-point pinch [15]. This study found in an unadjusted analysis that hand strength was greatest among the participants without arthritis or diabetes and among those with diabetes only compared with those with both conditions. Likewise, the present study found an unadjusted association between comorbidity and grip strength.

Our results must be interpreted within the context of several limitations. The data are cross-sectional, making it impossible to determine causality. We do not know the race composition in the studies used in generating the normative data as none of them reported this information. The comorbidity measure was based on self-report and medical chart confirmation of medical diagnosis is considered the gold standard. Although research has shown good agreement between self-report of diagnosis and medical records [31], self-reports may underestimate prevalence and explain the lack of association between comorbidity and grip. Also, our sample included those with cognitive impairment which might underestimate diminished grip given the relationship between impaired cognition and weaker grip [4].

Grip strength cut points have recently been established which facilitates the use of this test as part of clinical assessments to identify persons at risk for a mobility limitation [32]. Applying the overall cut points to this sample indicate that half (49.9% of men, 50.2% of women) are at risk for a mobility limitation. Using grip strength to screen older adults can potentially improve planning and implementation of preventive strategies aimed at reducing health disparities.

### Key points

- This sample of American Indians tended to have lower handgrip strength compared with same sex and age normative values.
- Weaker handgrip for men was correlated with increased age and poorer lower body functioning.
- Weaker handgrip for women was correlated with increased age, lower education and a greater number of ADL limitations.

### Supplementary data

Supplementary data mentioned in the text is available to subscribers in *Age and Ageing* online.

### Acknowledgements

The authors would like to thank Dr Blythe Winchester for her clinical insights of the results.

<table>
<thead>
<tr>
<th>Table 2. Ordinary least squares regression models for determinants of the mean grip strength by sex</th>
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<tr>
<td>Demographics</td>
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<td>Age, in years</td>
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<tr>
<td>Educational attainment</td>
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<tr>
<td>1–11 years Reference group</td>
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<tr>
<td>High school grad/GED</td>
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<tr>
<td>Some college or more</td>
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<tr>
<td>Comorbidity score</td>
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<td>Health-related behaviours</td>
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<td>Physically active</td>
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<tr>
<td>Disability</td>
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<td>Summary of ADL limitations</td>
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<td>Summary of IADL limitations</td>
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<td>SPPB score</td>
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*Note: SE, standard error; GED, general educational development; NA, not applicable; ADL, activities of daily living; IADL, instrumental activities of daily living; SPPB, short physical performance battery.

**F-statistic** = 5.92, model **R²** = 0.25.

**F-statistic** = 9.74, model **R²** = 0.25.

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The authors would like to thank Dr Blythe Winchester for her clinical insights of the results.
Research letters

Conflicts of interest

None declared.

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Reference


28. Syddall H, Evandrou M, Cooper C, Sayer AA. Social inequalities in grip strength, physical function and falls among


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