



# Sex, race and age differences in muscle strength and limitations in community dwelling older adults: Data from the Health and Retirement Survey (HRS)



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## ABSTRACT

**Background:** Aging-related muscle weakness is associated with increased risk of functional limitations and disability. This study examined the association between varying degrees of hand grip strength on functional ability in community-dwelling older adults.

**Methods:** Cross-sectional analysis of 4289 men and 5860 women  $\geq 60$  from 2006 and 2008 waves of the population-based Health and Retirement Study (HRS) were stratified by sex-specific grip strength tertiles (low, mid, high). Prevalence and adjusted odds of physical limitations (PL), and ADL/IADL limitation were calculated by sex, race/ethnicity and age group (60–69, 70–79, 80+). Models were weighted, adjusted for age, sex, race/ethnicity, education, smoking status, BMI, comorbidities and participation in physical activity.

**Results:** Prevalence of PL, ADL and IADL limitations were significantly lower among adults in the highest grip category as compared to those in the lowest grip category. Adjusted odds for PL OR 0.41 [0.33, 0.52]; ADL OR 0.51 [0.39, 0.67], and IADL OR 0.47 [0.38–0.59] limitations were significantly lower among adults in the highest grip compared to the lowest grip category. However, notable differences were observed in the strength of these associations by gender, race and age group.

**Conclusion:** Demographic characteristics are important factors to consider for risk stratification and the development of effective grip strength training interventions for older adults.

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## 1. Introduction

Aging is associated with declines in functional performance and disability (Jette & Branch, 1981; Verbrugge & Yang, 2002). Although the prevalence of certain disability types is declining in the general population (Manton, 2008; Freedman, Martin, Schoeni, & Cornman, 2008), prevalence remains high among older adults (Fuller-Thomson, Yu, Nuru-Jeter, Guralnik, & Minkler, 2009; Picavet & Hoeymans, 2002). Disability greatly limits the independence of older persons and leads to increases in long-term care placement and expenditures (Spillman, 2004). Thus, identifying factors that can inform the development of interventions for older adults at risk of functional disability is of great public interest.

Poor muscle strength, (*dynapenia*) (Clark & Manini, 2008, 2012), has been identified as a key risk factor for physical limitations, instrumental activities of daily living (IADL) and basic activities of daily living (ADL) (Bohannon, 2008; den Ouden, Schuurmans, Arts, & van der Schouw, 2011). Dynapenia has also been associated with increased risk of morbidity and mortality in older adults, impaired balance and risk of falls (Kuh, Bassey, Butterworth, Hardy, & Wadsworth, 2005; Newman, Kupelian, & Visser, 2006; Vermeulen, Neyens, van Rossum, Spreeuwenberg, de Witte, & Predicting, 2011). However, the association between varying degrees of muscle strength (as measured by hand grip strength) and functional outcomes are not well characterized. Given the importance of muscle strength in preserving functional independence in older adults, having a clear understanding of this association is particularly important for risk stratification and successful intervention for elders at high risk of functional impairment. The purpose of this study was to describe the association between varying degrees of grip strength and the

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prevalence of physical and ADL/IADL limitations in a community-based population.

## 2. Methods

### 2.1. Data source

This is a cross-sectional analysis of existing data from the 2006 and 2008 waves of the Health and Retirement Study (HRS). HRS is a nationally-representative panel survey of community-dwelling adults aged 50 and older conducted by the University of Michigan with support from the National Institute of Aging. The initial HRS sample was drawn in 1992 from a multi-stage, clustered area probability design of households, targeted individuals born between 1931 and 1941. HRS respondents who were eligible for and consented to the enhanced face-to-face interviews in 2006 and 2008 are included in the initial sample (Germain, Vasquez, & Batsis, 2015); additional descriptions of sampling procedures and HRS study design are available online at: (<http://hrsonline.isr.umich.edu>).

### 2.2. Sample

A total of 10,615 community dwelling adults aged 60 years and older with hand grip strength measurements were selected from the initial sample. After eliminating respondents missing handgrip ( $n=466$ ) a total of 10,149 (4289 men; 5860 women) remained for analyses. Respondents of all races/ethnicity were included in the sample. Characteristics for those missing grip strength are provided in the appendices. The study was exempt from Institutional Review Board review at all respective institutions due to the de-identified nature of the data used.

### 2.3. Measures

#### 2.3.1. Muscle strength

Hand grip strength in HRS was measured using Smedley spring-type hand dynamometer (TTM<sup>®</sup>, Tokyo, Japan) in a standing position with their arm at their side at a 90° angle (Crimmins,

Guyer, Langa, Ofstedal, Wallace, & Weir, 2008). Sex-specific tertiles were determined using univariate analyses and used as primary predictor in the analyses. Participants were then classified into three categories: low-grip (LG) (ref), mid-grip (MG) and high-grip (HG).

#### 2.3.2. Physical limitations (PL)

Respondents were asked to report whether 'they had difficulties (yes/no) in performing the following tasks because of a health or physical problem: walking several blocks, walking one block, sitting 2 h, getting up from chair, climbing one flight of stairs, stooping, reaching arms, pulling/pushing large objects, lifting weights and picking up a dime. All yes responses were compiled into a summary score in the HRS database ranging from 0 to 10. Univariate analyses revealed that 67% of our sample reported at least one limitation; thus we classified physical limitations as difficulty/inability with two or more of the above tasks (0=no limitation, 1=limitation).

#### 2.3.3. Functional limitations

Activities of daily living (ADLs) and instrumental ADLs (IADL) were used to assess functional limitations (Saliba, Orlando, & Wenger, 2000). Respondents were classified as having basic ADL limitation if they reported difficulty or inability with one or more of the following: bathing, dressing, eating, toileting, or getting out of bed. Respondents were classified as having an IADL limitation if they reported difficulty or inability to perform at least one of the following: preparing meals, managing money or needing help with house or yard work, or taking medications (0=no limitation, 1=limitation). All limitations reported in this manuscript were measured in HRS using a self-report questionnaire.

#### 2.3.4. Covariates

Race/ethnicity (white, black, other) sex, smoking status (yes, no) and physical activity (engagement in moderate/vigorous PA=1) were entered as categorical variables into the model. Age at time of physical assessment, years of education completed, number of medical comorbidities, and body mass index (BMI) in kg/m<sup>2</sup> were entered as continuous variables in the models (except

**Table 1**  
Sample characteristics.

	Overall 10,149	Men 4289	Women 5860	<i>p</i>
Age, years <i>M (sd)</i>	71.8 (7.72)	71.7 (7.38)	71.8 (7.96)	.52
Education years <i>M (sd)</i>	12.4 (3.15)	12.6 (3.36)	12.2 (2.98)	<.001
Race (%)				<.001
White	8557 (84.3)	3697 (86.2)	4860 (82.9)	
Black	1267 (12.5)	454 (10.6)	813 (13.9)	
Other	324 (3.2)	137 (3.19)	187 (3.2)	
Current Smoker (%)	1187 (11.7)	518 (12.1)	669 (11.4)	.47
Physically Active(%)	5976 (58.9)	2768 (64.6)	3208 (54.8)	<.001
No. of Comorbidities <i>M (sd)</i> <sup>a</sup>	2.06 (1.22)	2.03 (1.28)	2.08 (1.19)	.04
Mean Grip	28.8 (10.45)	37.4 (9.04)	22.5 (5.97)	<.001
Grip Strength Category <sup>b</sup>				.04
Low	2593 (25.6)	1089 (27.4)	1504 (35.1)	
Mid	5009 (49.4)	2124 (49.5)	2885 (35.1)	
High	2547 (25.1)	1076 (25.1)	1471 (29.8)	
Body Mass Index, kg/m <sup>2</sup>	27.8 (5.50)	28.6 (4.66)	27.7 (6.01)	<.001
Physical Limitations (%) <sup>c</sup>	5498 (54.2)	1940 (45.2)	3558 (60.7)	<.001
ADL Limitations (%) <sup>d</sup>	2284 (36.2)	838 (36.9)	1446 (35.8)	.54
ANYIADL Limitations (%) <sup>e</sup>	3673 (37.1)	1295 (31.1)	2378 (41.4)	<.001

<sup>a</sup> Comorbidities were defined as current diagnosis of diabetes, hypertension, lung disease, stroke, any cancer, arthritis, myocardial infarction and chronic heart failure.

<sup>b</sup> Low Grip  $\leq 31.25$  men,  $\leq 18.5$  women; High  $\geq 43.5$  men;  $\geq 26.5$ .

<sup>c</sup> Physical Limitations defined as difficulty or inability with  $\geq 2$ : walking several blocks, walking 1 block, sitting 2 h, getting up from chair, climbing stairs climbing one flight of stairs, stooping, reaching arms, pulling/pushing large objects, lifting weights and picking up a dime.

<sup>d</sup> Activities of Daily Living (ADL) defined as difficulty or inability with  $\geq 1$ : bathing, dressing, eating, toileting or getting out of bed.

<sup>e</sup> Instrumental Activities of Daily Living (IADL) defined as difficulty or inability with  $\geq 1$ : preparing meals, managing money or needing help with house/yard work, or taking medication.

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