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Original Study

Muscle Strength and Functional Limitations: Preserving Function in Older Mexican Americans

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A B S T R A C T

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Objectives: Understanding the role of muscle strength as a preventive factor for shorter-term declines in function may provide further insights into the disabling process. This study examined if muscle strength was associated with 2-year preservation of instrumental activities of daily living (IADL) function and activities of daily living (ADL) disability status in older Mexican Americans.

Design: Longitudinal, panel.

Setting: Urban and rural households in the Southwestern United States.

Participants: A subsample of 672 Mexican Americans aged at least 65 years was followed for 2 years.

Measurements: Muscle strength was assessed with a hand-held dynamometer. IADL and ADL were self-reported. Covariate-adjusted ordinal and multinomial logistic models were used to determine the association between handgrip strength and changes in IADL function, and ADL disability status over 2 years.

Results: Every 10-kg increase in handgrip strength was associated with 5% decreased odds [odds ratio (OR): 0.95; 95% confidence interval (CI): 0.92, 0.98] of experiencing a lost IADL function in 2 years. Likewise, every 10-kg increase in handgrip strength was associated with an 8% decreased odds (OR: 0.92; CI: 0.88, 0.97) for 2-year onset ADL disability, 12% decreased odds (OR: 0.88; CI: 0.83, 0.94) for 2-year ADL disability progression, and 7% decreased odds (OR: 0.93; CI: 0.89, 0.98) for 2-year ADL disability improvement, compared to those with no ADL disability at baseline and follow-up.

Conclusions: Higher muscle strength was related to a lower risk for 2-year onset of IADL and ADL disability in older Mexican Americans. Future investigations are warranted to examine how potential mediators influence the association between muscle strength and function, to inform interventions aiming to retain function in vulnerable older adult populations.

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The declines in muscle strength that occur over the life course reflect the reductions in muscle mass and function that take place as adults age.^{1,2} Muscle strength is often measured with a hand-held dynamometer, a simple and feasible metric intended to assess overall strength capacity. Not only is low handgrip strength associated

with poor health outcomes such as diabetes and an activities of daily living (ADL) disability,^{3–5} it is also associated with all-cause mortality.⁶ Moreover, low handgrip strength is a factor in the development of sarcopenia, which in turn, is associated with an increased risk for an ADL disability.⁷ Therefore, handgrip strength is an important biomarker of frailty and should be used for detecting sarcopenia and disease risk as adults age.^{8,9} A population of particular concern is older Hispanic Americans, as they have lower skeletal muscle mass across the life span compared to Whites and African Americans.¹

Measures of functional limitations are often assessed in older adults to determine self-care ability and independence. A person's ability to perform ADL (e.g., bathing, grooming, dressing) is a determinant of his or her functional status,¹⁰ whereas instrumental

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activities of daily living (IADL; e.g., shopping, driving, managing money) are needed for independent functioning in a community.¹¹ When someone reports that they need help performing or are unable to perform any of these activities, they are usually considered as having an ADL or IADL disability. These types of functional limitations are problematic because a variety of poor clinically relevant health outcomes have been linked to any number of ADL and IADL impairments.^{12,13} However, the presence or absence of a functional limitation based on standard definitions may not provide enough details into the progression of the disabling process and its associated health consequences.

Previous investigations have found that changes in the status of a functional impairment were associated with frailty, nursing home visits, and death.^{14,15} Because greater muscle strength is associated with a lower hazard for an ADL disability in older Mexican Americans over a 7- and 19-year time period,^{5,16} examining if greater muscle strength is associated with shorter-term losses of IADL function and ADL disability status may uncover additional details into the disabling process. This may then help identify potential mediators for muscle strength and functional impairments, and inform targeted interventions seeking to preserve function in this growing population. Therefore, this study sought to determine if greater muscle strength was associated with 2-year (1) preservation of IADL functioning, and (2) improvements in ADL disability status in older Mexican Americans.

Methods

Participants

Data were analyzed from the Hispanic Established Populations for Epidemiologic Studies of the Elderly (HEPESE) Frailty Study, a continuation of the HEPESE that investigated the enabling-disabling process in older Mexican Americans. To be included in the Frailty Study, participants had to be Mexican American, enrolled in the larger HEPESE Study, aged at least 65 years, physically able to complete the muscle strength measures safely at baseline, and residing in Arizona, California, Colorado, New Mexico, or Texas. Baseline interviews were conducted in 2006–2007 and follow-up data were collected in 2008–2009. Details of the sampling plan and cohort have been described previously.¹⁷ All participants provided written informed consent and study protocols were approved by the University of Texas Medical Branch Institutional Review Board.

Measures

Explanatory Variable

Muscle strength was assessed with a hand-held dynamometer (Jamar Hydraulic Dynamometer; J.A. Preston Corporation, New York, NY). The use of a hand-held dynamometer to assess muscle strength has shown to be reliable and valid in older Mexican American adults.¹⁶ Participants who had surgery to the hand or wrist in the previous 3 months were excluded from the handgrip strength test. After explaining the protocol and demonstrating the handgrip strength test, trained interviewers adjusted the grip size of the dynamometer to the hand size of each participant so they could perform a practice trial. A scale size of 5, 6, or 7 on the dynamometer was used for smaller, midsized, and larger hands, respectively. During the 2-test trials, participants remained seated with their arm resting on a table as they squeezed the dynamometer using an underhand grip with their dominant hand in the supinated position, exhaling while squeezing with maximal exertion. Verbal encouragement was provided by interviewers to further induce participant effort. The highest value of the 2-test trials performed was included.

Response Variables

The Older Americans Resources and Services IADL scale and the Rosow-Breslau scale were used to assess IADL functioning at baseline and follow-up.^{18,19} Participants were asked about their ability to use a telephone, drive, shop, prepare meals, perform light housework, take medications, manage money, do heavy housework, walk up and down stairs, and walk a half-mile. Those that indicated they were unable to perform any number of these 10 tasks were identified as having lost that particular IADL function.

A modified version of the Katz ADL scale was used to assess ADL disability status.²⁰ Participants reported if they could walk across a small room; bathe; groom; get dressed; eat; transfer from bed to chair; and toilet either without help, with help, or were unable to perform the activity. Those indicating they needed help or were unable to perform any of these activities were identified as having lost that specific ADL function and were also considered as having an ADL disability.

Participants with no ADL disability at baseline and follow-up were categorized as not having an ADL disability. Onset ADL disability was defined as having no ADL disability at baseline but having an ADL disability at follow-up. Persistent ADL disability was defined as having lost an ADL function at baseline and without the same ADL function at follow-up, whereas ADL disability progression was defined as having an ADL disability at baseline and then having an increase in the number of ADL functions lost at follow-up. ADL disability improvement was defined as having an ADL disability at baseline and then having a decrease in the number of ADL functions lost or no ADL disability at follow-up.²¹

Covariates

Participants self-reported age, sex, diabetes diagnosis, falls in the previous year (falls, no falls), and perceived health status (excellent, good, fair, poor).¹⁷ A Metro 9800 scale (Metro Scale & Systems Inc; Fort Myers, FL) was used to determine body weight, and participants stood by a tape measure against a wall to determine height. Body mass index (BMI) was calculated by taking the quotient of body weight in kilograms by height in meters-squared.

Participants were asked to recall their physical activity levels over the previous 7 days using the Physical Activity Scale for the Elderly (PASE).²² For each sex, those scoring in the lowest 20% of the PASE were considered physically inactive.^{17,23} Exhaustion was determined using 2 items from the Center for Epidemiologic Studies–Depression Scale (CES-D).¹⁷ Those indicating that they felt “everything was an effort” and “could not get going” for at least a moderate amount of time (≥ 3 days/week) on either item were considered chronically exhausted.²³ Pain interference was measured with a single item from the Medical Outcomes Study Short Form-36 Health Survey.^{17,24} Participants responding to “during the past four weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?” that they had a little bit, moderate, quite a bit, or extreme pain were considered as having pain interference. Walking speed was recorded from an 8-foot walking test. Participants who were unable to complete the walk test or who scored in the lowest 20% for their sex and height were considered as having a slow walking speed.¹⁷ Those reporting an unintentional weight loss of at least 10 lbs since the last interview were considered as experiencing an unexplained loss of weight.^{17,23}

Descriptive Information

Participants self-reported if they were married, diagnosed with a stroke or hypertension, were taking medications for their diabetes or hypertension, and the number of people living in their household. The CES-D was used to assess mental health. Those with scores of ≥ 16 were considered depressed.²⁵

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