Midlife Hand Grip Strength as a Predictor of Old Age Disability

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Context  Poor muscle strength, functional limitations, and disability often coexist, but whether muscle strength during midlife predicts old age functional ability is not known.

Objective  To determine whether hand grip strength measured during midlife predicts old age functional limitations and disability in initially healthy men.

Design and Setting  A 25-year prospective cohort study, the Honolulu Heart Program, which began in 1965 among Japanese-American men living on Oahu, Hawaii.

Participants  A total of 6089 45- to 68-year-old men who were healthy at baseline and whose maximal hand grip strength was measured from 1965 through 1970. Altogether, 2259 men died over the follow-up period and 3218 survivors participated in the disability assessment in 1991 through 1993.

Main Outcome Measures  Functional limitations including slow customary walking speed (≤0.4 m/s) and inability to rise from a seated position without using the arms, and multiple self-reported upper extremity, mobility, and self-care disability outcomes.

Results  After adjustment for multiple potential confounders, risk of functional limitations and disability 25 years later increased as baseline hand grip strength, divided into tertiles, declined. The odds ratio (OR) of walking speed of 0.4 m/s or slower was 2.87 (95% confidence interval [CI], 1.76-4.67) in those in the lowest third and 1.79 (95% CI, 1.14-2.81) in the middle third of grip strength vs those in the highest third. The risk of self-care disability was more than 2 times greater in the lowest vs the highest grip strength tertile. Adding chronic conditions identified at follow-up to the models predicting disability reduced the ORs related to grip strength only minimally.

Conclusions  Among healthy 45- to 68-year-old men, hand grip strength was highly predictive of functional limitations and disability 25 years later. Good muscle strength in midlife may protect people from old age disability by providing a greater safety margin above the threshold of disability.

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a stopwatch. Ability to rise from a chair was measured by asking the subject to stand up without using his arms and observing the performance. Disability was ascertained by asking the participants the following question: “Because of health or physical problems, do you have any difficulty . . . ?” Upper extremity disability items were doing heavy household work (washing the car, raking leaves, mowing the lawn, or cleaning up the garage) and lifting something as heavy as 4.5 kg (10 lb). Mobility disability items were walking 0.8 km (1/2 mile) and walking up 1 flight of stairs. Self-care disability items were dressing, eating, bathing, and toileting.

At exam 4, the presence of chronic conditions was ascertained with ongoing surveillance using hospital records (stroke, coronary heart disease) or laboratory test results (coronary heart disease, diabetes, hypertension), or on the basis of participants’ self-reports (chronic obstructive pulmonary disease, angina, arthritis). Death ascertainment was based on a review of newspaper obituaries and listings of death certificates filed with the Hawaii State Department of Health and through a computer linkage to the National Death Index.

Participants were divided into 3 groups based on the baseline hand grip strength tertiles. The relative risks of mortality prior to follow-up tests and functional limitations and disability at follow-up for the hand grip strength groups were estimated using multiple logistic regression models. The models were adjusted for baseline age, socioeconomic status, body weight and height, physical activity and smoking, and chronic conditions ascertained at exam 4.

RESULTS

At baseline, the average age was 54.0 years (SD, 5.5). The average hand grip strength was 39.2 kg (SD, 6.0), and the cutoff points for grip strength tertiles were 37.0 and 42.0 kg. The mean height was 160.3 cm (SD, 5.7), the mean weight was 63.2 kg (SD, 8.7), and mean body mass index was 23.7 kg/m² (SD, 3.1).

Among the 6089 men who qualified for participation among the survivors. Of the 3830 survivors, 3218 (84.0%) participated in the follow-up tests. Baseline grip strength did not predict participation among the survivors.

Of these 3218 initially healthy men, 72 (2.2%) became unable to rise from a chair without using their arms, and 201 (6.2%) had a walking speed of 0.4 m/s or slower at follow-up. The numbers with self-reported disability were difficulty walking 0.8 kg (1/2 mile) (n = 598 [18.6%]); walking up a flight of stairs (n = 451 [14.1%]); lifting 4.5 kg (10 lb) (n = 247 [7.7%]); doing heavy household work (n = 586 [18.2%]); dressing (n = 169 [5.3%]); bathing (n = 165 [5.2%]); eating (n = 72 [2.2%]); and toileting (n = 110 [3.4%]). There was a clear gradient of increasing risk for all functional limitations and disability outcomes according to weaker baseline hand grip strength tertiles (FIGURE). This gradient persisted after adjustment for multiple baseline confounders (TABLE). Finally, after adjusting for chronic conditions ascertained at exam 4, the risks of functional limitations and disability in the lowest and middle baseline grip strength tertiles decreased moderately after these adjustments, but remained statistically significant in most cases (Table).
There are also other potential explanations for our results. Grip strength may be a marker of physical activity, which itself preserves function and prevents disability. Low grip strength may indicate subclinical disease, which later develops into clinical disease and disability. Finally, good grip strength may mark some general intrinsic midlife vitality or motivation that tracks into good functional ability in old age.

The Japanese-American men studied here are not representative of all older people. However, it is unlikely that major racial or sex differences in the strength-disability relationship would be found, as the biomechanical principles of human movement are universal. Also, data were not available at baseline to allow for the exclusion of all participants with functional limitations and disability. However, activities of daily living disability is rare among middle-aged men: the prevalence is 0.9% among 45- to 54-year-old men and 1.8% among 55- to 64-year-old men and disability is usually related to a disease. After people with documented chronic conditions at baseline were excluded, it is likely that the baseline cohort contained very few disabled individuals.

Overall, there are very few long-term prospective studies on risk factors for disability and mortality in old age. Cigarette smoking, deviations from normal weight, and a low level of physical activity have been shown to be long-term predictors of self-reported disability and mortality in studies with 17 to 27 years of follow-up. This is the first study to show that muscle strength is a powerful predictor of physical disability as long as 25 years later. This study suggests that hand grip strength could be used for early screening of people at increased risk of physical disability in old age.

REFERENCES