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Gender Disparities in Self-Reported Physical Functioning: True Differences, Reporting Bias, or Incomplete Adjustment for Confounding?

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Abstract

OBJECTIVES—To determine if gender disparities in self-reported physical functioning remain after adjusting for potential confounding factors, and to assess associations for possible reporting bias.

DESIGN—Cross-sectional survey.

SETTING—U.S. population of non-institutionalized older adults.

PARTICIPANTS—Women and men aged ≥ 60 years ($n=5396$) who participated in the Third National Health and Nutrition Examination Survey.

MEASUREMENTS—Degree of self-reported limitation in 11 physical functions.

RESULTS—In unadjusted models, women reported more limitations than men in 10 of 11 tasks. In multivariate ordinal logistic regression models that included adjustment for age, race-ethnicity, education level, comorbidities, smoking, hemoglobin, serum albumin, knee pain, body mass index, skeletal muscle index, and physical performance tests, women reported more limitations only in lifting or carrying 10 pounds (adjusted OR 2.03; 95% CI 1.45 – 2.84). There was no evidence of systematic reporting differences between men and women for limitations in lifting or carrying 10 pounds, relative to the degree of limitation predicted by the model.

CONCLUSION—Older women have similar degrees of self-reported limitation in physical functioning as older men of the same age, health, and physical abilities.

Keywords

self-report; physical functioning; gender disparity; NHANES III

INTRODUCTION

The observation that women report worse physical functioning compared with men has been a consistent and reproducible finding in large population health surveys, epidemiological studies, and clinical cohorts (1-12). This gender disparity has been found across different

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ages, race-ethnicities, chronic health conditions, and using a variety of self-report instruments to assess functioning. Among non-Hispanic whites aged 50-59 years in the 2001-2007 National Health Interview Survey, 20.5% of women reported at least one limitation in activities of daily living compared to 13.8% of men (1). Among non-Hispanic blacks aged 50-59 years, 27.8% of women but only 19.5% of men reported at least one limitation. In a national survey of U.S. adults with diabetes, women reported greater physical limitation than men on each of nine tasks assessed (5). In the Framingham Heart Study, women reported greater functional limitation and physical disability than men on each of three different self-report measures of physical functioning (6).

Differences in functioning may be present because women live longer than men (13,14) and tend to accumulate more chronic diseases (4,14). Men are more likely to have disabling diseases that tend to be fatal, such as ischemic heart disease (14,15). Furthermore, gender differences in traditional roles within the household, disabled life expectancy, body composition, peak bone mass, muscle strength, and sedentary behavior may also contribute to varying degrees of physical functioning (15). However, questions remain whether the disparity may also be due in part to reporting bias. Women may have higher symptom sensitivity than men (14). It is also more socially acceptable for women to disclose information about illnesses, and women may report functional limitations more readily (14,16). Men may under-report functional limitations because social or cultural norms have conditioned men to project strength and capability.

Several previous studies of gender disparities in physical functioning reported either unadjusted results (1,2,4) or adjusted only for differences in sociodemographic characteristics (3,6,12). Few studies adjusted for differences in comorbidity (5,9,10) or physical performance tests (7,8). Physical performance tests, such as timed walks and chair rises, are important to examine because these allow comparisons of self-reported limitations with objective measures of functioning. Some studies have suggested that other factors known to influence physical functioning, such as body composition, joint pain, or laboratory measures of health, could account for gender disparities in self-reported physical functioning, but did not specifically compare limitations between men and women after adjusting for these factors (4,17-20). The primary objective of this study was to test in a large population-based sample if differences in self-reported functional limitations persisted after adjusting for many potentially important confounding factors. The secondary objective was to examine evidence of reporting bias in tasks for which gender disparities were observed. We hypothesized that women report similar functional limitations compared with men, after adjusting for differences in disease indicators, body composition, and physical performance tests.

METHODS

Study design and data source

In this cross-sectional study, we used data from the Third National Health and Nutrition Examination Survey (NHANES III), a population-based study conducted by the National Center for Health Statistics (21). Between 1988 and 1994, 33,994 participants aged 2 years and older were enrolled after being selected by probability sampling.

The Office of Human Subjects Research at the National Institutes of Health exempted this analysis from human subjects review.

Study participants

We included participants aged 60 years and older because only this subgroup had assessment of physical function in NHANES III. Because performance testing was

anticipated to be a major correlate of self-reported functioning, we limited the analysis to individuals (n=5396) who were evaluated on at least one of the following physical performance tests: repeated chair rise, 8-foot walk, or lock and key. Participants completed the Household Adult Questionnaire, which included questions on physical functioning, and then had a standardized medical examination, including physical performance testing at either the mobile examination center (92.3%) or their homes (7.7%).

Physical functioning questionnaire

Participants answered 11 questions about their ability to perform the following tasks: prepare meals, walk between rooms on the same level, stand from an armless chair, get in or out of bed, eat, dress, walk ¼ mile, walk up 10 steps, do household chores (vacuuming, sweeping, dusting, straightening up), stoop/crouch/kneel, and lift or carry 10 pounds. Possible responses were no difficulty, some difficulty, much difficulty, unable to do, or don't know/refused.

Covariates of interest

Data on age, gender, race-ethnicity, and education level were included. We also included data on self-reported comorbidities that commonly impact functioning: arthritis, stroke, diabetes mellitus, chronic bronchitis, emphysema, asthma, myocardial infarction, congestive heart failure, and non-skin cancer (22). We included current cigarette smoking, serum albumin and hemoglobin because they are prognostic of physical functioning (19,20). We included knee pain because many of the physical functions involved the lower extremities, and pain may affect functioning (14). Knee pain was determined by pain with passive motion or tenderness on palpation during the examination.

We included data on body mass index (BMI) and skeletal muscle index, which are prognostic indicators of health and physical functioning (18,23). BMI, measured as weight in kilograms divided by the square of height in meters, was represented using World Health Organization categories of underweight (< 18.5 kg/m²), normal weight (18.5 – 24.9 kg/m²), overweight (25.0 – 29.9 kg/m²), and obese (≥ 30.0 kg/m²). Skeletal muscle index was estimated from a prediction equation based on bioelectrical impedance analysis resistance, age, gender, and height following methods proposed by Janssen and colleagues (23).

The repeated chair rise test was a timed test of five consecutive rises from an armless straight chair. The 8-foot walk, a test of usual speed to walk 8 feet, was represented as gait speed (meters per second). The lock and key test was a timed test of unlocking a lock with a key. Active internal and external rotations of both shoulders were recorded in NHANES III as full, partial, or unable to perform. Active flexion of the hips and knees were scored similarly. These tests have good reliability (24-26).

Statistical analysis

All analyses accounted for the multistage clustered sampling and weights of NHANES III. Continuous variables were compared between genders using the unpaired *t* test, and categorical variables were compared using the chi-square statistic.

We performed univariate ordinal logistic regression analysis for the 11 physical functions to test the association between gender and self-reported limitation, and then multivariate ordinal logistic regression analysis to adjust for important covariates. To determine the relative influence of covariates, we constructed two sets of hierarchical regression models. In the first set, we included gender, age, and physical performance tests as the independent variables. In the second set, we included all remaining covariates of interest.

We reported a summary odds ratio for models for which the proportional odds assumption was upheld. Given the anti-conservative nature of the score test of proportion odds, when the score test was significant, we computed 3 separate models (unable to do/much difficulty/some difficulty versus no difficulty; unable to do/much difficulty versus some difficulty/no difficulty; unable to do versus much difficulty/some difficulty/no difficulty) and qualitatively examined if the parameter estimates were similar across these models (27). Where parameter estimates were similar, we reported a summary odds ratio from the original model. For two tasks (dressing, and eating), parameter estimates varied widely among the models, with small numbers of participants reporting either much difficulty or unable to do these tasks. For these tasks, we collapsed response categories to achieve more stable models.

In separate models, we tested interactions between gender and physical performance tests to determine if the association of gender with functional limitations differed depending on the level of measured performance.

For those functions in which gender was significantly associated with the degree of functional limitation in the adjusted models, we examined the residuals of the models to see if there was evidence supporting reporting bias. Participants who had large positive residuals reported more severe limitations than predicted by the model; conversely, participants who had large negative residuals reported less severe limitations than predicted. We used residuals ≤ -145 and residuals $\geq +145$ to identify individuals for whom the observed ordinal response differed greatly from predicted (bottom 1st and top 5th percentiles, respectively), and would therefore be highly specific in categorizing participants as either under-reporting or over-reporting. In a sensitivity analysis, we used ± 120 as cut-points.

Data were blank or coded as blank but applicable for several variables, including education level in 0.7% of cases, height in 0.2%, weight in 0.3%, hemoglobin in 5.9%, serum albumin in 7.8%, bioelectrical impedance analysis resistance in 17.3%, chair rise test in 10.3%, 8-foot walk test in 7.1%, lock and key test in 4.5%, shoulder rotation in 0.3%, and hip and knee flexion in 6.3%. For physical performance tests, data were coded as blank for participants who made no attempt at the test because they felt they could not perform it safely. Data coded as blank but applicable were for participants who did not attempt the test for other reasons (e.g. time constraints). We treated data coded as blank but applicable as missing at random, and imputed missing values for these variables. All p values were 2-tailed, with values ≤ 0.05 considered to indicate statistical significance. We used SAS version 9.2 (SAS Institute Inc., Cary, NC) for all analyses.

RESULTS

Participant characteristics

More women than men reported at least 1 comorbid condition (68.9% vs. 61.0%), and a greater proportion of women experienced pain in at least 1 knee (16.2% vs. 8.7%) (Table 1). Women also had lower skeletal muscle index than men ($26.76 \pm 0.16\%$ (mean $\pm$ standard error of the mean) vs. $36.86 \pm 0.16\%$), and performed worse on 5 of the 7 physical performance tests. Women reported more difficulty than men in 10 of the 11 physical functions.

Univariate and multivariate regression analyses

Adjustment for gender differences in age and physical performance tests reduced the number of functional tasks for which women were more likely than men to report limitations from 10 tasks to 6 tasks: 1) standing from an armless straight chair; 2) walking $\frac{1}{4}$ mile; 3) walking up 10 steps; 4) household chores; 5) stooping, crouching, or kneeling; and 6) lifting

or carrying 10 pounds (Table 2). After adjustment for all covariates, women were more likely than men to report limitations in lifting or carrying 10 pounds.

Tests of interactions between gender and physical performance tests were not significant for any of the self-reported functions (all $p > 0.05$), indicating that the association between gender and functional limitations did not vary with the level of performance.

Examination of residuals for evidence of over-reporting or under-reporting

We examined the distribution of residuals of the multivariate model for self-reported difficulty lifting and carrying 10 pounds to determine if women or men were more likely to report more severe limitations than predicted by the model. Comparing those reporting any difficulty (versus no difficulty), there were larger proportions of women in both tails of the distribution (12.5% of women under-reported and 5.5% of women over-reported, compared to 8.5% and 3.0% of men, respectively). This result suggests over-reporting by some women and under-reporting by other women, but no systematic difference in reporting between men and women. Results were similar for comparisons between other levels of difficulty and when the cut-point for extreme residuals was ± 120 .

DISCUSSION

In this large population-based sample of community-dwelling older adults, we found that women and men had similar levels of self-reported limitations on most physical functions, after adjustment for important confounding factors. In unadjusted analyses, women were more likely than men to report a greater level of functional limitation in 10 of 11 functions studied. Women also performed worse than men on most physical performance tests, and had more comorbid conditions, more knee pain, less optimal BMI, lower skeletal muscle index, and lower levels of serum albumin and hemoglobin. Adjusting for only age and physical performance test results, women had more functional limitations than men on 6 of 11 tasks. After further adjusting for other important confounding factors, women had more limitations than men on only lifting or carrying 10 pounds.

Previous studies that reported more functional limitations among women than men adjusted for gender differences in demographic characteristics (3,6,12), although some did not (1,2,4). Notably, two studies compared gender differences in self-reported limitations after adjustment for physical performance tests (7,8). In a community-based sample of adults aged 65 years and older, Merrill and colleagues found that differences in physical performance tests accounted for most of the gender differences in self-reported limitations (7). However, a similar study by Rahman and Liu reported that women were still more likely than men to report more limitations with physical tasks after adjusting for measured performance (8). The adjustments did not attenuate the gender differential in the reporting of functional limitations. Our results support the observations of Merrill and colleagues to some degree, in that adjustment for age and physical performance tests eliminated or attenuated gender disparities for some tasks. However, both of these studies included adjustments for only age and physical performance tests, leaving open the possibility that any remaining observed differences in self-reported physical functioning between women and men may be due to differences in comorbidities, BMI, or other factors that could influence physical functioning. While age and physical performance are important, our results indicate that consideration of a broader set of potential confounding factors is necessary to assess more fully if gender disparities in physical functioning exist.

We found gender disparities in self-reported limitations in lifting or carrying 10 pounds, even after adjustment for many potential confounders. This difference suggests that women may have more difficulty in some tasks than men. This task requires more upper extremity

strength than the other functions examined, and differences between women and men in arm strength may have contributed to the gender differential in self-reported limitations. Although we adjusted for skeletal muscle index, the study did not include specific performance tests that require arm strength. It is possible that if we had been able to adjust for performance on tasks requiring arm strength, the gender disparity in this task might have been attenuated. We found no evidence that reporting bias contributed to the gender disparities in limitations on lifting or carrying 10 pounds. While reporting bias is a potential explanation for gender disparities in self-reported functioning, our results suggest that it is likely not a major contributor.

The strengths of this study include the large population-based sample, examination of 11 self-reported functions, availability of data on a broad range of potential confounding factors, and data on reliably measured physical performance tests. However, we did not have data on cognitive dysfunction and depressive symptoms, which can be associated with limitations in physical functioning (14). If women had poorer mental health than men, adjusting for these factors would have further decreased differences between women and men. We also did not have physical performance tests that corresponded closely to each self-reported function. This limitation may have allowed for some confounding to remain, as noted above for functions involving the upper extremity. However, physical performance tests that assess one part of the body have prognostic value for functions that involve unrelated parts of the body, and the comprehensive performance battery included here may provide an adequate overall assessment of functioning (28). Our sample was limited to persons aged 60 years and older, and we do not know if similar associations apply to younger individuals. Finally, because of the cross-sectional nature of our study, we were unable to examine if there are gender differences in disability incidence and recovery or in functional transitions (29,30).

Contrary to prior studies, our results indicate that older women report similar degrees of functional limitation as older men of similar age, health, and physical abilities. Viewed from a different perspective, the diversity of self-reported functional limitations among older men and older women is greater than the diversity of self-reported functional limitations between older men and older women. This observation has several important implications. Researchers who use self-reported physical functioning as an outcome measure should recognize that gender differences may be confounded by a number of factors. Cost-effectiveness analyses that use self-reported functional limitations or disability-adjusted life years as measures of effectiveness may be biased if the proportions of women and men differ substantially between the groups or interventions compared. Studies of gender equity in access to care, healthcare utilization, or costs of care may also be biased if self-reported functional limitations are used as the primary measure of need. Lastly, health planning and program evaluations that use self-reported functional limitations to help prioritize among different conditions should consider if these priorities are confounded by gender differences in the prevalence of these conditions.

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Table 1
Characteristics of the Participants*

Characteristic	Men	Women	P
	(n = 2609)	(n=2787)	
Age, y	70.12 ± 0.20	71.18 ± 0.33	0.002
Race-ethnicity			0.56
Non-Hispanic White	84.9	84.5	
Non-Hispanic Black	7.9	8.6	
Mexican-American / Other	7.2	6.9	
Education level, y			<0.0001
≥ 13	30.9	24.8	
9 – 12	42.3	51.9	
0 – 8	26.8	23.3	
Number of comorbidities [†]			0.0006
0	39.0	31.1	
1	32.3	38.6	
2	16.8	18.3	
≥ 3	11.9	12.0	
Current cigarette smoking	17.1	14.0	0.04
Hemoglobin, g/dL	14.55 ± 0.04	13.45 ± 0.04	<0.0001
Serum albumin, g/dL	4.10 ± 0.02	4.00 ± 0.02	<0.0001
Number of painful knees			<0.0001
0	91.3	83.8	
1	5.5	9.4	
2	3.2	6.8	
Body mass index, kg/m ²			<0.0001
< 18.5	1.7	3.1	
18.5 – 24.9	32.5	38.0	
25 – 29.9	45.1	34.0	
≥ 30	20.7	24.9	
Skeletal muscle index, %	36.86 ± 0.16	26.76 ± 0.16	<0.0001
Right shoulder rotation			
Any limitation	12.3	11.4	0.41
Left shoulder rotation			
Any limitation	11.9	11.9	0.97
Right hip and knee flexion			
Any limitation	3.1	7.7	<0.0001
Left hip and knee flexion			
Any limitation	3.0	7.6	<0.0001
Repeated chair rise test, sec	13.52 ± 0.22	14.71 ± 0.23	<0.0001
8-foot walk test, m/sec	0.78 ± 0.01	0.72 ± 0.01	<0.0001
Lock and key test, sec	6.68 ± 0.19	8.75 ± 0.24	<0.0001

Characteristic	Men	Women	P
	(n = 2609)	(n=2787)	
Preparing own meals [‡]			
Any difficulty	8.1	11.5	0.0005
Walking from one room to another [‡]			
Any difficulty	6.4	9.6	0.0005
Standing from armless straight chair [‡]			
Any difficulty	16.1	23.9	<0.0001
Getting in or out of bed [‡]			
Any difficulty	13.3	16.1	0.01
Eating, cutting food, drinking from glass [‡]			
Any difficulty	4.3	5.1	0.26
Dressing [‡]			
Any difficulty	7.8	9.9	0.02
Walking quarter of a mile [‡]			
Any difficulty	22.9	32.7	<0.0001
Walking up 10 steps without resting [‡]			
Any difficulty	19.4	31.9	<0.0001
Household chores [‡]			
Any difficulty	14.9	28.8	<0.0001
Stooping, crouching, or kneeling [‡]			
Any difficulty	39.2	51.2	<0.0001
Lifting or carrying 10 pounds [‡]			
Any difficulty	14.0	31.1	<0.0001

* Plus-minus values are mean $\pm$ standard error of the mean. All other values are %.

[†] Self-reported comorbidities include arthritis, myocardial infarction, congestive heart failure, stroke, diabetes, asthma, emphysema, and non-skin cancer.

[‡] Self-reported level of functional limitation (no difficulty, some difficulty, much difficulty, or unable to do).

Table 2
Unadjusted and Adjusted Odds Ratios (OR) with 95% Confidence Intervals (CI) of Self-Reported Functional Limitation among Women Compared with Men*

	Unadjusted	Adjusted for Age and Physical Performance Tests	Adjusted for All Covariates*
	OR 95% CI	OR 95% CI	OR 95% CI
Preparing own meals	1.47 1.19 – 1.81	0.99 0.73 – 1.33	0.67 0.38 – 1.16
Walking from 1 room to another	1.56 1.21 – 2.00	1.14 0.81 – 1.62	1.23 0.59 – 2.56
Rising from armless straight chair	1.64 1.39 – 1.93	1.29 1.07 – 1.56	0.76 0.53 – 1.11
Getting in or out of bed	1.26 1.06 – 1.50	0.95 0.75 – 1.21	0.73 0.44 – 1.21
Eating, cutting food, drinking from glass	1.19 0.88 – 1.60	0.79 0.52 – 1.22	0.87 [‡] 0.45 – 1.71
Dressing	1.31 1.06 – 1.61	0.99 [§] 0.71 – 1.37	0.74 [§] 0.45 – 1.20
Walking ½ mile	1.67 1.45 – 1.92	1.37 1.14 – 1.65	0.92 0.66 – 1.30
Walking up 10 steps without resting	1.96 1.68 – 2.29	1.67 1.35 – 2.07	1.03 0.76 – 1.39
Household chores	2.30 1.93 – 2.73	2.00 1.59 – 2.51	1.55 0.99 – 2.42
Stooping, crouching, kneeling	1.73 1.52 – 1.98	1.51 1.29 – 1.78	0.81 0.60 – 1.09
Lifting or carrying 10 pounds	2.72 2.34 – 3.16	2.73 2.23 – 3.34	2.03 1.45 – 2.84

* Adjusted for age, physical performance tests, race-ethnicity, education level, comorbidities, smoking, hemoglobin, serum albumin, knee pain, body mass index, and skeletal muscle index.

[‡] Odds ratio from model comparing any difficulty versus no difficulty.

[§] Odds ratio from model comparing unable to do/much difficulty versus some difficulty versus no difficulty.