

Socioeconomic and Ethnic Differences in Disease Burden and Disparities in Physical Function in Older Adults

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Although the prevalence of disability among older adults in the United States has generally declined over the past decade, this trend has not extended to all segments of the population.^{1–4} Disability among ethnic minorities and economically disadvantaged groups has not declined, resulting in widening ethnic and socioeconomic disparities.^{5–11} Racial minorities and those who are economically disadvantaged are up to 3 times more likely to experience disability than are Whites and those who are not economically disadvantaged, respectively.^{8,10,12,13} Achieving health equity has been a public policy priority, and collective interventions have been proposed.^{12,14,15} Functional limitations in older adults are particularly important because of their prognostic and economic implications.¹⁶ Functional limitations predict further future decline in physical function,¹⁷ an increased risk of dementia,¹⁸ loss of independence, institutionalization, and mortality.^{19–21}

According to the Institute of Medicine model of the enabling–disabling process, disability is a product of the complex interactions between a person and his or her psychological, social, and physical environments.²² In this context, functional limitations are partly a consequence of an individual's burden of disease. Musculoskeletal conditions, chronic neurological and cardiopulmonary disorders, sensory and cognitive deficits, anemia, sarcopenia, and chronic pain may lead to functional limitations and disability. Many of the chronic health conditions that can affect physical functioning are more common among ethnic minorities and economically disadvantaged groups,^{5,6,9–12} raising the question of whether a greater burden of disease can primarily explain the higher prevalence of functional limitations and disability in these groups.

Previous studies of socioeconomic and ethnic disparities in functional limitations reported unadjusted data or data adjusted only for differences in demographic characteristics.^{10,11,23–27} Few studies have examined the role of differences in comorbid conditions, obesity, or smoking or

Objectives. We investigated whether a greater burden of disease among poorer individuals and ethnic minorities accounted for socioeconomic and racial disparities in self-reported physical functioning among older adults.

Methods. We used data from adults aged 60 years or older (n=5556) in the Third National Health and Nutrition Examination Survey, 1988–1994 to test associations between education level, poverty index, and race/ethnicity and limitations in 11 functions. We adjusted for demographic features and measures of disease burden (comorbid conditions, smoking, hemoglobin level, serum albumin level, knee pain, body mass index, and skeletal muscle index).

Results. Associations between education and functional limitations were attenuated after adjustment, but those with 0–8 years of education were more likely than those with 13 or more years of education to have limitations in 3 functions. Poverty was associated with a higher likelihood of limitations despite adjustment. The likelihood of limitations among non-Hispanic Blacks and Mexican Americans was similar to that of non-Hispanic Whites after adjustment.

Conclusions. Socioeconomic disparities in functional limitations among older Americans exist independent of disease burden, whereas socioeconomic differences and disease burden account for racial disparities. (*Am J Public Health.* 2011;101:1322–1329. doi:10.2105/AJPH.2010.199455)

simultaneously examined a range of indicators of disease burden.^{6,9,28} We sought to determine whether socioeconomic and ethnic differences in functional limitations among noninstitutionalized older adults in the United States remain after adjusting for measures of disease burden.

METHODS

We used data from the Third National Health and Nutrition Examination Survey (NHANES III), 1988–1994, a national population-based study that the National Center for Health Statistics conducted.²⁹ In NHANES III, the health of noninstitutionalized individuals aged 2 months or older was assessed by an interview and physical examination. Only adults aged 60 years or older were questioned about the presence of functional limitations. Our sample included only those individuals aged 60 years or older who had a physical examination (n=5724). From this group, we excluded 168 participants who identified their race/ethnicity as other than non-Hispanic White, non-Hispanic

Black, or Mexican American because of the small number of individuals in this group, yielding a final sample of 5556 participants.

Dependent Variables

Participants were asked to report the degree of limitation they had in each of 11 physical functions, with possible responses of no difficulty, some difficulty, much difficulty, or unable to do. These functions, which included basic activities of daily living and more complex instrumental activities of daily living,³⁰ were preparing meals; walking between rooms; rising from a chair; getting in and out of bed; dressing; eating; walking one quarter mile; walking up a flight of stairs without resting; doing household chores; stooping, crouching, and kneeling; and lifting or carrying objects as heavy as 10 pounds. We used each function as a separate dependent variable.

Independent Variables

The independent variables of interest were education level, poverty index, and race/ethnicity. Years of formal education was recorded

in NHANES III as highest grade completed. We categorized participants into 3 levels: 0–8, 9–12, and ≥ 13 years of education. Poverty index (also known as poverty income ratio) is a computed measure of income adequacy derived from tables published annually by the US Census Bureau.³¹ A poverty index of 1.0 represents the level of family income that is at the federal poverty level, and a poverty index of 2.0 represents a family income that is 200% of the federal poverty level. We categorized participants into 3 levels of the poverty index: < 1.0 , 1.0–1.9, and ≥ 2.0 . Race/ethnicity was self-reported as non-Hispanic White, non-Hispanic Black, and Mexican American. We used age as a continuous variable. We categorized marital status as married, widowed, divorced or separated, and never married.

Measures of health behavior, medical conditions, and body composition represented disease burden. We assessed health behavior by self-reported current cigarette smoking. We examined chronic medical conditions known to substantially affect physical function: arthritis, stroke, diabetes mellitus, chronic bronchitis, emphysema, asthma, myocardial infarction, congestive heart failure, nonskin cancer, and blindness. We collected the presence of these comorbidities from self-report. We assessed cognitive function on the basis of tests of orientation, attention, and memory. We measured orientation using a correct response to the day of the week (orientation to person and place were not tested). We assessed attention by 5 serial subtractions of 3s from 20 and evaluated memory by delayed recall of 3 items. We recorded correct responses as 1 and incorrect responses as 0. We included 2 laboratory measures, hemoglobin concentration and serum albumin levels, because they are indicators of general health status and prognostic of physical function.^{32,33}

We also included current knee pain elicited by physical examination because knee pain is known to affect functions involving the lower extremities, and many of the tasks involved the lower extremities. Knee pain was categorized as absent, present in 1 knee, or present in both knees. Body composition was assessed by body mass index and skeletal muscle mass. We calculated body mass index as weight in kilograms divided by height in meters squared and grouped it using World Health Organization

categories of underweight, normal weight, overweight, and obesity (< 18.5 , 18.5–24.9, 25.0–29.9, and ≥ 30.0 , respectively).³⁴ We derived skeletal muscle mass from bioelectrical impedance measurements and represented it as skeletal muscle index (SMI) to account for differences in nonskeletal muscle mass, where $SMI = (\text{skeletal muscle mass} / \text{body mass}) \times 100$.³⁵ Higher SMI values indicate greater muscle mass.

Statistical Analysis

All analyses accounted for the complex sampling design of NHANES III and incorporated sampling weights to provide correct standard errors. We used ordinal logistic regression analysis to examine the association between education level, poverty index, and race/ethnicity and the degree of limitation in each of the 11 functions. In the first set of models, we used education level, age, and gender as the independent variables. In sequential models, we added race/ethnicity, marital status, and poverty index as additional independent variables, and then to adjust for disease burden we added current cigarette smoking, comorbid conditions, hemoglobin level, serum albumin level, current knee pain, tests of cognitive function, body mass index, and SMI. We then used a similar approach for the poverty index and race/ethnicity. We assessed the validity of the proportional odds assumption in the ordinal logistic regression models qualitatively by examining the similarity of odds ratios (ORs) for contrasts between each level of the dependent variable.³⁶ ORs for different contrasts were similar; therefore, a single OR represented associations. Data were missing or coded as missing but applicable for education level in 0.7% of case participants, height in 0.2%, weight in 0.3%, hemoglobin in 5.9%, serum albumin in 7.8%, and bioelectrical impedance analysis resistance in 17.3%. We used multiple imputation with the Markov chain Monte Carlo methods to impute values for missing independent variables, with results derived from 5 imputed data sets.³⁷ We used SAS version 9.2 (SAS Institute, Cary, NC) for all analyses.

RESULTS

Mean \pm SE age of participants was 70.8 ± 0.2 years, with a higher proportion of women

than men (51.7% vs 48.3%; Table 1). Because of oversampling of ethnic minorities, 20.3% of participants were non-Hispanic Blacks, 19.1% were Mexican Americans, and 60.6% were non-Hispanic Whites. Education attainment was ≥ 13 years for 19.9%, 9–12 years for 39.7%, and 0–8 years for 40.4%. A majority (51.9%) had a poverty index of < 2.0 .

Compared with those with ≥ 13 years of education, participants with 9–12 years of education were more likely to have a poverty index of < 2.0 (36.5% vs 16.6%), be current cigarette smokers, have more comorbid conditions and worse cognitive function, report current knee pain, be obese, and have a lower hemoglobin concentration. Similar associations were observed for those with 0–8 years of education as compared with those with ≥ 13 years. Compared with participants with a poverty index of ≥ 2.0 , those with a poverty index of either 1.0–1.99 or < 1.0 had a higher disease burden, as indicated by more commonly having comorbid conditions, worse cognitive function, current cigarette smoking, current knee pain, obesity, and a lower hemoglobin concentration. Non-Hispanic Blacks and Mexican Americans had lower education levels and poverty indexes than those of non-Hispanic Whites. Compared with non-Hispanic Whites, a larger proportion of non-Hispanic Blacks and Mexican Americans had diabetes, blindness, worse cognitive function, and current knee pain and were obese, and non-Hispanic Blacks were somewhat more likely to be current smokers.

Associations Between Education Level and Functional Limitations

Participants with 9–12 years of education were more likely to report a worse level of functioning than those with ≥ 13 years of education for 5 of 11 functional tasks in age- and gender-adjusted analyses (Table 2). For example, participants with 9–12 years of education were 1.52 times more likely to report more difficulty walking one quarter of a mile than those with ≥ 13 years of education. Adjusting for age, gender, race/ethnicity, poverty index, and marital status, participants with 9–12 years of education were more likely to report worse functioning for 3 tasks (preparing meals, walking one quarter mile, and stooping, crouching, or kneeling). Adjusting for measures of disease

TABLE 1—Participant (n = 5556) Characteristics Stratified by Education Level, Poverty Index, and Race/Ethnicity: Third National Health and Nutrition Examination Survey, United States, 1988–1994

Characteristic	Education ≥13 y (n = 1106), % or Mean ±SE	Education 9–12 y (n = 2205), % or Mean ±SE	Education 0–8 y (n = 2245), % or Mean ±SE	Poverty Index ≥2.0 (n = 2671), % or Mean ±SE	Poverty Index 1.0–1.99 (n = 1739), % or Mean ±SE	Poverty Index <1.0 (n = 1146), % or Mean ±SE	Non-Hispanic White (n = 3365), % or Mean ±SE	Non-Hispanic Black (n = 1126), % or Mean ±SE	Mexican American (n = 1065), % or Mean ±SE
Age, y	70.1 ±0.3	70.0 ±0.3	73.3 ±0.4	69.8 ±0.3	72.3 ±0.3	72.9 ±0.4	70.9 ±0.3	70.4 ±0.4	68.5 ±0.4
Women	51.1	62.4	53.7	53.5	60.9	68.6	57.0	59.9	54.4
Education level, y									
≥13	...	...	...	37.3	13.8	8.1	29.6	14.2	6.9
9–12	...	...	...	49.3	50.1	37.0	49.6	40.8	21.8
0–8	...	...	...	13.4	36.1	54.9	20.8	45.0	71.3
Poverty index									
≥2.0	83.4	63.5	34.3	...	...	...	65.5	34.8	30.3
1.0–1.99	13.3	27.7	39.8	...	...	...	25.8	32.4	37.7
<1.0	3.3	8.8	25.9	...	...	...	8.7	32.8	32.0
Race/ethnicity									
Non-Hispanic White	94.9	91.5	76.6	93.9	86.0	68.0	...	...	...
Non-Hispanic Black	4.5	7.4	16.4	4.9	10.6	25.3	...	...	...
Mexican American	0.6	1.1	7.0	1.2	3.4	6.7	...	...	...
Marital status									
Married	66.8	61.1	51.1	69.3	50.1	35.0	62.0	42.0	64.4
Widowed	20.8	27.6	38.4	21.5	36.1	47.0	27.2	40.2	23.2
Divorced or separated	7.3	7.5	6.0	5.5	9.0	11.7	6.5	13.3	8.5
Never married	5.1	3.8	4.5	3.7	4.8	6.3	4.3	4.5	3.9
Current smoking	10.6	17.2	15.3	13.6	16.3	18.5	14.4	19.9	14.7
Comorbidities									
Arthritis	41.5	44.4	51.2	41.6	49.3	55.4	44.6	52.3	44.3
Stroke	4.6	6.0	7.1	5.4	7.9	3.8	6.3	2.6	2.2
Diabetes mellitus	9.1	13.0	15.8	10.5	15.5	17.4	11.7	19.4	23.2
Chronic bronchitis	1.9	3.2	2.1	4.3	1.9	1.0	7.1	8.0	5.9
Emphysema	4.1	7.0	10.5	4.7	10.0	12.5	6.6	11.6	5.9
Asthma	7.5	10.1	10.6	8.3	11.1	12.5	9.9	5.7	6.8
Myocardial infarction	11.1	10.4	14.4	10.0	14.7	12.6	11.8	10.1	7.6
Congestive heart failure	8.8	10.4	8.8	10.2	8.6	8.3	10.1	5.4	3.8
Nonskin cancer	1.7	3.0	2.4	3.3	2.6	1.4	6.1	0.8	0.3
Blindness	1.9	2.4	4.5	2.1	3.7	4.4	2.7	4.1	3.2
Hemoglobin, g/dL	14.0 ±0.1	13.9 ±0.1	13.8 ±0.1	14.0 ±0.1	13.9 ±0.1	13.5 ±0.1	14.0 ±0.1	13.1 ±0.1	14.0 ±0.1
Serum albumin, g/dL	4.0 ±0.1	4.0 ±0.1	4.0 ±0.1	4.1 ±0.1	4.0 ±0.1	4.0 ±0.1	4.0 ±0.1	3.9 ±0.1	4.1 ±0.1
Painful knees, No.									
0	91.6	87.2	82.3	89.5	85.0	80.2	87.9	82.1	80.4
1	3.7	5.1	7.5	4.6	6.0	7.7	5.1	6.9	6.1
2	4.7	7.7	10.2	5.9	9.0	12.1	7.0	11.0	13.5

Continued

TABLE 1—Continued

Cognitive function	0.9 ±0.1	0.9 ±0.1	0.9 ±0.1	0.9 ±0.1	0.9 ±0.1	0.9 ±0.1	0.9 ±0.1	0.9 ±0.1	0.9 ±0.1	0.9 ±0.1
Orientation (out of 1)	4.7 ±0.1	4.4 ±0.1	4.4 ±0.1	4.5 ±0.1	3.9 ±0.1	3.1 ±0.1	4.3 ±0.1	4.3 ±0.1	3.2 ±0.1	3.4 ±0.1
Attention (out of 5)	2.7 ±0.1	2.6 ±0.1	2.6 ±0.1	2.6 ±0.1	2.4 ±0.1	2.2 ±0.1	2.6 ±0.1	2.6 ±0.1	2.0 ±0.1	2.4 ±0.1
Recall (out of 3)	2.0	2.8	2.8	2.0	3.3	4.0	2.5	3.8	3.8	1.2
Body mass index, kg/m ²	18.5–24.9	32.9	32.9	36.9	32.5	34.0	36.1	29.6	29.6	28.9
<18.5	38.1	38.2	38.2	39.7	36.6	36.9	38.8	35.0	35.0	41.6
25.29.9	18.7	26.1	26.1	21.4	27.6	25.1	22.6	31.6	31.6	28.3
≥30	32.1 ±0.2	30.5 ±0.2	30.5 ±0.2	31.7 ±0.2	30.4 ±0.2	29.8 ±0.4	31.2 ±0.1	30.7 ±0.3	30.7 ±0.3	30.9 ±0.3
Skeletal muscle index, %										

burden, participants with 9–12 years of education did not differ from those with ≥13 years of education in level of functioning for any of the tasks.

Participants with 0–8 years of education were more likely than were participants with ≥13 years to report worse functioning for all 11 tasks in age- and gender-adjusted analyses. Adjustment for age, gender, race/ethnicity, marital status, and poverty index modestly attenuated these associations, but those with 0–8 years of education were still more likely to report worse functioning on 10 tasks. Further adjustment for disease burden attenuated the associations further, and participants with 0–8 years of education were more likely than those with ≥13 years of education to report worse functioning on only 3 tasks (walking one quarter mile, walking up 10 steps, and household chores).

Associations Between the Poverty Index and Functional Limitations

In age- and gender-adjusted analyses, participants with a poverty index of 1.0–1.99 were more likely than were participants with a poverty index of ≥2.0 to have a worse level of functioning on all 11 tasks, with ORs that ranged from 1.45 to 1.92 (Table 3). Adjustment for socioeconomic features attenuated the association for all tasks, but those with a poverty index of 1.0–1.99 were more likely to report worse functioning for 9 tasks. Adjustment for disease burden further attenuated the associations, but participants with a poverty index of 1.0–1.99 still had a higher likelihood of reporting worse functioning on 4 tasks (rising from a chair, getting out of bed, walking one quarter mile, and lifting or carrying 10 pounds) compared with those with a poverty index of ≥2.0.

Participants with a poverty index of <1.0 had a much higher likelihood of functional limitations for all 11 tasks (OR=1.91–3.24) than did participants with a poverty index of ≥2.0. The associations were moderately attenuated (OR=1.69–2.84) by adjustment for demographic features and were further attenuated by adjustment for measures of disease burden, but those with a poverty index of <1.0 still had more severe limitations than did those with a poverty index of ≥2.0 on 10 tasks (OR=1.43–2.15).

Associations Between Race/Ethnicity and Functional Limitations

In age- and gender-adjusted analyses, non-Hispanic Blacks were more likely than were non-Hispanic Whites to report worse functioning on 10 of 11 tasks (OR=1.37–2.37; Table 4). Adjusting for socioeconomic features, non-Hispanic Blacks were more likely to report worse functioning on 5 tasks, but with further adjustment for disease burden there was no evidence of increased risk among non-Hispanic Blacks. After adjustment, non-Hispanic Blacks had significantly lower risks of functional limitations in rising from a chair, getting out of bed, and stooping, crouching, and kneeling than did non-Hispanic Whites.

Mexican Americans were more likely than were non-Hispanic Whites to report worse functioning on 10 tasks in age- and gender-adjusted analyses, with ORs ranging from 1.42 to 2.14. After further adjustment for socioeconomic features, Mexican Americans had risks of functional limitations similar to non-Hispanic Whites on all tasks. With adjustment for measures of disease burden, Mexican Americans had a lower risk of limitations in stooping, crouching, and kneeling than did non-Hispanic Whites.

DISCUSSION

In this population-based study, we found that socioeconomic disparities in functional limitations were present among older adults even after accounting for differences in disease burden. Lower income and, less consistently, lower levels of formal education were both associated with a higher likelihood of functional limitations. There was a graded association with the poverty index, whereas the increased risk for functional limitations was concentrated among those with 0–8 years of education. In contrast, racial/ethnic disparities in functional limitations were largely explained by differences in socioeconomic factors and disease burden. Mexican Americans were no more likely than were non-Hispanic Whites to report functional limitations after adjustment for differences in education and income. After further adjustment for disease burden, non-Hispanic Blacks were no more likely than were non-Hispanic Whites to report functional limitations.

TABLE 2—Association Between Education Level and Self-Reported Functional Limitation: Third National Health and Nutrition Examination Survey, United States, 1988–1994

Functional Limitation	Adjusted for Age and Gender		Adjusted for Age, Gender, Race/Ethnicity, Marital Status, and Poverty Index		Adjusted for All Covariates ^a	
	9–12 y, OR (95% CI)	0–8 y, OR (95% CI)	9–12 y, OR (95% CI)	0–8 y, OR (95% CI)	9–12 y, OR (95% CI)	0–8 y, OR (95% CI)
Preparing own meals	1.74 (1.20, 2.53)	2.73 (1.81, 4.12)	1.59 (1.10, 2.30)	2.03 (1.36, 3.04)	1.37 (0.93, 2.03)	1.20 (0.78, 1.84)
Walking from 1 room to another	1.18 (0.80, 1.74)	2.18 (1.62, 2.95)	1.04 (0.71, 1.53)	1.55 (1.10, 2.19)	0.90 (0.60, 1.36)	1.02 (0.68, 1.55)
Rising from armless straight chair	1.19 (0.89, 1.59)	1.97 (1.59, 2.43)	1.06 (0.79, 1.42)	1.49 (1.18, 1.87)	0.95 (0.71, 1.27)	1.14 (0.87, 1.48)
Getting in or out of bed	1.24 (0.89, 1.71)	2.23 (1.67, 2.99)	1.08 (0.78, 1.49)	1.61 (1.18, 2.18)	0.94 (0.66, 1.35)	1.06 (0.74, 1.51)
Eating, cutting, drinking from glass	0.99 (0.60, 1.62)	1.87 (1.04, 3.35)	0.86 (0.52, 1.41)	1.31 (0.71, 2.41)	0.74 (0.42, 1.30)	0.81 (0.41, 1.57)
Dressing	1.32 (0.94, 1.84)	1.97 (1.33, 2.93)	1.20 (0.87, 1.68)	1.55 (1.02, 2.37)	1.05 (0.73, 1.51)	1.02 (0.63, 1.65)
Walking 1/4 mile	1.52 (1.23, 1.88)	2.43 (1.94, 3.03)	1.34 (1.08, 1.67)	1.80 (1.40, 2.31)	1.22 (0.97, 1.54)	1.38 (1.08, 1.78)
Walking up 10 steps without resting	1.34 (1.09, 1.65)	2.60 (2.07, 3.26)	1.19 (0.96, 1.46)	1.85 (1.42, 2.40)	1.05 (0.84, 1.30)	1.32 (1.01, 1.73)
Household chores	1.43 (1.07, 1.93)	2.64 (1.96, 3.55)	1.31 (0.97, 1.75)	2.06 (1.51, 2.81)	1.22 (0.89, 1.66)	1.51 (1.08, 2.10)
Stooping, crouching, kneeling	1.28 (1.08, 1.52)	1.91 (1.58, 2.32)	1.20 (1.01, 1.42)	1.66 (1.36, 2.03)	1.08 (0.89, 1.30)	1.24 (0.98, 1.57)
Lifting or carrying 10 pounds	1.25 (0.98, 1.59)	2.58 (1.99, 3.34)	1.08 (0.85, 1.39)	1.78 (1.39, 2.27)	0.94 (0.73, 1.22)	1.20 (0.91, 1.58)

Note. CI = confidence interval; OR = odds ratio. The referent for the computation of ORs was education level ≥ 13 years.

^aAdjustment for age, gender, race/ethnicity, poverty index, marital status, current cigarette smoking, arthritis, stroke, diabetes, chronic bronchitis, emphysema, asthma, myocardial infarction, congestive heart failure, nonskin cancer, blindness, cognitive function, hemoglobin level, serum albumin level, current knee pain, body mass index, and skeletal mass index.

Although education level and income are both measures of socioeconomic position, they had different associations with functional limitations. Functional limitations among those with 0–8 years of education were more likely for more physically demanding tasks and for

instrumental activities of daily living, such as household chores, than for the more basic tasks of eating and dressing. In contrast, associations with the poverty index were similar across the range of tasks, from the most fundamental to the most challenging. Extreme poverty appears

to identify a subgroup whose limitations in physical functioning are qualitatively different from those identified by education level, for whom limitations paralleled the hierarchy of difficulty. Although poverty and low education level are associated, this finding indicates that

TABLE 3—Association Between Poverty Index and Self-Reported Functional Limitation: Third National Health and Nutrition Examination Survey, United States, 1988–1994

Functional Limitation	Adjusted for Age and Gender		Adjusted for Age, Gender, Race/Ethnicity, Education Level, and Marital Status		Adjusted for All Covariates ^a	
	Poverty Index 1.0–1.99, OR (95% CI)	Poverty Index <1.0, OR (95% CI)	Poverty Index 1.0–1.99, OR (95% CI)	Poverty Index <1.0, OR (95% CI)	Poverty Index 1.0–1.99, OR (95% CI)	Poverty Index <1.0, OR (95% CI)
Preparing own meals	1.50 (1.09, 2.05)	2.74 (1.83, 4.13)	1.22 (0.90, 1.66)	1.93 (1.29, 2.89)	0.97 (0.70, 1.33)	1.47 (0.98, 2.21)
Walking from 1 room to another	1.68 (1.29, 2.20)	2.95 (2.15, 4.04)	1.45 (1.10, 1.91)	2.18 (1.51, 3.14)	1.20 (0.89, 1.61)	1.72 (1.21, 2.45)
Rising from armless straight chair	1.81 (1.44, 2.26)	2.44 (1.88, 3.18)	1.63 (1.30, 2.04)	2.00 (1.49, 2.68)	1.39 (1.11, 1.73)	1.61 (1.21, 2.15)
Getting in or out of bed	1.92 (1.49, 2.46)	2.86 (2.16, 3.77)	1.72 (1.34, 2.20)	2.38 (1.77, 3.19)	1.41 (1.05, 1.88)	1.84 (1.39, 2.44)
Eating, cutting, drinking from glass	1.68 (1.18, 2.38)	3.24 (2.20, 4.77)	1.52 (1.09, 2.13)	2.84 (1.97, 4.09)	1.26 (0.88, 1.81)	2.15 (1.44, 3.21)
Dressing	1.48 (1.09, 2.01)	2.43 (1.77, 3.33)	1.33 (0.99, 1.81)	2.03 (1.48, 2.79)	1.10 (0.79, 1.54)	1.57 (1.14, 2.15)
Walking 1/4 mile	1.85 (1.53, 2.25)	2.64 (2.17, 3.21)	1.60 (1.30, 1.97)	2.03 (1.60, 2.58)	1.29 (1.02, 1.64)	1.63 (1.30, 2.03)
Walking up 10 steps without resting	1.75 (1.46, 2.10)	2.99 (2.31, 3.87)	1.47 (1.22, 1.77)	2.08 (1.55, 2.79)	1.20 (0.97, 1.49)	1.73 (1.33, 2.25)
Household chores	1.69 (1.35, 2.11)	2.45 (1.91, 3.15)	1.44 (1.15, 1.81)	1.89 (1.46, 2.44)	1.16 (0.90, 1.49)	1.43 (1.07, 1.90)
Stooping, crouching, kneeling	1.45 (1.21, 1.73)	1.91 (1.56, 2.36)	1.32 (1.11, 1.57)	1.69 (1.34, 2.13)	1.06 (0.88, 1.26)	1.31 (1.06, 1.61)
Lifting or carrying 10 pounds	1.89 (1.52, 2.35)	3.15 (2.37, 4.20)	1.63 (1.31, 2.03)	2.34 (1.76, 3.11)	1.43 (1.14, 1.79)	1.91 (1.44, 2.53)

Note. CI = confidence interval; OR = odds ratio. The referent for the computation of ORs is a poverty index ≥ 2.0.

^aAdjustment for age, gender, race/ethnicity, education level, marital status, current cigarette smoking, arthritis, stroke, diabetes, chronic bronchitis, emphysema, asthma, myocardial infarction, congestive heart failure, nonskin cancer, blindness, cognitive function, hemoglobin level, serum albumin level, current knee pain, body mass index, and skeletal mass index.

TABLE 4—Association Between Race/Ethnicity and Self-Reported Functional Limitation: Third National Health and Nutrition Examination Survey, United States, 1988–1994

Functional Limitation	Adjusted for Age and Gender		Adjusted for Age, Gender, Education Level, Poverty Index, and Marital Status		Adjusted for All Covariates ^a	
	Non-Hispanic Black, OR (95% CI)	Mexican American, OR (95% CI)	Non-Hispanic Black, OR (95% CI)	Mexican American, OR (95% CI)	Non-Hispanic Black, OR (95% CI)	Mexican American, OR (95% CI)
Preparing own meals	2.37 (1.83, 3.07)	1.79 (1.34, 2.39)	1.76 (1.34, 2.31)	1.19 (0.83, 1.70)	1.05 (0.73, 1.51)	1.05 (0.69, 1.61)
Walking from 1 room to another	2.14 (1.64, 2.78)	1.83 (1.31, 2.55)	1.47 (1.05, 2.07)	1.14 (0.74, 1.74)	1.00 (0.69, 1.45)	1.04 (0.65, 1.67)
Rising from armless straight chair	1.44 (1.16, 1.78)	1.66 (1.32, 2.08)	1.04 (0.81, 1.33)	1.08 (0.82, 1.42)	0.66 (0.49, 0.89)	0.98 (0.71, 1.34)
Getting in or out of bed	1.37 (1.09, 1.72)	1.72 (1.25, 2.38)	0.93 (0.70, 1.22)	1.02 (0.70, 1.50)	0.65 (0.47, 0.90)	1.03 (0.70, 1.50)
Eating, cutting, drinking from glass	1.45 (1.08, 1.95)	1.62 (1.06, 2.47)	0.97 (0.65, 1.45)	0.97 (0.59, 1.59)	0.58 (0.33, 1.04)	0.87 (0.52, 1.46)
Dressing	1.48 (1.13, 1.93)	1.55 (1.14, 2.10)	1.09 (0.81, 1.47)	1.04 (0.75, 1.43)	0.70 (0.48, 1.02)	0.97 (0.70, 1.36)
Walking 1/4 mile	1.79 (1.46, 2.21)	1.42 (1.17, 1.72)	1.28 (1.03, 1.60)	0.89 (0.72, 1.10)	0.92 (0.70, 1.21)	0.85 (0.68, 1.07)
Walking up 10 steps without resting	2.28 (1.85, 2.81)	1.91 (1.60, 2.29)	1.56 (1.24, 1.96)	1.14 (0.93, 1.41)	1.19 (0.92, 1.54)	1.16 (0.94, 1.44)
Household chores	1.62 (1.31, 2.02)	1.44 (1.18, 1.76)	1.17 (0.93, 1.47)	0.87 (0.71, 1.07)	0.84 (0.65, 1.09)	0.89 (0.69, 1.15)
Stooping, crouching, kneeling	1.08 (0.85, 1.36)	1.08 (0.89, 1.32)	0.83 (0.66, 1.04)	0.73 (0.58, 0.91)	0.57 (0.44, 0.73)	0.66 (0.52, 0.83)
Lifting or carrying 10 pounds	1.89 (1.52, 2.35)	2.14 (1.73, 2.65)	1.27 (1.03, 1.58)	1.20 (0.95, 1.52)	0.92 (0.74, 1.14)	1.26 (0.97, 1.62)

Note. CI = confidence interval; OR = odds ratio. The referent for the computation of ORs is Non-Hispanic White.

^aAdjustment for age, gender, education level, poverty index, marital status, current cigarette smoking, arthritis, stroke, diabetes, chronic bronchitis, emphysema, asthma, myocardial infarction, congestive heart failure, nonskin cancer, blindness, cognitive function, hemoglobin level, serum albumin level, current knee pain, body mass index, and skeletal mass index.

these are not interchangeable socioeconomic indicators of risk of functional limitations.

Poverty may have stronger and more widespread associations with functional limitations because it is a more proximate and current measure of socioeconomic position than is education level among older adults. There may be more heterogeneity in socioeconomic position among those with similar levels of education than among those with similar levels of income. Poverty may also be more strongly associated with functional limitations than is education level because poverty may be the result of functional limitations. Disease and physical limitations during mid or older adulthood can result in work loss and reduced earning potential and may have led to higher levels of poverty in this group. Longitudinal studies of the sequence of transitions in health, functioning, and employment in younger cohorts are needed to address this question.

Our findings extend those of previous studies that reported independent associations of income and education level with functional limitations.^{38–42} Prior studies adjusted for demographic characteristics and few chronic conditions. Associations with socioeconomic status may therefore have been attributable to other measures of disease burden. Our results suggest

that differences in disease burden alone do not account for socioeconomic disparities in functional limitations. Poverty and low education may be associated with disability because of cumulative effects of unhealthy behaviors, less adequate social networks and other support systems, and neighborhood influences, among other factors unaccounted for in our study.^{43–45} Moreover, persons of low socioeconomic status are more likely to hold blue-collar jobs, which are associated with increased potential risk of musculoskeletal injury and disability.⁴⁶ Workers with lower-wage jobs often have less control over their work schedules, which may limit their access to preventive care services. People whose jobs require heavy physical work are also less likely to exercise.⁴⁷ All these factors can increase the risk of functional limitations. Reporting differences between disadvantaged and more advantaged groups and different experiences of limitations may account for some of the observed disparities.

Contrary to studies that report ethnic disparities in disability,^{4–9} we found that risks of functional limitations were generally similar between non-Hispanic Blacks, Mexican Americans, and non-Hispanic Whites after adjustment for demographic characteristics—including education level and poverty index—and disease

burden. Similar findings were recently reported by Song et al. using data from the Health and Retirement Study.⁴⁸ Among respondents aged 51 years or older with arthritis, disability in activities of daily living was higher among Blacks and Hispanics than among non-Hispanic Whites. After adjusting for chronic conditions, health behaviors, and economic factors, racial and ethnic differences in disability were largely attenuated, although not eliminated.

We examined a sample of older adults that was not restricted to persons with arthritis, allowing for more generalizable results. In a study of whether the Black–White disability gap persisted over 6 years, Kelley-Moore and Ferraro found that the trajectory of racial differences in disability was not significantly different after adjustment for socioeconomic resources, social integration, and other health indicators.⁴⁹ Our study differs from other studies in that we found no significant racial disparities in functional limitations after adjustment for socioeconomic differences and disease burden, suggesting that these factors account for ethnic differences in physical functioning.

Strengths of our study include the large population-based sample, examination of limitations in a range of functional tasks, and assessment of disease burden by the presence

of not only chronic conditions but also cognitive functioning, laboratory measures, pain, and body composition. However, we did not include other measures, such as social networks, medical insurance, and health behaviors other than cigarette smoking—factors that potentially could be associated with both socioeconomic position and functional limitations. We could not assess the interaction between individuals with disability and their environment, and cultural differences may affect reporting of disability. Also, examination of measures of wealth rather than income might have resulted in different associations than those reported here. Because of the cross-sectional nature of the study, we could not address whether our findings apply to disability transitions. To investigate the predominant direction of associations between poverty and functional limitations, research should follow the trajectory of income and functioning over the life course. Lastly, our results relate only to disparities in physical functioning and may not apply to other measures of health.

Our findings provide a better understanding of disparities in physical functioning and their determinants by demonstrating that economic factors and disease burden largely account for racial/ethnic differences in risk of functional limitations but not for differences by poverty or education level. Socioeconomic disparities in physical functioning should not be attributed to differences in disease burden alone. Consideration of a broader set of social factors may lead to better understanding of the mechanisms underlying health disparities across the socioeconomic spectrum. ■

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Contributors

G.H. Louie and M.M. Ward originated the study, completed the analyses, and contributed to the writing.

Both authors helped to conceptualize ideas, interpret findings, and review drafts of the article.

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

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