Health-Related Quality of Life Among Older Adults With and Without Functional Limitations

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Objectives. We examined factors that influence health-related quality of life (HRQOL) among individuals aged 50 years and older with and without functional limitations.

Methods. We analyzed data from the 2009 Behavioral Risk Factor Surveillance System to assess associations among demographic characteristics, health care access and utilization indicators, modifiable health behaviors, and HRQOL characterized by recent physically and mentally unhealthy days in those with and those without functional limitations. We defined functional limitations as activity limitations owing to physical, mental, or emotional health or as the need for special equipment because of health.

Results. Age, medical care costs, leisure-time physical activity, and smoking were strongly associated with both physically and mentally unhealthy days among those with functional limitations. Among those without functional limitations, the direction of the effects was similar, but the size of the effects was substantially smaller.

Conclusions. The availability of lower cost medical care, increasing leisure-time physical activity, and reducing rates of cigarette smoking will improve population HRQOL among older adults with and without functional limitations. These factors provide valuable information for determining future public health priorities. (*Am J Public Health.* 2012;102:496–502. doi:10.2105/AJPH.2011.300500)

Disability affects a substantial portion of the population, and the prevalence of disabilities increases with age. Adults with disabilities represent 31% of those aged 55–64 years and 52% of those aged 65 years and older.[1] Annual disability-associated health care expenditures have been estimated at almost $400 billion, or 27% of all US adult health care expenditures in 2006,[2] making this an important economic issue for public health.

Disability definitions have evolved over the past 2 centuries because of the medical profession's changing attitudes regarding health care treatment of individuals with disabilities and changing societal perspectives, including the destigmatization of attitudes and beliefs regarding disability and increased support for designing environments that encourage independent living.[3,4] Recently, advocates for a social model of disability[5,6] have argued that disability results from functional impairment and limitations that are the result of social, cultural, and environmental factors. Expanding this more integrated conceptualization of disability, the World Health Organization published the International Classification of Functioning Disability and Health (ICF) in 2001.[7] The ICF depicts disability as resulting from the interaction of a person's functional impairment with environmental factors to create limitations. The ICF provides a framework for considering health and disability at the individual and population level across the entire lifespan and provides an important step forward for assessing the relationships among disability, environment, and health outcomes.

The shift in focus in public health to health promotion and quality of life is advancing quickly because of increases in life expectancy and the increasing number of individuals living with chronic diseases. Furthermore, as the population of the United States continues to age, the public health community has become more focused on understanding how to improve health-related quality of life (HRQOL) among individuals with multiple chronic conditions and disabilities.[8] HRQOL is a multidimensional population health outcome that supplements more traditional measures of mortality and morbidity and is useful because it provides broad summary measures of perceived health.[9,10] HRQOL constructs include measures of physical health, mental health, and social functioning.[11,12] These measures have the potential to bridge boundaries between disciplines and among social, mental, and medical services. For example, Health and Human Services' Healthy People 2020 initiative has provided overarching goals that emphasize the desire to create high quality lives for individuals with disabilities, including the creation of social and physical environments that promote optimal health, and has recommended the use of HRQOL measures to assess progress in this area.[13]

When depicting the nature of the relationships among disability, functional limitations, and HRQOL, it is important to consider the perspective of the individual evaluating the health outcome. Previous studies have shown significant differences between self-report and proxy reports for individuals with disabilities.[14,15] For example, 1 study found that more than 50% of adults with serious and persistent disabilities reported good or excellent HRQOL despite living a daily life that other individuals might regard as less than optimal.[15] This apparent contradiction between self-reported health and assessment of health by others was named "the disability paradox." This paradox emphasizes the importance of self-report for determining HRQOL. The disability paradox can be explained, in part, by the fact that quality of life and well-being do not involve merely the absence of illness and disability. Indeed, many people with disabilities or illness experience a fine quality of life, and, conversely, many who are not ill or infirm still do not flourish. Furthermore, although self-report is generally the preferred method for measuring HRQOL,[10,16] another concern in measuring HRQOL among people with longstanding functional limitations is

that some popular measures of HRQOL include function domains in their summary measures of HRQOL. Consequently, these measures will reduce scores of HRQOL related to functional limitations among those who may otherwise perceive their HRQOL to be very good, resulting in an HRQOL score that is artificially low.[17,18] This concern has been documented for the Rand Medical Outcomes Study Short Form–36 health survey as a measure of HRQOL[19] derived from differential item analyses. These differential item analysis estimates appear to be smaller for the Centers for Disease Control and Prevention (CDC) Healthy Days measures of HRQOL.[20]

In a seminal article on understanding the structure of perceived health (more recently referred to as HRQOL) among older Americans, Johnson and Wolinsky[21] developed a conceptual and statistical model to understand the relationships among 4 primary components of health: disease, disabilities, functional limitations, and perceived health. As part of their causal model, functional limitations are considered, in part, to result from disabilities and are a useful way for classifying how a particular disability has affected an individual.[22]

Measuring HRQOL can assist in determining the burden of disabilities and chronic diseases and can provide valuable new insights into the relationships between HRQOL and risk factors. We investigated which risk factors and public health policies should be considered for improving HRQOL among those with and those without functional limitations. On the basis of the conceptual definitions the ICF presented, the theoretical model presented by Johnson and Wolinsky,[21] and the health services model of Andersen,[23,24] we assessed the associations between HRQOL and predisposing factors (age, race/ethnicity, and marital status), enabling factors (health care coverage, medical care cost issues, and health care utilization), and modifiable health behaviors (smoking, nutrition, and leisure-time physical activity) among individuals aged 50 years and older with and without functional limitations. We derive our definition for functional limitations from Healthy People 2010 surveillance objectives. The definition represents the standard questions and classifications used for the CDC Behavioral Risk Factor Surveillance System (BRFSS). This definition combines general limitations in function owing to disability or health conditions and adds the use of assistive technology to capture those who may not report limitations because these aids obviate the body limitation. Asking respondents about attribution to disability and health conditions especially helps include older adults with disability, who might otherwise ascribe their limitations to aging. We hypothesized that poor HRQOL would be associated with lower rates of health care coverage, difficulties with cost for medical care, higher smoking rates, poor nutrition, and less leisure-time physical activity. We also hypothesized that the factors that influence HRQOL would differ for those with functional limitations from those without. On the basis of the results of these analyses, we have identified promising future directions for public health prevention and research.

METHODS

The BRFSS, a state-based cross-sectional survey, is the largest ongoing telephone health survey in the United States. Its objective is to collect uniform, state-specific data from adults regarding preventive health practices and risk behaviors associated with chronic diseases, injuries, and infectious diseases. Data are collected in all 50 states, the District of Columbia, Puerto Rico, the US Virgin Islands, and Guam. The BRFSS methods, design, and data sets can be found at http://www.cdc.gov/brfss. Approximately 430 000 adults aged 18 years and older were interviewed in 2009. We restricted all analyses to 268 120 adults in the 50 states and the District of Columbia aged 50 years and older because of their greater likelihood to report functional limitations.

Independent Variables

Functional limitations. We defined functional limitations according to responses to 2 questions: "Are you limited in any way in any activities because of physical, mental, or emotional problems?" and "Do you now have any health problem that requires you to use special equipment, such as a cane, a wheelchair, a special bed, or a special telephone?" We classified respondents who replied yes to either question as having a functional limitation.[22]

Demographic factors. We included 6 demographic factors in the multivariate models: age group (those aged 50–64 years and those aged≥65 years); gender; race/ethnicity (Hispanic, White non-Hispanic, Black non-Hispanic, other non-Hispanic); education (<high school graduate, high school graduate or have general equivalency diploma, ≥some college education); income (<$25 000, $25 000–$74 999, ≥$75 000); and marital status (currently married; separated, widowed, or divorced; never married or member of an unmarried couple).

Health care access. We assessed the effects of 3 health care access variables: health insurance coverage, regular health care provider, and medical care cost issues. The question for health insurance coverage was "Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs [health maintenance organizations], or government plans such as Medicare?" The question for regular health care provider was "Do you have one person you think of as your personal doctor or health care provider?" Finally, the question for medical care cost issues was "Was there a time in the past 12 months when you needed to see a doctor but could not because of cost?"

Health care utilization. We assessed the effects of 2 health care utilization variables: reporting a routine medical checkup in the past year, and reporting having received an influenza vaccine in the past year. We derived whether an individual had had a routine medical checkup in the past year from the following question: "About how long has it been since you last visited a doctor for a routine checkup?" For individuals who responded that they had a routine checkup in the past 12 months, we coded the variable as yes. We derived whether an individual had had an influenza vaccine in the past 12 months from 2 questions: "During what month and year did you receive your most recent flu shot?" and "During what month and year did you receive your most recent flu vaccine that was sprayed in your nose?" We coded an answer indicating yes to within the past 12 months as yes but otherwise as no.

Modifiable health behaviors. We assessed the effects of 3 potentially modifiable health behaviors on HRQOL: current cigarette smoking, consumption of fruits and vegetables, and leisure-time physical activity. We derived current cigarette smoking from an affirmative response to "Have you smoked at least 100

cigarettes in your entire life?" and an affirmative response of either "every day" or "some days" to the question "Do you now smoke cigarettes every day, some days, or not at all?" The indicator variable for having eaten fruits and vegetables 5 times per day was a BRFSS computed variable we derived from questions regarding consumption of fruits and vegetables. We derived participating in leisure-time physical activity from the question "During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?"

Health-Related Quality of Life

The CDC previously developed 4 core HRQOL measures that have demonstrated content validity, construct validity, criterion validity with the Rand Medical Outcomes Study Short Form–36 health survey, predictive validity, test–retest reliability, and internal consistency.[10,20,25–28] We used 2 of the 4 CDC core HRQOL measures as outcome measures in this study; they represent 2 HRQOL domains: physical health and mental health. Healthy People 2020 will be using these 2 measures over the next decade. The first measure, physically unhealthy days, answers the question "Now thinking about your physical health, which includes physical illness and injuries, for how many days during the past 30 days was your physical health not good?" The second measure, mentally unhealthy days, answers the question "Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?"

Statistical Analysis

To account for the BRFSS complex sample survey design and sampling weights, we used SAS-callable SUDAAN version 10.0 (RTI International, Research Triangle Park, NC). We considered prevalence estimates and means statistically significant if the 95% confidence intervals (CIs) did not overlap. We used multiple regression models to simultaneously estimate the independent effects of demographic factors, health care access, health care utilization, and modifiable health behaviors. We stratified models by functional limitation status. We have reported unstandardized parameter estimates (b) and P values. Given the large sample size for both those with and those without functional limitations, we considered these parameter estimates statistically significant at $P<.01$.

RESULTS

Compared with individuals without functional limitations, those with functional limitations were more likely to be older, female, Black non-Hispanic, less educated, in a household with a lower annual income, and separated, widowed, divorced, or unmarried (Table 1). Those with functional limitations were more likely to have a regular health care provider (93.4%; 95% CI=93.0, 93.8 vs 90.5%; 95% CI=90.1, 90.8, respectively) and report medical care cost issues (15.9%; 95% CI=15.3, 15.8 vs 7.3%; 95% CI=7.0, 7.6, respectively). Those with functional limitations were also more likely to have had a routine medical checkup and influenza immunization in the past year. Finally, those with functional limitations were more likely to be cigarette smokers (18.4%; 95% CI=17.8, 19.0 vs 12.9%; 95% CI=12.5, 13.3) and less likely to eat 5 or more fruits and vegetables each day (24.4%; 95% CI=23.7, 25.0 vs 26.1%; 95% CI=25.7, 26.6) or to have participated in leisure-time physical activity in the last month (57.7%; 95% CI=57.0, 58.4 vs 79.0%; 95% CI=78.5, 79.4).

Those aged 50 years and older with functional limitations reported an average of 9 more physically unhealthy days (11.4; 95% CI=11.2, 11.6 vs 2.1; 95% CI=2.0, 2.2) and 4 more mentally unhealthy days (5.8; 95% CI=5.6, 6.0 vs 1.9; 95% CI=1.8, 2.0) than did those same aged adults without functional limitations. Most of those with and those without functional limitations reported no mentally unhealthy days, and more than 30% of those with functional limitations and 74% of those without functional limitations reported no physically unhealthy days.

Individuals differed significantly on responses to several of the independent variables among those with and those without functional limitations by age group (Table 2). Among those aged 50 to 64 years, the percentage who could not afford medical care was substantial (23.3% vs 9.6% for those with and those without limitations, respectively), but this gap decreased for those aged 65 years and older (6.5% vs 2.9%), likely because of the broader availability of Medicare coverage. Among those aged 50 to 64 years, 25.4% of those with functional limitations were current smokers, whereas 15.3% of those without functional limitations were current smokers; the difference in percentages of current smokers by functional status was smaller for those aged 65 years and older (9.2% vs 7.8%). As expected, those with functional limitations in both age groups were much less likely to report engaging in leisure-time physical activity than were those without functional limitations.

For the HRQOL outcomes, individuals with a functional limitation reported substantially more physically unhealthy days for both age groups than did those without functional limitations (12.1 days vs 1.8 days for those aged 50–64 years, and 10.6 days vs 2.5 days for those aged ≥ 65 years). Interestingly, for individuals with functional limitations, those aged 65 years and older reported 1.5 fewer physically unhealthy days than did those aged 50 to 64 years. For those without functional limitations, the difference was in the opposite direction. The mean number of mentally unhealthy days for both functional status groups was substantially less for those aged 65 years and older (3.6 days for those with functional limitations and 1.3 days for those without functional limitations) relative to those aged 50 to 64 years (7.7 days and 2.2 days, respectively).

In general, the independent associations with physically unhealthy days for those with functional limitations were substantially larger than they were for those without functional limitations (Table 3). Physically unhealthy days decreased with increasing age among those with functional limitations but increased with increasing age among those without functional limitations. Physically unhealthy days decreased with increasing annual household income among those with and those without functional limitations. For the health care access and health care utilization variables, differences in physically unhealthy days were the largest for medical care cost issues: 2.67 and 1.94 more days for those with and those without functional limitations, respectively.

TABLE 1—Descriptive Statistics and Modifiable Health Behaviors of Persons Aged 50 Years and Older With (n = 67 857) and Without (n = 144 805) Functional Limitations: 2009 BRFSS

Variables	Functional Limitation		No Functional Limitation	
	No.	Weighted % (95% CI)	No.	Weighted % (95% CI)
Aged ≥ 65 y	34 725	44.3 (43.6, 45.0)	61 880	34.8 (34.4, 35.3)
Male gender	25 625	45.6 (44.9, 46.4)	58 887	49.6 (49.1, 50.1)
Race/ethnicity				
White non-Hispanic	57 751	79.0 (78.2, 79.7)	124 965	79.3 (78.8, 79.8)
Black non-Hispanic	5390	10.2 (9.7, 10.8)	9378	8.3 (7.9, 8.6)
Hispanic	2395	7.1 (6.5, 7.6)	5546	8.2 (7.7, 8.6)
Other non-Hispanic	2321	3.7 (3.4, 4.1)	4916	4.2 (4.0, 4.6)
Educational level				
< high school graduate	8331	12.6 (12.1, 13.2)	9847	7.7 (7.4, 8.1)
High school graduate or GED	21 610	30.6 (30.0, 31.3)	43 933	28.0 (27.6, 28.5)
≥ some college	37 916	56.8 (56.0, 57.5)	91 025	64.2 (63.7, 64.7)
Annual household income, $				
< 25 000	31 063	40.5 (39.8, 41.3)	33 991	20.0 (19.6, 20.5)
25 000–74 999	27 498	41.4 (40.7, 42.1)	69 821	45.2 (44.7, 45.7)
≥ 75 000	9296	18.1 (17.5, 18.7)	40 993	34.8 (34.3, 35.3)
Marital status				
Currently married	30 873	57.1 (56.4, 57.8)	87 514	71.3 (70.8, 71.7)
Separated, divorced, or widowed	31 401	34.9 (34.2, 35.6)	46 887	22.4 (22.0, 22.8)
Never married or unmarried couple	5583	8.0 (7.6, 8.5)	10 404	6.3 (6.0, 6.6)
Health care access				
Has any health care coverage	63 197	92.2 (91.8, 92.7)	134 883	92.2 (91.8, 92.5)
Has a regular health care provider	63 660	93.4 (93.0, 93.8)	131 838	90.5 (90.1, 90.8)
Medical care cost issues	9584	15.9 (15.3, 16.5)	9182	7.3 (7.0, 7.6)
Health care utilization				
Routine checkup in past y	54 842	81.9 (81.3, 82.4)	111 723	77.8 (77.3, 78.2)
Had flu shot or spray in past y	42 502	60.2 (59.5, 60.9)	78 746	50.9 (50.4, 51.4)
Modifiable health behaviors				
Current cigarette smoker	12 084	18.4 (17.8, 19.0)	18 260	12.9 (12.5, 13.3)
Ate ≥ 5 fruits and vegetables per d	16 399	24.4 (23.7, 25.0)	37 828	26.1 (25.7, 26.6)
Engaged in leisure-time physical activity in last mo	38 497	57.7 (57.0, 58.4)	113 354	79.0 (78.5, 79.4)

Note. BRFSS = Behavioral Risk Factor Surveillance System; CI = confidence interval; GED = general equivalency diploma.

Having health care coverage, having a regular provider, receiving an influenza immunization in the last year, and having a routine medical checkup in the last year were also associated with more physically unhealthy days in both groups, but the relative effects were smaller than those for medical care cost issues. It is possible that those reporting more physically unhealthy days were sicker and, hence, more likely to seek health care coverage, have a regular health care provider, receive an influenza immunization, and receive regular checkups; however, because of the cross-sectional nature of this analysis, the directionality of these relationships cannot be determined. For the modifiable health behaviors among those with functional limitations, physically unhealthy days was higher among current smokers (1.46 more days than nonsmokers) and lower among those who engaged in leisure-time physical activity (5.28 fewer days than sedentary individuals). For those without limitations, leisure-time physical activity was associated with fewer physically unhealthy days.

For mentally unhealthy days, the size of the effects was also substantially larger for those with functional limitations. The largest demographic effects were for age, income, and gender. For those with functional limitations, those aged 65 years and older reported 3.64 fewer mentally unhealthy days than did those aged 50 to 64 years. For those without limitations, this difference was 0.86 days. For the health care utilization and health care access variables, only medical care cost issues was statistically significant for either functional status group. Those with limitations who also reported medical care cost issues had 3.49 more mentally unhealthy days than did those who did not; those without limitations who reported medical care cost issues had 2.68 more days than did those who did not. For modifiable health behaviors, mentally unhealthy days were associated with current smoking (2.35 more days than nonsmokers) and reporting leisure-time physical activity (1.98 fewer days than the sedentary) for those with functional limitations. For those without functional limitations, smoking was associated with more mentally unhealthy days whereas eating fruits and vegetables and leisure-time physical activity were associated with fewer mentally unhealthy days.

DISCUSSION

The Health and Human Services' Healthy People 2020 initiative has identified 4 overarching goals that relate to HRQOL, disability, and aging. Measuring HRQOL can help determine the burden of preventable diseases, injuries, and disabilities and can provide valuable new insights into the relationships between HRQOL and risk factors. We found that those with functional limitations reported more physically and mentally unhealthy days than did those without functional limitations.[29] Also, a substantial proportion of individuals with functional limitations reported no physically or mentally unhealthy days, indicating high levels of HRQOL.[15] There were notable age differences among those with functional limitations: those aged 65 years and older reported fewer physically and mentally unhealthy days than did those aged 50 to 64 years. Although this effect may result from healthy survivor effects, it is also likely related to response shift.[30,31] Response shift occurs when individuals (1) change their internal standards of measurement, (2) reprioritize their values, or (3) redefine their understanding of the construct being assessed. Many

TABLE 2—Descriptive Statistics for Selected Covariates and Outcomes by Age and Functional Limitation for Persons Aged 50 Years and Older: 2009 BRFSS

	Functional Limitation		No Functional Limitation	
	Aged 50–64 Years, Weighted % (95% CI)	Aged ≥ 65 Years, Weighted % (95% CI)	Aged 50–64 Years, Weighted % (95% CI)	Aged ≥ 65 Years, Weighted % (95% CI)
Covariates				
Medical care cost issues	23.3 (22.4, 24.2)	6.5 (6.0, 7.1)	9.6 (9.2, 10.0)	2.9 (2.7, 3.3)
Current smoker	25.4 (24.6, 26.3)	9.2 (8.6, 9.7)	15.3 (14.8, 15.7)	7.8 (7.5, 8.2)
Leisure-time physical activity	59.3 (58.3, 60.3)	54.4 (53.5, 55.3)	80.0 (79.5, 80.6)	75.9 (75.3, 76.5)
HRQOL outcomes				
Physically unhealthy days	12.1 (11.8, 12.3)	10.6 (10.3, 10.8)	1.8 (1.7, 2.0)	2.5 (2.3, 2.6)
Mentally unhealthy days	7.7 (7.5, 8.0)	3.6 (3.5, 3.8)	2.2 (2.1, 2.3)	1.3 (1.2, 1.4)
No physically unhealthy days	30.5 (29.6, 31.4)	38.9 (38.1, 39.8)	74.4 (73.8, 75.0)	75.2 (74.6, 75.8)
No mentally unhealthy days	49.5 (48.5, 50.4)	71.7 (70.9, 72.5)	75.1 (74.5, 75.7)	85.5 (85.0, 86.0)

Note. BRFSS = Behavioral Risk Factor Surveillance System; CI = confidence interval; HRQOL = health-related quality of life.

individuals aged 50 to 64 years develop functional limitations associated with chronic diseases, and as they begin to age, it is likely they start to modify their internal standards, values, or understanding of the construct being asked about, which then affects their reports of perceived health. That is, we suspect that people may increasingly view their health relative to their age (e.g., "For a person my age I'm feeling pretty good"). This may also relate to changing demands in life, with more people in the older category likely having ended their employment and dealing with fewer daily work demands. These results highlight the importance of understanding age-related response shift phenomena among older adults with and without disabilities and should be considered when collecting longitudinal data and designing evaluation studies.

In the multivariate models, we found that medical care cost issues, smoking, and leisure-time physical activity resulted in large significant effects on both physically and mentally unhealthy days among those with functional limitations and that the absolute magnitude of these effects exceeded those of individuals without functional limitations. These results highlight important factors to consider intervening on and the potential benefits of targeting individuals with disabilities for these programs.

In terms of medical care cost issues, 23% of individuals with functional limitations aged 50 to 64 years reported being unable to see a physician because of cost. This is a significant health disparity in which those individuals who are in the greatest need of health care services are also the most likely to report cost issues. Furthermore, the large significant effects of medical care cost issues on both physically and mentally unhealthy days suggests that low-cost medical services (sometimes provided by Medicare and Medicaid) are often unavailable for individuals aged 50 to 64 years and that the resulting lack of affordable health care has significant effects on HRQOL.

To increase leisure-time physical activity among older adults, public health agencies need to continue implementing effective policies and practices that promote physical activity, including decision prompts, community campaigns, social support in community settings, and community deliverable exercise programs.[32–36] The findings from our study also indicate that individuals with disabilities experience poorer HRQOL and are less physically active, suggesting they could potentially reap substantially more benefits of increased physical activity compared with those without disabilities. This finding reinforces public health objectives aimed at increasing levels of physical activity among persons with disabilities and decreasing the gap in physical activity prevalence between those with and those without disabilities.[36,37] Although numerous studies have failed to demonstrate that physical activity prevents or minimizes disabilities,[38] recent studies have focused on how to motivate people with disabilities to engage in community-based physical activity programs; but further research is needed.[39] Future efforts to promote physical activity must consider how people interact with their environment, make adequate accommodations for their specific limitations, and use effective behavioral management and environmental change strategies.[40] In addition, targeted messages toward certain subpopulations such as ethnic minorities should be evaluated.[41] We also recognize that some individuals with functional limitations may not be able to engage in leisure-time physical activity, but there are likely to be a substantial proportion of individuals who can. For example, individuals with arthritis and individuals who are clinically depressed are good candidates for interventions that increase the likelihood of engagement in regular leisure-time physical activity.

Finally, there were large significant effects of smoking on HRQOL for individuals with functional limitations. In addition, we showed that substantially more individuals aged 50 to 64 years with functional limitations report current smoking relative to comparably aged persons without functional limitations. Therefore, targeted smoking cessation programs and tobacco prevention policies should be explored to determine whether these efforts can efficiently reduce these large health disparities.[42,43]

This study has several limitations. First, because BRFSS is a survey derived predominantly from residential telephone owners and includes only noninstitutionalized adults, it may underrepresent those with more severe functional limitations who may have worse HRQOL. BRFSS may also underrepresent low-income individuals and those with cell phones but not landlines. Moreover, given the cross-sectional nature of the BRFSS data, it is difficult to determine causality. We have modeled the relationship between leisure-time physical activity and HRQOL in a unidirectional manner using linear regression models. Several longitudinal studies have supported this interpretation related to the impact of changes in physical activity on HRQOL outcomes,[44–46] but we assume that these relationships are likely to be bidirectional, and causality is difficult to determine without the use of randomized placebo-controlled studies. Furthermore, some associations may have

TABLE 3—Multivariate Regression Models for Physically and Mentally Unhealthy Days by Functional Limitation Status: 2009 BRFSS

Variables	Physically Unhealthy Days Model		Mentally Unhealthy Days Model	
	Functional Limitation, *b* (*P*)	No Functional Limitation, *b* (*P*)	Functional Limitation, *b* (*P*)	No Functional Limitation, *b* (*P*)
Intercept	10.66 (<.001)	1.51 (<.001)	6.94 (<.001)	2.62 (<.001)
Male gender	–0.05*	–0.26 (<.001)	–0.86 (<.001)	–0.70 (<.001)
Race/ethnicity				
White non-Hispanic (Ref)	1.00	1.00	1.00	1.00
Black non-Hispanic	–0.08*	0.27*	–0.19*	–0.13*
Hispanic	0.61*	0.92 (<.001)	0.48*	0.17*
Other	0.70*	0.54 (.018)	0.47*	0.21*
Educational level				
< high school graduate	0.75 (.013)	1.28 (<.001)	0.66 (.014)	0.51 (.002)
High school graduate or GED (Ref)	1.00	1.00	1.00	1.00
≥ some college	–0.99 (<.001)	–0.27 (<.001)	–0.06*	0.01*
Annual household income, $				
< 25 000	2.95 (<.001)	0.94 (<.001)	1.69 (<.001)	0.42 (<.001)
25 000–74 999 (Ref)	1.00	1.00	1.00	1.00
≥ 75 000	–1.78 (<.001)	–0.25 (<.001)	–1.44 (<.001)	–0.25 (<.001)
Marital status				
Currently married (Ref)	1.00	1.00	1.00	1.00
Separated, divorced, or widowed	–0.34*	–0.01*	0.33 (.038)	0.37 (<.001)
Never married or unmarried couple	–0.22*	0.23*	0.22*	0.34 (.006)
Aged ≥ 65 y	–1.87 (<.001)	0.28 (<.001)	–3.64 (<.001)	–0.86 (<.001)
Health care access				
Has any health care coverage	1.04 (.006)	0.31 (.034)	0.00*	–0.23*
Has a regular health care provider	1.20 (.002)	0.46 (<.001)	0.35*	0.11*
Medical care cost issues	2.67 (<.001)	1.94 (<.001)	3.49 (<.001)	2.68 (<.001)
Health care utilization				
Routine checkup in past y	1.00 (<.001)	0.41 (<.001)	0.01*	0.01*
Had flu shot or spray in past y	0.63 (<.001)	0.23 (<.001)	0.20*	0.04*
Modifiable health behaviors				
Current cigarette smoker	1.46 (<.001)	0.08*	2.35 (<.001)	0.81 (<.001)
Ate ≥ 5 fruits and vegetables per d	0.43 (.026)	–0.06*	–0.18*	–0.25 (<.001)
Leisure-time physical activity in last mo	–5.28 (<.001)	–1.11 (<.001)	–1.98 (<.001)	–0.49 (<.001)

Note. BRFSS = Behavioral Risk Factor Surveillance System; GED = general equivalency diploma.
*Not significant.

nonlinear effects, such as age associations for physically and mentally unhealthy days.

Individuals with disabilities represent a considerable proportion of the community, and the results of this study highlight that these individuals may differentially benefit from targeted public health policies, programs, and interventions. According to the results of this study as well as previous studies, there are several options for priority public health action. These include (1) further developing federal, state, and local public health partnerships to explore aspects of HRQOL that can be influenced at both the population level and the individual level for all individuals but particularly those with disabilities and functional limitations (including area agencies on aging, disability commissions, and developmental disability councils), which will require increasing levels of collaboration to efficiently use the limited financial resources that are currently available for these efforts; (2) exploring the financial barriers to health care services, particularly for those with disabilities; (3) assessing longitudinal relationships among disabilities, functional limitations, aging, and HRQOL; and (4) further evaluating promising programs to reduce smoking and increase physical activity among those with and those without functional limitations.

People with disabilities represent a vast proportion of individuals in the population who public health is intended to benefit. They experience a number of health-related problems that are potentially amenable to public health interventions. Further, people with disabilities are a highly disadvantaged group that are often subject to negative social environments and may have limited access to social support; as such, they should be a priority population for public health efforts. Furthermore, because of the potential for growing financial costs associated with the projected increase in burdens, identifying means to improve the health of aging populations may prove to be a cost-effective solution as well as a meaningful step in improving the quality of life for older adults. ■

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Contributors

W.W. Thompson and M.M. Zack designed the study. M.M. Zack analyzed the data. J.P. Barile helped with the statistical interpretation of the study. G.L. Krahn and E.M. Andresen provided content expertise on disability and health-related quality of life. All authors assisted in interpreting the results and writing the article.

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Human Participant Protection

This study was a secondary analysis of anonymous, publically available data, and institutional review board approval was not required.

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