Gender Differences in Multiple Underlying Dimensions of Health-related Quality of Life Are Associated with Sociodemographic and Socioeconomic Status

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Purpose: The purpose of the study was to examine whether gender differences in summary health-related quality of life (HRQoL) are due to differences in specific dimensions of health, and whether they are explained by sociodemographic and socioeconomic (SES) variation.

Methods: The National Health Measurement Study collected cross-sectional data on a national sample of 3648 black and white noninstitutionalized adults ages 35 to 89 years. Data included the Short Form 36-Item survey, which yielded separate Mental and Physical Component Summary scores (MCS and PCS, respectively), and five HRQoL indexes: Short Form 6 dimension, EuroQol 5 dimension, the Health Utilities Indexes Mark 2 and 3, and the Quality of Well-Being Scale Self-Administered form. Structural equation models were used to explore gender differences in physical, psychosocial, and pain latent dimensions of the 5 indexes, adjusting for sociodemographic and SES indicators. Observed MCS and PCS scores were examined in regression models to judge robustness of latent results.

Results: Men had better estimated physical and psychosocial health and less pain than women with similar trends on the MCS and PCS scores. Adjustments for marital status or income reduced gender differences more than did other indicators. Adjusting results for partial factorial invariance of HRQoL attributes supported the presence of gender differentials, but also indicated that these differences are impacted by dimensions being related to some HRQoL attributes differently by gender.

Conclusions: Men have better estimated health on 3 latent dimensions of HRQoL—physical, psychosocial, and pain—comparable to gender differences on the observed MCS and PCS scores. Gender differences are partly explained by sociodemographic and SES factors, highlighting the role of socioeconomic inequalities in perpetuating gender differences in health outcomes across multiple domains. These results also emphasize the importance of accounting for measurement invariance for meaningful comparison of group differences in estimated means of self-reported measures of health.

Key Words: gender differences, health-related quality of life, patient-reported outcomes, structural equation modeling, health dimensions, EQ-5D, HUI2, HUI3, SF-6D, QWB-SA

(*Med Care* 2011;49: 1021–1030)

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The authors declare no conflict of interest.

Dasha Cherepanov was supported by a grant (P01-AG020679) to the University of Wisconsin, Madison, from the National Institute on Aging and a grant (T32 HS000046) to University of California, Los Angeles, and RAND Corporation, Santa Monica, from the Agency for Healthcare Research and Quality. Ron D. Hays was supported in part by the UCLA Resource Center for Minority Aging Research/Center for Health Improvement in Minority Elderly (RCMAR/CHIME), NIH/NIA Grant Award Number P30AG021684, the UCLA/Drew Project EXPORT, NCMHD, 2P20MD000182, and the UCLA Older Americans Independence Center, NIH/NIA Grant P30-AG028748.

Presented at the 16th Annual NRSA Trainees Research Conference (June 26, 2010), Boston, Massachusetts.

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Supplemental Digital Content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site, www.lww-medicalcare.com.

ISSN: 0025-7079/11/4911-1021

Gender differences are well documented for multiple health-related outcomes, such as disease prevalence, mortality, health behaviors, and care utilization.[1–4] These differences are not all in the same direction, as women tend to self-report worse health and utilize more health care services, but live longer than men. The increasing life expectancy for both men and women with a narrowing gender gap across the past 30 years[5] highlights the importance of measuring and optimizing health-related quality of life (HRQoL) for both genders in the United States.

Preference-based measures of HRQoL collect self-reports of function and well-being on multiple health-related attributes and combine these by using preference weighted algorithms into a single summary score anchored by 0 (dead) and 1 (full health). These summary measures of overall health are increasingly used to examine the outcomes of clinical trials and interventions, to study population trends in health and health disparities, and to assess the cost-effectiveness of new medical technologies. Five commonly used indexes of HRQoL in the United States include the Short Form 6 dimension (SF-6D),[6] EuroQol 5 dimension (EQ-5D),[7] the Health Utilities Index Mark 2 (HUI2)[8] and Mark 3 (HUI3),[9] and the Quality of Well-Being Scale Self-Administered form (QWB-SA).[10] Earlier research indicates that women have worse self-reported HRQoL across all 5 of these indexes, and that small gender differences remain across most of these indexes after sociodemographic and socioeconomic (SES) variation between men and women is taken into account.[11] It is unknown whether gender differences in HRQoL are driven by specific underlying dimensions of health or whether gender differences exist across all underlying health dimensions.

Physical and mental health have been identified as underlying domains of generic health measures,[12] and the Short Form 36-Item survey (SF-36v2) yields separate Mental Component Summary (MCS) and Physical Component Summary (PCS) scores.[13] Factor analysis has suggested that the 5 HRQoL indexes share 3 underlying health dimensions: physical, psychosocial, and pain.[14] Determining whether gender differences are limited to or stronger in certain dimensions will generate understanding of the source of gender disparities on the overall aggregate summary level of HRQoL.

This study is the third in a sequence of studies using the National Health Measurement Study (NHMS) data to examine gender differences in HRQoL. The first[11] identified gender differences measured by the 5 HRQoL indexes. The second[14] decomposed those indexes into latent attributes of health common to the 5 measures. This study asks whether summary HRQoL gender differences stem from differences in one or more of the underlying latent dimensions of health. We first examine whether there are gender differences in how the attributes capture the latent dimensions, and then test the hypothesis: women report lower health on underlying physical, psychosocial, and pain dimensions. The existence of SES disparities in HRQoL[15] and the importance of sociodemographic and SES factors in explaining gender differences in summary measures of HRQoL[11] lead us to test a second hypothesis: differences in sociodemographic and SES characteristics partly explain gender differences in the underlying dimensions. Finally, we conduct a parallel analysis of the widely used mental and physical components—SF-36v2 MCS and PCS—to judge robustness of gender differences detected in the latent dimensions.

METHODS

Data and Subjects

Data are from the NHMS,[16] a national cross-sectional random-digit-dial telephone survey of 3,844 noninstitutionalized adults, ages 35 to 89 years, residing in the continental United States. Data were collected between June 2005 and August 2006. Four HRQoL questionnaires, the EQ-5D, the SF-36v2, the HUI2/3, and the QWB-SA, were administered in random order to all respondents through a computer-adaptive telephone interview and used to estimate the 5 utility index scores: SF-6D,[6] EQ-5D,[7] HUI2[8] and HUI3,[9] and QWB-SA.[10] The SF-36v2 questionnaire was also used to compute the MCS and PCS scores, summarizing vitality, social functioning, role limitations due to emotional problems, mental health, physical functioning, role limitations due to physical health problems, bodily pain, and general health scales.[13] Survey weights were constructed based on the NHMS sampling design and poststratified by gender, race, and age. This analysis includes respondents who reported their race/ethnicity as either white or African American/black, resulting in a sample size of 3648.

Measures

Each of the 5 HRQoL indexes—SF-6D, EQ-5D, HUI2, HUI3, and QWB-SA—produces a summary score based on combining its respective attributes by methods and models specific to the index. Item responses on each HRQoL instrument are used to form attributes. Attributes are health scales focused on a single aspect of health and function (e.g., physical functioning, anxiety/depression) with discrete levels, where each level is defined by a descriptor of the subject's level of impairment or assessment of their health or well-being. Combination of discrete attribute values defines health states, which include 1 level from each attribute covered by the index. For the SF-6D, QWB-SA, HUI2 and HUI3, attribute values were individually preference scored, hence the standard scoring systems for these measures lead to an ordering of the attribute levels. Preference scoring for EQ-5D was done at the overall health state level.

For these analyses, the following attributes were used: 6 health attributes from SF-6D (with 2 to 5 levels per attribute), estimated from 11 of 36 questions on SF-36v2; 5 attributes from EQ-5D (3 levels each); 4 attributes from QWB-SA (3 to 10 levels); and 1 and 8 attributes from HUI2 and HUI3 (4 to 6 levels), respectively. Distinct preference scores on each of these attributes were converted to ordinal values for modeling to allow the levels on each attribute to be estimated freely (nonequidistant levels). The 5 ordinal attributes represented by single items on EQ-5D were used. As a final step in preparing the data, all ordinal attribute variables were recoded such that higher levels indicate better estimated health. HUI2 and HUI3 indexes are scored from the same questionnaire and result in collinear attributes. Hence, only the self-care attribute was included from the HUI2. A detailed description of these data are published elsewhere.[11,14,16]

Covariates

The covariates—gender, age, race, marital status, education and income—were coded as follows:

- Gender: 1 = "men", 0 = "women"
- Age: "35 to 44" (reference category), "45 to 54," "55 to 64," "65 to 74," and "75 to 89" years
- Race/ethnicity: 1 = "white," 0 = "African American/black"
- Marital status: "widowed/divorced/separated," "never married," "married/living with a partner" (reference category)
- Education: "less than high school," "high school graduate," "some postsecondary education," and "a college degree or higher" (reference category)

- Household income over the previous year: "less than \$20,000," "\$20,000 to \$34,999," "\$35,000 to \$74,999," and "\$75,000 or more" (reference category)

Analyses

Cross-loading[17,18] confirmatory factor analysis (CFA) models of the 24 HRQoL attributes (Table 2) were first fit based on the previously published factor structure,[14] separately among men (n = 1549), women (n = 2099) and both (n = 3648). To explore whether meaningful comparisons of estimated group factor means can be made, we conducted an analysis of factorial invariance (loadings and thresholds) by gender.[19,20] This was done by the χ^2 test for difference[19] of nested multiple-group CFA (MGA) models to judge whether imposed model restrictions significantly worsened the model fit in 2 ways: (1) a model with all parameters set equal across gender compared with models with loadings and thresholds of 1 attribute at-a-time set free across gender; (2) a model with all attribute parameters set free across gender compared with models with loadings and thresholds of 1 attribute at-a-time set equal across gender.

The gender differences in the underlying dimensions adjusted for sociodemographic and SES variation were modeled using the full sample in the structural equation modeling[21] (SEM) framework using the above-described cross-loading factor structure. Five SEM models were fit by simultaneously regressing the 3 hypothesized latent dimensions on age, gender, and race (model 1) followed by one-at-a-time adjustment for the sociodemographic and SES variables: marital status (model 2), education (model 3), and income (model 4). A final model was fit with all covariates in the model simultaneously (model 5). Subsequently, the 5 models were refit using multiple group SEM (MG-SEM), which allowed attributes with significantly different item parameters (loadings and thresholds) across gender (detected in MGA) to be freely estimated while constraining all other model parameters to equality across gender. In MG-SEM, group differences in latent dimensions are captured by latent factor intercepts, hence all covariates were centered to either weighted sample (for age and race/ethnicity as the data are poststratified to Census 2000) or Census 2000 (marital status, education, income) proportions. Thus, the MG-SEM estimated gender differences in latent dimensions are adjusted for partial factorial invariance.

For sensitivity analysis, we examined whether additional direct regression paths from covariates to HRQoL attributes should be included in the SEM models. Modification indices indicate whether freeing additional regression paths within an SEM model will statistically significantly or meaningfully improve the model fit in terms of χ^2 with 1 degree of freedom and expected parameter change.[21]

The CFA and SEM models were estimated using δ parameterization and mean-adjusted weighted least squares robust estimation designed for modeling ordinal data while using survey weights.[21–26] All factor loadings and threshold parameters were allowed to be estimated while factor variances and means were fixed, respectively, at 1 and 0.[21]

The model fit of the CFA and SEM models was evaluated by commonly used goodness-of-fit statistics: Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA).[21] TLI and CFI values of >0.95 and RMSEA of <0.06 indicate a relatively good fit between the hypothesized model and the observed data.[27] In addition, differences in CFI (ΔCFI) have been reported relative to a cut-off value of ΔCFI = 0.002, in investigations of measurement invariance, since χ^2 tests are sensitive to sample size and may detect trivial differences in the properties of a measure across groups.[28]

To evaluate robustness of the latent results, we fit the 5 covariate-adjusted models in the weighted-least squares (WLS) regression framework using the observed MCS and PCS scores as outcome variables. As in the SEM analyses, all covariates were modeled as indicator variables and survey weights were used to account for the NHMS survey design.

Descriptive statistics and WLS models were estimated by the SAS/STAT System for Windows version 9.1 (copyright 2002-2003 SAS Institute Inc.). The latent model analyses were performed by M*plus* Version 5.2.[19]

RESULTS

Respondent Characteristics

There were more women than men both in the sample and underlying population (54%), whereas the 10-year age group and race/ethnicity proportions were similar by gender (Table 1). As in the US census, more women (24% vs. 13%) were widowed, divorced, or separated and more men (81% vs. 69%) were married or living with a partner. Fewer women than men had a college degree or higher (38% vs. 45%), and a greater proportion of women (29% vs. 23%) were in 1 of the 2 lower income categories (<\$20,000; \$20,000 to \$34,999).

These weighted proportions of sample characteristics were previously compared with other national surveys, reflecting similarly and well the corresponding US Census 2000 target population by gender, age, race, and marital status.[11] The NHMS had a greater proportion of highest levels of income and education than the general US population. However, all surveys showed more women than men being unmarried/not living with a partner and in the lowest income categories and fewer women with a college degree or higher.

CFA Model Results

Table 2 shows the loadings for the hypothesized CFA model, fit by gender and for the full sample, of HRQoL attributes that jointly share the physical, psychosocial, and pain latent dimensions. The CFA loadings and model fit statistics indicating good model fit (CFI, TLI > 0.95, RMSEA < 0.06) were similar for men and women.

MGA analyses of factorial invariance (not shown) revealed that 12 attributes have statistically significantly ($P < 0.05$) different loadings and thresholds across gender—SF-6D physical functioning, social functioning, vitality, role limitation; QWB-SA self-care/usual activities, physical activity, acute/chronic symptoms; HUI2 self-care; HUI3 ambulation, hearing, vision, dexterity—with most of these cross-loading across the dimensions. Partial factorial invariance of HRQoL attributes across gender indicates that group

TABLE 1. Sample Characteristics Among Black and White Adults in the National Health Measurement Study

	Women (N = 2099)		Men (N = 1549)		Full Sample (N = 3648)	
	Unweighted No.	Weighted %	Unweighted No.	Weighted %	Unweighted No.	Weighted %
N = 3648 (*P* = 0.01)*	2099	53.5	1549	46.5	3648	100
Age group (*P* = 0.10)*						
35–44	342	32.6	249	28.7	591	30.8
45–54	456	24.8	323	22.4	779	23.7
55–64	357	20.0	307	21.1	664	20.5
65–74	513	13.2	407	15.8	920	14.4
74–89	431	9.4	263	12.0	694	10.6
Total	2099		1549		3648	
Race/ethnicity (*P* = 0.09)*						
Black	705	12.5	381	10.3	1086	11.4
White	1394	87.5	1168	89.7	2562	88.6
Total	2099		1549		3648	
Marital status (*P* < 0.0001)*						
Widowed/divorced/separated	1091	23.9	328	12.8	1419	18.8
Never married or single	225	7.3	137	6.5	362	6.9
Married/living with a partner	782	68.7	1082	80.7	1864	74.3
Total	2098		1547		3645	
Education (*P* = 0.02)*						
Less than high school	282	8.8	142	6.8	424	7.9
High school graduate	671	28.9	444	28.7	1115	28.8
Some post-HS education	497	24.7	316	19.4	813	22.2
College degree or higher	641	37.6	635	45.1	1276	41.1
Total	2091		1537		3628	
Household income (*P* = 0.07)*						
<$20,000	525	12.7	215	9.2	740	11.0
$20,000–$34,999	406	16.1	252	14.0	658	15.1
$35,000–$74,1000	562	34.3	563	39.1	1125	36.6
≥ $75,000	384	36.9	438	37.7	822	37.3
Total	1877		1468		3345	
	Weighted Mean	Standard Error	Weighted Mean	Standard Error	Weighted Mean	Standard Error
SF-36v2 MCS score (*P* = 0.01)*	53.4	0.3	54.6	0.3	54.0	0.2
SF-36v2 PCS score (*P* = 0.14)*	49.0	0.4	49.7	0.3	49.3	0.3

**P* value for difference between men and women; SF-36v2 MCS and PCS estimates are based on a sample size of 3634.

differences in estimated factor means may be affected (and possibly inflated) by differences in interpreting certain items and their levels.[20] However, the ΔCFI of ≤0.002 for all χ^2 difference tests indicated that subtle differences in model fit were detected.

SEM and WLS Model Results

SEM models were fit in the full sample because at least partial factorial invariance was met and small ΔCFI values indicated possibly subtle differences in model fit.[20,28] The latent gender effects from the SEM models are summarized in Table 3 and plotted in Figure 1.

The SEM models 1 to 5 fit the data well (CFI, TLI >0.95, RMSEA <0.06). Gender differences on latent dimensions were positive, indicating that on average men have better estimated latent physical and psychosocial health and less latent pain than women across models. The trends in gender differences across adjustment models were similar for the 3 dimensions, although the magnitude of differences was larger on physical and psychosocial dimensions than on the pain dimension. On average, men were 0.18 standard deviation units healthier than women on the physical dimension, 0.18 standard deviation units healthier on the psychosocial dimension and 0.12 standard deviation units healthier on the pain dimension, adjusted for age and race (Table 3, Fig. 1). Gender differences decreased across all dimensions of HRQoL when adjusted separately for marital status, education, income, and all covariates simultaneously. On the physical and psychosocial dimensions, gender differences were statistically significant ($P<0.05$) despite adjustment, except for a weakly significant ($P<0.08$) result in the simultaneously adjusted model 5 on the psychosocial dimension. Gender differences on the pain dimension were only statistically significant in model 1 ($P<0.05$; age and race). Partial factorial invariance adjusted MG-SEM results (Fig. 1; Table 2, Appendix, Supplemental Digital Content 1, http://links.lww.com/MLR/A237) show the presence of reduced gender differences on all 3 latent dimensions with comparable covariate-adjusted trajectory of change to the SEM results described above. Similar findings for gender differences emerged using the observed SF-36v2 PCS and MCS scores, although as in MG-SEM results were rarely significant (Table 4; Table 2, Appendix, Supplemental Digital Content 1, http://links.lww.com/MLR/A237).

Figure 1 shows the small but consistently positive gender differences (favoring men) with similar trends when

TABLE 2. CFA Results for the 3 Factor Model for Full Sample and by Gender Among Black and White Adults in the National Health Measurement Study

	Women (N = 2099)			Men (N = 1549)			Full Sample (N = 3648)		
	Pattern Matrix*			Pattern Matrix†			Pattern Matrix‡		
Factor Name	**Physical**	**Psychosocial**	**Pain**	**Physical**	**Psychosocial**	**Pain**	**Physical**	**Psychosocial**	**Pain**
SF-6D physical functioning	0.86			0.80			0.83		
EQ-5D mobility	0.70		0.21	0.75		0.17	0.69		0.22
HUI3 ambulation	0.90			0.92			0.91		
QWB-SA physical activity	0.63		0.30	0.87		0.04	0.74		0.19
QWB-SA self-care/Mobility	0.74			0.71			0.73		
SF-6D mental health		0.76			0.71			0.74	
EQ-5D anxiety/depression		0.82			0.78			0.81	
HUI3 emotion		0.79			0.75			0.77	
HUI3 cognition		0.63			0.56			0.60	
SF-6D bodily pain			0.88			0.89			0.89
EQ-5D pain/discomfort			0.85			0.87			0.86
HUI3 Pain			0.85			0.88			0.86
EQ-5D self-care	0.80	0.17		0.72	0.24		0.69	0.27	
EQ-5D usual activities	0.61		0.34	0.64		0.32	0.62		0.34
HUI2 self-care		0.16	0.80		0.54	0.51		0.31	0.68
QWB-SA self-care/usual activities	0.52	0.30	0.13	0.55	0.33	0.08	0.56	0.33	0.08
SF-6D role limitation	0.76	0.19		0.61	0.26		0.69	0.22	
SF-6D social functioning	0.40	0.50		0.26	0.52		0.34	0.52	
SF-6D vitality		0.70			0.80			0.73	
HUI3 hearing	0.23			0.28			0.24		
HUI3 speech		0.61			0.40			0.50	
HUI3 vision	0.40			0.31			0.36		
HUI3 dexterity		0.25	0.40		0.09	0.48		0.22	0.40
QWB-SA acute/chronic symptoms	0.34	0.43		0.51	0.19		0.42	0.33	

*CFI = 0.987, TLI = 0.991, RMSEA = 0.033.
†CFI = 0.973, TLI = 0.987, RMSEA = 0.043.
‡CFI = 0.982, TLI = 0.991, RMSEA = 0.033; CFI, TLI values >0.95 and RMSEA <0.06 indicate good model fit.
CFI indicates Comparative Fit Index; EQ-5D, EuroQol 5 dimension; HUI2, Health Utilities Index Mark 2; HUI3, Health Utilities Index Mark 3; QWB-SA, Quality of Well-Being Scale Self-Administered form; RMSEA, Root Mean Square Error of Approximation; SF-6D, Short Form 6 dimension; TLI, Tucker-Lewis Index.

adjusted for covariates across latent (physical, psychosocial, pain) and observed (PCS, MCS) variables.

Sensitivity analysis revealed 9 significant direct paths for certain covariates (race, gender, age dummies) in the SEM models but no significant results in the MG-SEM models. However, modification indices were small ($\chi^2 < 25$) and inclusion of these direct paths in SEM models did not change estimated gender differences, indicating that freeing these paths may unnecessarily complicate the models. Hence, these direct paths were not included in the final SEM models.

DISCUSSION

We found that previously described gender differences in overall HRQoL are not driven by women's disadvantage in only 1 or 2 underlying dimensions of health. Our results show gender differences on all three dimensions underlying the attributes of the 5 commonly used HRQoL indexes—SF-6D, EQ-5D, HUI2, HUI3, and QWB-SA. Gender differences, although small, persistently indicate lower estimated health among women than men on physical, psychosocial, and pain dimensions and on MCS and PCS scores of the SF-36v2. Overall, the aggregate gender differences previously found in HRQoL[11] result about equally from all 3 underlying dimensions (physical, psychosocial, and pain).

The magnitude of gender differences with and without adjustment for sociodemographic and SES factors varies by latent dimension, with the smallest differences found on pain and the largest on the physical and psychosocial dimensions. Differences are reduced by adjustment for sociodemographic and SES factors. Gender-related variation in income and marital status explain more of the differentials than do age, race, and education and the differentials change in parallel for all 3 dimensions with adjustment (Fig. 1). The pattern in estimates in the physical and psychosocial dimensions also parallels that of SF-36v2 and SF-12v2 (not shown) PCS and MCS scores. The importance of marital status and income in HRQoL[11,15] have been previously documented, and gender differentials in these characteristics exist in the US population. A 2005 Census report[29] documented more men than women have at least a Bachelor's degree and men have higher median earnings than women by race and Hispanic origin. Median income of families maintained by women with no husband present was lower than that of other type of families, and in general, women aged 18 years and older were more likely than their male counterparts to live in poverty. Hence, our results reinforce veridical impact of women's social and economic disadvantage on their well-being and health. However, socioeconomic status is difficult to fully capture, as it is defined by multiple factors, and typically just a few indicators are collected in population

TABLE 3. Structural Equation Model Results of Gender Differences in Latent Health-related Quality of Life Dimensions Among Black and White Adults in the National Health Measurement Study

Dimension	Latent Physical					Latent Psychosocial					Latent Pain				
Covariate	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
(Reference Group)	STD Estimate (Standard Error)					STD Estimate (Standard Error)					STD Estimate (Standard Error)				
Gender (women)	0.18*	0.14*	0.15*	0.12*	0.12*	0.18*	0.13*	0.16*	0.13*	0.12†	0.12*	0.09	0.10	0.07	0.07
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)
Age (y)															
(35–44)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
45–54	−0.34*	−0.35*	−0.32*	−0.37*	−0.36*	0.06	0.07	0.08	0.06	0.07	−0.16†	−0.16†	−0.13	−0.17†	−0.15
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
55–64	−0.70*	−0.67*	−0.67*	−0.65*	−0.66*	0.03	0.09	0.05	0.11	0.13	−0.47*	−0.45*	−0.45*	−0.44*	−0.44*
	(0.08)	(0.09)	(0.09)	(0.09)	(0.09)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.08)	(0.08)	(0.08)	(0.08)	(0.09)
65–74	−0.77*	−0.72*	−0.68*	−0.58*	−0.58*	0.16†	0.25*	0.25*	0.39*	0.41*	−0.25*	−0.22*	−0.18*	−0.09	−0.08
	(0.08)	(0.08)	(0.08)	(0.08)	(0.09)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
74–89	−1.09*	−1.00*	−1.00*	−0.79*	−0.80*	0.02	0.15	0.09	0.36*	0.37*	−0.36*	−0.29*	−0.29*	−0.16	−0.15
	(0.09)	(0.09)	(0.08)	(0.09)	(0.09)	(0.07)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.09)	(0.09)
Race/ethnicity	0.39*	0.30*	0.30*	0.11	0.11	0.27*	0.16*	0.18*	0.00	−0.03	0.24*	0.17*	0.18*	0.04	0.02
(Black)	(0.06)	(0.06)	(0.06)	(0.07)	(0.07)	(0.05)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.07)	(0.07)
Marital status															
Widowed/ divorced/ separated		−0.30*			0.03		−0.41*			−0.11		−0.21*			0.03
		(0.06)			(0.06)		(0.05)			(0.06)		(0.06)			(0.06)
Never married/single		−0.29*			−0.01		−0.42*			−0.18		−0.35*			−0.14
		(0.11)			(0.11)		(0.08)			(0.09)		(0.10)			(0.10)
(Married/living with a partner)		—			—		—			—		—			—
Education															
Less than high school			−0.79*		−0.22*			−0.86*		−0.32*			−0.55*		−0.12
			(0.08)		(0.10)			(0.09)		(0.10)			(0.10)		(0.11)
High school graduate			−0.33*		−0.07			−0.24*		−0.01			−0.25*		−0.06
			(0.06)		(0.07)			(0.06)		(0.07)			(0.06)		(0.07)
Some post-high school			−0.38*		−0.21*			−0.22*		−0.08			−0.31*		−0.18*
			(0.07)		(0.07)			(0.06)		(0.06)			(0.07)		(0.07)
(College degree or higher)			—		—			—		—			—		—
Income															
<$20,000				−1.13*	−1.06*				−1.08*	−0.92*				−0.83*	−0.79*
				(0.09)	(0.10)				(0.08)	(0.10)				(0.09)	(0.10)
$20,000–$34,999				−0.52*	−0.46*				−0.62*	−0.52*				−0.36*	−0.32*
				(0.08)	(0.09)				(0.07)	(0.08)				(0.08)	(0.09)
$35,000–$74,1000				−0.23*	−0.19*				−0.13†	−0.11				−0.22*	−0.19*
				(0.07)	(0.07)				(0.06)	(0.06)				(0.07)	(0.07)
(≥ $75,000)				—	—				—	—				—	—

*$P \leq 0.05$; †$P \leq 0.08$.

Model fit: CFI = 0.965, TLI = 0.983, RMSEA = 0.036 (model 1); CFI = 0.966, TLI = 0.982, RMSEA = 0.035 (model 2); CFI = 0.965, TLI = 0.981, RMSEA = 0.034 (model 3); CFI = 0.961, TLI = 0.978, RMSEA = 0.034 (model 4); CFI = 0.966, TLI = 0.977, RMSEA = 0.031 (model 5); Note: CFI, TLI values > 0.95, and RMSEA < 0.06 indicate good model fit. Analytical sample size: 3648 (model 1), 3645 (model 2), 3628 (model 3), 3345 (model 4), and 3326 (model 5).

CFI indicates Comparative Fit Index; RMSEA, Root Mean Square Error of Approximation; TLI, Tucker-Lewis Index.

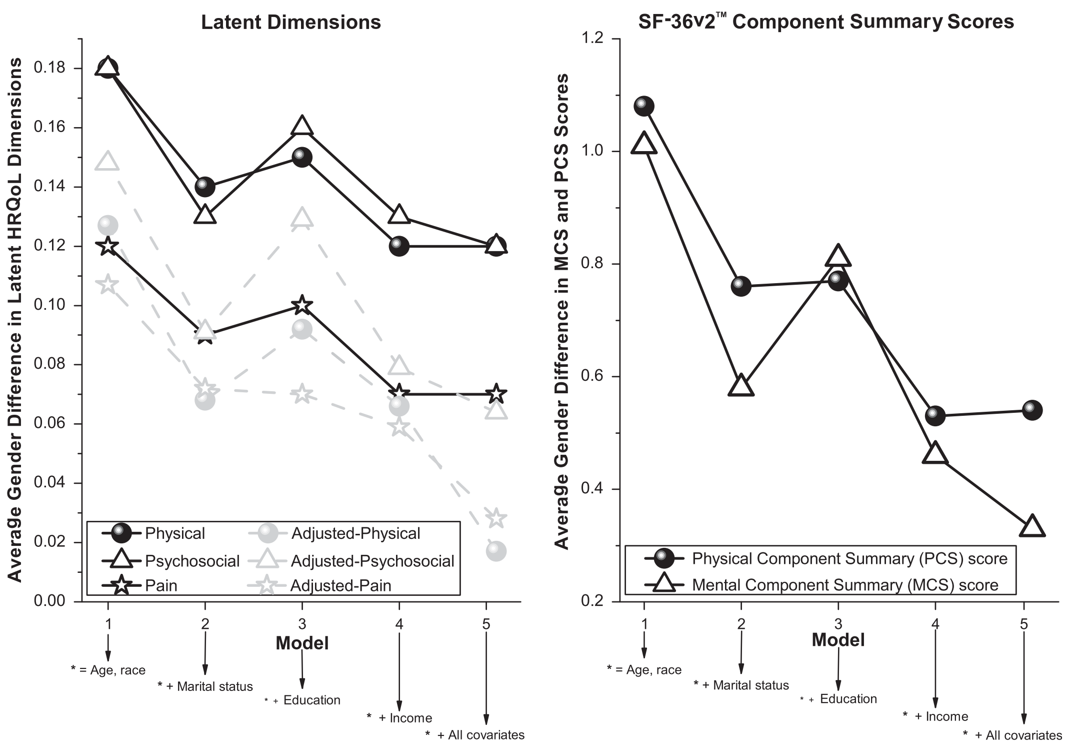

FIGURE 1. Estimated Gender differences in 3 latent dimensions of health-related quality of life (HRQoL) attributes and Short Form 36-Item survey (SF-36v2) mental and physical component summary scores by adjustment model with women as the reference group. Adjusted-dimension results account for partial factorial invariance of HRQoL attributes.

studies.[30,31] Better measures of social and economic factors, capturing change over the life course, may have resulted in stronger effect of adjustment on gender differences.

Analyses adjusting for partial factorial invariance of HRQoL attributes supported the presence of gender differences on all three latent dimensions, but also indicated that gender differences are impacted by latent dimensions being related to some HRQoL attributes in a different way for men and women. These results stress the importance of examining and accounting for measurement invariance (eg differential item functioning) for meaningful comparison of group means of self-reported measures of health.

The relatively smaller gender difference found on the pain dimension, than on physical and psychosocial dimensions, may be partly due to the close association of the pain and physical dimensions. This may have led the physical dimension to account for most of the observed gender difference in the simultaneously modeled underlying factor structure of HRQoL attributes.[14] Indeed, constructs of physical function and pain have been combined into common attributes by others.[10] For example, some generic indexes of self-reported HRQoL and health status, such as the QWB-SA, summarize questions pertaining to physical health and pain into other attributes (e.g., QWB-SA acute and chronic symptoms).[10]

HRQoL indexes are meant to summarize the common impact of diverse health conditions. Hence, our results do not necessarily imply that specific differences in disease occurrence between men and women are responsible for the observed gender differential or directly associated with sociodemographic and SES differences. However, gender differences found on the latent dimensions are consistent with other studies on women's health.[1,30–34] Women experience lower physical functioning and more pain, possibly because they experience higher prevalence of chronic disabling autoimmune and rheumatologic disorders,[1,35–37] anemia, thyroid conditions, urinary tract infections, gallbladder conditions, migraines, and eczema.[1,35–39] Women are more commonly affected with depressive and anxiety disorders than men[1,32] and this may explain our finding that women had lower scores on the underlying psychosocial dimension. Although men are more often affected with other mental health problems, such as antisocial behavior, substance abuse and suicide,[1,3] these aspects of health are not well captured by attributes loading on the psychosocial dimension. In addition, women may have a lower threshold and tolerance for pain, seek treatment for pain more often than men, and give higher pain ratings in experimentally administered stimuli.[38,39]

This study has some limitations. We examined gender differences in 3 dimensions jointly defined by attributes of the 5 HRQoL indexes: EQ-5D, SF-6D, HUI2, HUI3 and QWB-SA. Although these indexes are commonly used in the United States, it has been suggested that other important dimensions of health may exist. For example, the World Health Organization measure of HRQoL, WHOQOL-BREF,[40,41] defines attributes of social relationships and environment. In addition, subsequent research on gender and

TABLE 4. WLS Regression Results of Gender Differences in Observed SF-36v2 PCS and MCS Among Black and White Adults in National Health Measurement Study

Health Status	SF-36v2 PCS					SF-36v2 MCS				
	1	2	3	4	5	1	2	3	4	5
Covariate (Reference Group)	Estimate (Standard Error)					Estimate (Standard Error)				
Intercept	49.39* (0.74)	50.53* (0.85)	52.02* (0.77)	54.13* (0.81)	54.46* (0.84)	50.04* (0.72)	51.79* (0.75)	51.68* (0.74)	53.06* (0.76)	53.64* (0.81)
Gender (women)	1.08* (0.47)	0.76 (0.49)	0.77 (0.46)	0.53 (0.46)	0.54 (0.47)	1.01* (0.42)	0.58 (0.42)	0.81† (0.43)	0.46 (0.43)	0.33 (0.43)
Age (y)										
35–44	—	—	—	—	—	—	—	—	—	—
45–54	−1.47* (0.61)	−1.42* (0.60)	−1.23* (0.62)	−1.53* (0.59)	−1.47* (0.59)	0.14 (0.62)	0.25 (0.60)	0.23 (0.61)	0.15 (0.59)	0.23 (0.59)
55–64	−5.28* (0.77)	−5.01* (0.78)	−5.04* (0.76)	−4.74* (0.74)	−4.80* (0.74)	0.44 (0.67)	0.86 (0.63)	0.58 (0.66)	1.03 (0.66)	1.14† (0.64)
65–74	−6.14* (0.69)	−5.73* (0.69)	−5.35* (0.70)	−4.22* (0.73)	−4.22* (0.74)	2.30* (0.56)	2.88* (0.56)	2.87* (0.57)	3.82* (0.65)	3.93* (0.63)
74–89	−8.41* (0.78)	−7.71* (0.83)	−7.63* (0.79)	−5.66* (0.90)	−5.79* (0.91)	1.15† (0.66)	2.17* (0.66)	1.76* (0.67)	3.51* (0.78)	3.73* (0.74)
Race/ethnicity										
(Black)	2.96* (0.65)	2.32* (0.70)	2.25* (0.64)	0.40 (0.69)	0.52 (0.71)	3.24* (0.65)	2.19* (0.68)	2.62* (0.64)	1.25† (0.68)	0.88 (0.70)
Marital status										
Widowed/divorced/separated		−2.41* (0.62)			0.77 (0.66)		−3.35* (0.54)			−1.25* (0.62)
Never married/single		−2.29† (1.24)			0.30 (1.10)		−4.33* (1.21)			−2.59* (1.08)
(Married/living with a partner)		—			—		—			—
Education										
Less than high school			−7.81* (1.15)		−2.60* (1.23)			−6.82* (1.01)		−2.62* (1.18)
High school graduate			−3.14* (0.54)		−1.05† (0.56)			−1.37* (0.48)		−0.02 (0.50)
Some post-high school education			−2.81* (0.64)		−1.44* (0.64)			−1.16† (0.61)		−0.42 (0.57)
(College degree or higher)			—		—			—		—
Income										
<\$20,000				−11.18* (1.02)	−10.52* (1.16)				−8.09* (1.08)	−6.50* (1.21)
\$20,000–\$34,999				−4.84* (0.81)	−4.34* (0.88)				−4.10* (0.75)	−3.16* (0.81)
\$35,000–\$74,1000				−2.41* (0.50)	−2.11* (0.55)				−0.15 (0.44)	0.15 (0.46)
(≥ \$75,000)				—	—				—	—
R^2	9.62%	10.62%	14.39%	20.05%	20.74%	2.78%	5.86%	6.73%	10.92%	12.22%

*$P \leq 0.05$. $^{\dagger}P \leq 0.08$.
Analytical sample size: 3634 (model 1), 3631 (model 2), 3614 (model 3), 3340 (model 4), and 3321 (model 5).
MCS indicates Mental Component Summary score; PCS, Physical Component Summary score; SF-36v2, Short Form 36-Item survey.

health should address subgroups not represented by this study, such as ages beyond 35 to 89 years, institutionalized people, and those falling into the "other" racially/ethnically diverse subgroups of the US population. We did not explore how other self-reported measures of health (e.g., symptoms/conditions, disease-targeted measures) relate to gender differences in underlying dimensions of HRQoL. Importantly, we also did not examine how gender differences vary with age. Men tend to die younger than women, possibly leading to healthier men surviving to older age, with a resulting larger gender difference in HRQoL. The life expectancy advantage for women may be outweighed by lower quality of life.[42,43] In addition, the possibility that gender variations in health behaviors may have a significant impact in explaining gender differences in HRQoL outcomes and mortality remains largely unexplored. We have also considered that differential item functioning may exist by other important subgroups.

The primary strength of this study is the use of a large dataset from a recently surveyed national sample of US adults on 5 simultaneously administered and commonly used preference-based indexes of HRQoL. This study presents a first look at the relationship of gender and 3 underlying health-related dimensions (physical, psychosocial, and pain), jointly defined by attributes of 5 commonly used indexes of HRQoL.

CONCLUSIONS

United States men have better estimated health than do women on latent physical, psychosocial, and pain dimensions, and also on the SF-36v2 physical and mental component summary scores. Gender differences are reduced but not fully explained by adjustments for sociodemographic and SES variation between men and women, except for the pain dimension. All 5 health-related outcomes showed similar patterns in gender differences when adjusted for sociodemographic and SES variables, with income and marital status contributing the most to explaining gender differences. Our study complements previous findings of gender differences as captured by the 5 HRQoL indexes, highlights the importance of studying the relationship of gender and health among independent health-related factors of HRQoL, and continues to emphasize the impact of socioeconomic disparities on the well-being of women.

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