Excess Weight and Physical Health-Related Quality of Life in Postmenopausal Women of Diverse Racial/Ethnic Backgrounds

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Abstract

Background: Studies of weight and health-related quality of life (HRQOL) generally focus on white populations. This analysis examines the association between clinical weight categories and physical HRQOL in five racial/ethnic groups of older women and determines the extent to which emotional/psychological (social support, caregiver burden) and physical health (diabetes, osteoarthritis) factors modify this relationship.

Methods: The cross-sectional analysis, completed in 2007, used baseline data from postmenopausal women enrolled in the Women's Health Initiative (WHI) during the 5-year recruitment period (1993–1998).

Results: Of 161,393 women, 83% were non-Hispanic white, 9% were African American, 4% were Hispanic/Latina, 3% were Asian/Pacific Islander, and <1% were American Indian/Alaska Native. Obesity (body mass index [BMI] ≥ 30 kg/m²) was most common in non-Asian minority groups. Regression modeling showed higher odds of poor physical HRQOL with increasing weight category in all groups. In the total sample, these odds were at least 6 times as high in women with class 3 obesity as in women of normal weight and were only mildly attenuated after the analysis adjusted for emotional/psychological factors. Further adjustment for physical health factors made odds ratio (OR) estimates drop from 2.36 to 1.59 for class 1 obesity and from 6.96 to 3.71 for class 3 obesity. This pattern generally persisted within each racial/ethnic group.

Conclusions: Heavier weight negatively affects physical HRQOL in postmenopausal women across diverse racial/ethnic backgrounds. Weight-relevant physical health factors have a greater impact on this weight-HRQOL association than do emotional/psychological factors.

Introduction

MORE THAN 70% OF U.S. ADULTS aged ≥ 60 years are overweight or obese.^{1,2} The prevalence of obesity continues to rise, especially among middle-aged and older adults.³ In addition, the proportion of elderly is expected to rise dramatically in coming decades,⁴ up from 12% to 20% by 2050.⁵ Therefore, obesity in older adults is an increasingly important clinical and public health issue.

Studies indicate that obesity, either alone or in association with such other chronic disorders as cardiovascular disease (CVD) and diabetes, has an adverse effect on overall health-related quality of life (HRQOL).^{5–7} Excess weight is likely to influence physical HRQOL through its detrimental physical health consequences (e.g., diabetes, CVD, respiratory disorders, osteoarthritis, and functional disability).^{8–11} Emotional and psychological consequences may accompany the physical attributes of heavier people, such as mood disorders,^{12,13}

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higher distress or stress levels,^{12–15} lower self-esteem,^{13,16} stigma,^{13,14,17,18} lack of social support structures,¹⁹ and poorer emotional well-being.^{8,20,21} Data are mixed, however, on whether social engagement or perceived support is diminished among obese individuals.^{22–25}

Both generic^{5,26,27} and obesity-specific^{12,15,28} measures of HRQOL have been used to assess physical and mental or emotional consequences of excess body weight. Both types of instruments consistently demonstrate that women considered to have an obese body mass index (BMI ≥ 30 kg/m²) have a lower HRQOL compared with those of normal weight BMI (18.5–24.9 kg/m²).^{5,12,26–28} People considered to have an overweight BMI (25–29.9 kg/m²) demonstrate either significantly better HRQOL²⁹ or no significant difference in HRQOL^{5,26} vs. normal (<25 kg/m²) participants.

Particular demographic factors have been related to the negative impact of obesity on HRQOL, which is greatest among older,^{6,7,30,31} white,^{11,16,32,33} and female^{15,31,33} individuals as well as those with lower education levels.^{34,35} Furthermore, weight-related stigma and psychological consequences differ with age, gender, and possibly cultural background.^{2,31} As weight-related comorbidities and barriers to treatment are disproportionately common among minority groups,³⁶ it is essential to explore ethnically diverse samples to understand the extent of and possible contributors to weight-related changes in physical HRQOL. Recent data (2000–2005) show that the most extreme obesity class is the fastest growing segment of the U.S. population, with a $\geq 50\%$ increase in rates,³⁷ so it is important to consider how risk changes across obesity categories.

A majority of studies have examined obesity and HRQOL in white, middle-aged populations.^{5–8,11,12,15,29,38} This study aims to (1) quantify associations and potential overlap between different excess weight categories and physical HRQOL in a large racially/ethnically diverse sample of older women and (2) examine the role of physical health and emotional/psychological factors in accounting for the BMI-associated risk of poor physical HRQOL across excess weight categories. We hypothesized that physical HRQOL will proportionately decline with increasing excess weight category, although the strength of this association will significantly vary by race/ethnicity. We also expected that both physical health and emotional/psychological factors (e.g., history of a mood disorder, negative life events, lack of social support) would significantly account for the relationship between obesity and poor physical HRQOL, reducing the association between BMI categories and poor physical HRQOL across weight categories when included in the same model. However, we expected that these factors would vary in relative importance by race/ethnicity.

Materials and Methods

The University of Pittsburgh Institutional Review Board approved the protocol to analyze data from the observational study component and all three clinical trial components of the Women's Health Initiative (WHI) (an Appendix of WHI investigators is available online at www.liebertonline.com). As described in detail elsewhere,³⁹ the WHI recruited over 160,000 postmenopausal women from 40 clinical centers across the United States from 1993 to 1998. For this cross-sectional analysis, women were included if they were enrolled

at baseline in the observational or clinical component of the WHI trial. The underweight BMI category (<18.5) was excluded for two main reasons: first, we examine the effect of excess body weight on physical HRQOL, and, second, comorbid medical illness associated with low BMI frequently confounds the already complex weight-HRQOL association.

Sociodemographic data

Participants were categorized into three age groups (50–59, 60–69, 70–79) and the five major racial/ethnic groups (American Indian/Alaska Native [AI/AN], Asian/Pacific Islander [A/PI], African American [AA], Hispanic/Latina [H/L], and non-Hispanic white, [NHW]). Education, marital status, and employment status were collapsed to fewer levels (Table 1), whereas annual household income remained in \$10,000 increments up to \$20,000, then in \$15,000 increments up to \$50,000, then in \$25,000 increments up to \$100,000 and finally in \$50,000 increments. Health insurance and smoking status were dichotomized (not insured vs. insured and current nonsmokers vs. current smokers, respectively).

Body mass index

Clinical weight (kilograms) and height (meters) were measured. We calculated BMI to classify participants into a weight category consistent with World Health Organization (WHO) criteria: normal weight (18.5–24.9 kg/m²), overweight (25–29.9 kg/m²), class 1 obesity (30–34.9 kg/m²), class 2 obesity (35–39.9 kg/m²), and class 3 obesity (≥ 40 kg/m²).

Physical health

Assessment included self-reported presence of six major obesity-related conditions: coronary heart disease (CHD, including a history of cardiac arrest, congestive heart failure, coronary revascularization, or angina), diabetes, hypertension, hyperlipidemia, osteoarthritis, and asthma. It also included the presence or absence of moderate/severe pain (including generalized aches or pains, low back pain, neck pain, or joint pain or stiffness) and self-reported health status (excellent/very good, good, and fair/poor).

Emotional/psychological health

We examined a number of factors that are direct measures or potential markers of emotional stress or psychological health, which we termed “emotional/psychological” factors. The following factors were each coded as a dichotomous variable (yes/no): having a history of mood disorder (including anxiety or depression), having a history of ≥ 5 negative life events (up to 12) over the past year (such as serious illness or death of a spouse/partner or close friend/family member; major problems with money, divorce, or breakup with spouse/partner; major conflicts with children; major traumatic event; physical or verbal abuse; death of a pet; loss of a job or retirement of a close friend/family member). Our cutoff at experiencing ≥ 5 negative life events was based on finding a significant association with an increased risk of depression in a prior WHI study.⁴⁰ Other measures included having a caregiver role, living alone, having good social support (e.g., someone to have fun with, to love and make you feel wanted, to help with chores when sick, to take you to the doctor if you need it, to give good advice if you have a

TABLE 1. SOCIODEMOGRAPHIC CHARACTERISTICS OF WOMEN'S HEALTH INITIATIVE STUDY POPULATION, STRATIFIED BY RACE/ETHNICITY

Characteristic	Full sample (n = 161,393)	American Indian/ Alaska Native (n = 715)	Asian/Pacific Islander (n = 4,192)	Black/African American (n = 14,627)	Hispanic/ Latina (n = 6,512)	White, non-Hispanic (n = 133,534)
Age						
50–59	53,558 (33.1) ^a	302 (42.2)	1,482 (35.4)	6,077 (41.5)	3,274 (50.3)	41,714 (31.2)
60–69	72,587 (44.9)	290 (40.6)	1,748 (41.7)	6,253 (42.7)	2,540 (39.0)	60,762 (45.5)
70–79	35,664 (22.0)	123 (17.2)	962 (22.9)	2,297 (15.7)	698 (10.7)	31,058 (23.3)
Weight category ^b						
Normal weight	54,782 (34.2)	168 (24.0)	2,292 (55.0)	2,256 (15.6)	1,582 (24.6)	47,950 (36.2)
Overweight	55,524 (34.2)	208 (29.7)	1,276 (30.6)	4,709 (32.5)	2,449 (38.0)	46,235 (34.9)
Class 1 obesity	29,671 (18.5)	179 (25.6)	326 (7.8)	3,895 (26.9)	1,504 (23.4)	23,394 (17.7)
Class 2 obesity	12,162 (7.6)	85 (12.1)	91 (2.2)	2,083 (14.4)	594 (9.2)	9,164 (6.9)
Class 3 obesity	6,424 (4.0)	55 (7.9)	37 (0.9)	1,468 (10.1)	285 (4.4)	4,490 (3.4)
Marital status						
Never married	7,076 (4.4)	27 (3.8)	234 (5.6)	890 (6.2)	292 (4.6)	5,542 (4.2)
Married	100,012 (62.3)	388 (55.0)	2,834 (68.0)	5,882 (40.7)	3,718 (58.0)	86,145 (64.7)
Divorced/widowed	53,522 (33.3)	291 (41.2)	1,101 (26.4)	7,697 (53.2)	2,399 (37.4)	41,370 (31.1)
Education level						
Less than high school	8,641 (5.4)	121 (17.1)	216 (5.2)	1,750 (12.1)	1,774 (27.8)	4,610 (3.5)
High school graduate or equivalent	44,046 (27.4)	203 (28.7)	1,258 (30.2)	3,810 (26.4)	1,806 (28.3)	36,285 (27.4)
Some college education	44,477 (27.7)	228 (32.2)	848 (20.4)	3,831 (26.5)	1,474 (23.1)	37,474 (28.2)
College graduate	35,787 (22.3)	93 (13.2)	1,137 (27.3)	2,346 (16.2)	793 (12.4)	30,987 (23.4)
Advanced or graduate degree	27,623 (17.2)	62 (8.8)	702 (16.9)	2,701 (18.7)	545 (8.5)	23,307 (17.6)
Annual household income						
Median, in thousand dollars	35,000–49,999	20,000–34,999	50,000–74,999	20,000–34,999	20,000–34,999	35,000–49,999
Employment						
Full-time or part-time job	56,116 (37.2)	257 (37.8)	1,619 (39.4)	5,433 (39.4)	2,263 (37.1)	45,889 (36.8)
Retired	71,260 (47.2)	253 (37.3)	2,061 (50.2)	6,319 (45.8)	1,838 (30.2)	59,997 (48.2)
Disabled	2,206 (1.5)	40 (5.9)	13 (0.3)	643 (4.7)	228 (3.7)	1,252 (1.0)
Homemaker	7,778 (5.2)	39 (5.7)	147 (3.6)	374 (2.7)	724 (11.9)	6,399 (5.1)
Unemployed	8,539 (5.7)	65 (9.6)	144 (3.5)	704 (5.1)	730 (12.0)	6,808 (5.5)
Health insurance: Insured	153,741 (96.2)	640 (91.8)	4,072 (98.0)	13,276 (93.0)	5,064 (80.7)	128,985 (97.3)
Current tobacco use (%)	(6.9)	(10.6)	(4.0)	(11.4)	(7.2)	(6.6)

All variables are statistically significant ($p < 0.001$) for each demographic across all racial/ethnic groups.

^aValues expressed as counts (%). Subtotals may vary based on different numbers of missing data for each variable.

^bWeight categories are defined in terms of body mass index (kg/m²): normal weight, 18.5–24.9; overweight, 25–29.9; class 1 obesity, 30–34.9; class 2 obesity, 35–39.9; class 3 obesity, ≥ 40 .

problem, or to listen to you when you need to talk), being active in groups, having a strong religious affiliation (e.g., attending a religious service at least once a week or feeling that religion provides strength or comfort), and having a pet. Each of these items was extracted from validated instruments used in the original WHI study on life events,⁴¹ social support and burden,⁴² religiosity/spirituality,⁴³ and caregiving burden.⁴⁴

Physical health-related quality of life

In the WHI, investigators used the RAND-36 Health Survey 1.0 to examine HRQOL measures, which included a physical health composite (PHC) score generated from four subscales measuring self-rated bodily pain, physical functioning, general health perceptions, and role limitations due to physical health.⁴⁵ The RAND-36 summary scores are T-score norm-based scoring approaches; therefore, interpretation of these T-scores is based on a general U.S. population mean of 50.0, with a standard deviation (SD) of 10.0.⁴⁵ In the analysis presented here, physical HRQOL refers only to the physical well-being aspect, and, thus, a low PHC score (< 42) indicates

poor physical HRQOL. Three primary reasons led to our focus on physical HRQOL. First, internists and general practitioners provide a majority of care for the medically complex and obese patient, which makes an understanding of factors affecting physical conditions of greater relevance to clinical decision making.⁴⁶ Second, physical HRQOL has a higher degree of correlation with obesity than does mental HRQOL, as evidenced in several studies.^{47–51} Third, the PCS from the SF-36 has been used alone as a measure of change in physical functioning over time among those with multiple chronic medical conditions.⁴⁶ Normative data showed that approximately 20% or fewer age-stratified groups obtained a PHC score of < 42 and determined this cutoff to be the point at which perceived physical health problems were impeding life functioning.⁴⁵ Therefore, the cutoff was deemed clinically meaningful and used in this analysis.

Statistical analyses

Procedures included univariate analyses to characterize the study population, bivariate analyses with chi-square tests to assess race/ethnicity-related differences among categorical

covariates, and use of the Somers' *d* statistic to check for linear trends between BMI categories and selected independent variables (marital status, self-rated health, and emotional/psychological factors). Before multivariable modeling, the association between BMI categories (predictor) and the physical HRQOL (outcome) indicator was observed overall and then stratified by race/ethnicity. In addition, the physical HRQOL outcome was dichotomized based on a clinically meaningful cutoff, with low scores suggesting poor physical HRQOL.

For multivariable analyses, a multistep hierarchical modeling approach to logistic regression was used to determine the association of sets of predictor variables (physical health and emotional/psychological factors), with the risk of poor physical HRQOL stratified by race/ethnicity. We initially examined models that included the full sample, using a race/ethnicity $\times$ BMI interaction term. Because the interaction was not significant, indicating that the effect of obesity on physical HRQOL was similar across racial/ethnic groups, all subsequent analyses combined women of all racial/ethnic backgrounds. In all models, clinical weight category was the main predictor variable for the outcome of poor physical HRQOL. At each step, odds ratios (ORs) were calculated and compared. An OR >1.0 indicated a greater risk of poor physical HRQOL, and 95% confidence intervals (CIs) were included to establish statistical significance. Model 1, which adjusted only for age group, allowed for examination of the effects of other demographic variables. Model 2, which also adjusted for marital status, education, income, employment, insurance, and current smoking, allowed for isolation of the effect of BMI category adjusted for potential confounders. This model showed the overall effect of clinical weight categories on physical HRQOL. Model 3, which adjusted for model 2 variables plus emotional/psychological factors, allowed for assessment of whether emotional-psychological factors substantially modified the weight-related decrement in physical HRQOL. Model 4 adjusted for the previous factors plus physical health variables (comorbidities, pain, and self-rated health status). Comparison of the ORs from model 3 and model 4 provides an estimate of how much of the weight-related decrement in physical HRQOL is due to the physical sequelae of obesity. For a secondary analysis, we also examined for a possible interaction between race/ethnicity and education.

In all analyses, SPSS for Windows version 15.0 (SPSS, Inc., Chicago, IL) was used. Given the large sample size, the level of significance for *p* values was <0.01 . Although a Bonferroni correction for multiple comparisons was considered, the large sample size and very high level of significance obviate the need for this method, as it is not likely to alter the results.

Results

The WHI sample included a total of 161,809 women. Those without data on weight or height to calculate BMI or PHC (0.3% missing) or lack of self-report to a specific race/ethnicity (1.1% missing) were excluded from specific multivariable analyses; therefore, the sample size varies slightly across tables. In addition, 1,813 women who reported other race/ethnicity were not included in analyses examining associations within groups of women of the same race/ethnicity.

Sociodemographic characteristics

The sample population included postmenopausal women with a BMI ≥ 18.5 kg/m² (Table 1). The majority of women (82.7%) were NHW, 9.1% were AA, 4% were H/L, 2.6% were A/PI, and 0.4% were AI/AN. In each racial/ethnic group, 29.7%–38.0% of women were overweight. The prevalence of obesity was relatively low (10.9%) in A/PI women and highest among AA and AI/AN (51.4% and 46.2%, respectively). The majority of AA women were divorced/widowed (53.2%), whereas most other women were married ($>55.0\%$). More than 80% of most racial/ethnic groups had at least a high school education (with the exception of H/L women, of whom 27.8% reported less than high school), and $>90\%$ reported being insured (again, H/L women were the exception at 80.7%). The mean PHC score for this sample of women was 50.1 with an SD of 10.3, suggesting good physical HRQOL overall.

Health status

Of the major obesity-related conditions (Table 2), hypertension and osteoarthritis were among the most common in all racial/ethnic groups. Moderate/severe pain was frequently reported in all groups (range 28.4%–48.3%) but was most common in the AI/AN group (54.1%). Data for self-rated health were "excellent/very good" among most racial/ethnic groups (range 40.5%–61.5%), although the larger proportion of AAs instead rated their health as "good" (45.5%). Among emotional/psychological factors, a history of mood disorder was most common in AI/AN women and H/L women (13.2% and 12.4%, respectively) (Table 2). AI/AN, AA, and H/L women reported experiencing ≥ 5 negative life events at least 1.5 times as often as A/PI and NHW women. The proportion reporting good social support was fairly high across all racial/ethnic groups (range 48.3%–60.7%), but living alone and strong religious affiliation were more often reported by AA women compared with A/PI women (37.1% and 57.9% vs. 18.3% and 27.8%, respectively). AI/AN women most often reported having a pet (49.6%), and AA women least often reported one (26.6%).

Trends between weight categories and select main variables

Table 3 shows the prevalence of marital status, self-rated health, emotional/psychological factors, and poor physical HRQOL in women of different weight categories. Being married and having excellent/very good self-rated health declined significantly with increasing weight status ($p < 0.001$). The largest absolute differences across increasing weight category were seen for fair/poor self-rated health, ≥ 5 negative life events, and poor physical HRQOL. Between those who were of normal BMI and those who were morbidly obese, excellent/very good self-rated health declined by more than half, and fair/poor self-rated health increased approximately 5-fold, respectively. Furthermore, poor physical HRQOL was at least 3.5 times greater among morbidly obese women (55%) compared to normal weight women (14.7%). Smaller changes (<10 percentage point absolute difference) occurred across increasing clinical weight category, with a decreasing proportion of women having good social support, a slightly increasing proportion having a pet and having a caregiver role, and minimal change in those living alone.

TABLE 2. HEALTH STATUS OF WOMEN'S HEALTH INITIATIVE STUDY POPULATION, STRATIFIED BY RACE/ETHNICITY

Health factor	Full sample (n = 161,393)	American Indian/ Alaska Native (n = 715)	Asian/Pacific Islander (n = 4,192)	Black/African American (n = 14,627)	Hispanic/ Latina (n = 6,512)	White, non-Hispanic (n = 133,534)
Major obesity-related conditions						
Coronary heart disease ^b	10,831 (6.7) ^a	81 (11.3)	204 (4.9)	1,538 (10.5)	404 (6.2)	8,485 (6.4)
Diabetes	9,588 (5.9)	119 (16.8)	345 (8.2)	2,039 (14.0)	609 (9.4)	6,343 (4.8)
Hypertension	54,120 (33.8)	290 (41.2)	1,500 (35.9)	7,945 (55.2)	1,958 (30.4)	41,760 (31.5)
Hyperlipidemia	21,467 (14.1)	96 (14.1)	842 (20.5)	2,195 (15.9)	911 (15.3)	17,146 (13.6)
Osteoarthritis	28,771 (17.8)	150 (21.0)	776 (18.5)	2,437 (16.7)	1,212 (18.6)	23,849 (17.9)
Asthma	12,528 (7.9)	96 (13.7)	362 (8.7)	1,306 (9.2)	488 (7.7)	10,097 (7.6)
Pain: Moderate/severe ^c	65,204 (40.4)	387 (54.1)	1,192 (28.4)	6,887 (47.1)	3,145 (48.3)	52,813 (39.6)
Self-rated health						
Excellent/very good	92,807 (57.9)	308 (43.4)	2,180 (52.2)	5,060 (34.9)	2,570 (40.5)	81,750 (61.5)
Good	52,907 (33.0)	255 (35.9)	1,605 (38.4)	6,595 (45.5)	2,364 (37.3)	41,451 (31.2)
Fair/poor	14,636 (9.1)	147 (20.7)	391 (9.4)	2,829 (19.5)	1,407 (22.2)	9,638 (7.3)
Emotional/psychological factors						
Having a history of mood disorder	9,300 (5.9)	90 (13.2)	145 (3.5)	1,133 (8.2)	733 (12.4)	7,067 (5.4)
Having good social support	95,414 (59.3)	344 (48.3)	2,471 (59.1)	7,687 (52.9)	3,157 (49.1)	80,799 (60.7)
Being active in groups	56,893 (37.1)	225 (32.6)	1,119 (27.1)	5,671 (40.5)	1,617 (26.6)	47,653 (37.6)
Having strong religious affiliation	67,594 (42.0)	271 (38.0)	1,161 (27.8)	8,391 (57.9)	3,213 (50.1)	53,623 (40.3)
Having a pet	66,012 (41.3)	351 (49.6)	1,609 (38.7)	3,819 (26.6)	2,924 (45.9)	56,550 (42.7)
Living alone	42,556 (29.7)	186 (30.9)	719 (18.3)	4,640 (37.1)	1,253 (24.4)	35,261 (29.5)
Having a caregiver role ^d	65,263 (40.7)	331 (47.0)	1,311 (31.5)	6,637 (46.0)	2,807 (44.0)	53,454 (40.3)
Experiencing ≥ 5 negative life events	45,384 (28.8)	295 (43.3)	959 (23.4)	5,748 (41.1)	2,451 (40.9)	35,272 (26.9)

All variables are statistically significant ($p < 0.001$) for each baseline health variable across all racial/ethnic groups.

^aValues expressed as counts (%).

^bCoronary heart disease includes a history of cardiac arrest, coronary revascularization, congestive heart failure, or angina.

^cModerate/severe pain includes the presence of generalized, low back, neck, or joint pain.

^dA caregiver role involves caring for someone (friend or relative) on a regular basis (e.g., once a week or more). All absolute numbers may not total 100 due to some missing data.

TABLE 3. TRENDS FOR RATES OF MARITAL STATUS, SELF-RATED HEALTH, EMOTIONAL/PSYCHOLOGICAL FACTORS, AND PHYSICAL HEALTH-RELATED QUALITY OF LIFE BY WEIGHT CATEGORY

Independent variable	Clinical weight category ^a					p value for trend
	Normal weight	Overweight	Class 1 obesity	Class 2 obesity	Class 3 obesity	
Marital status						<0.001
Never married	2,354 (4.3) ^b	2,209 (4.0)	1,269 (4.3)	629 (5.2)	435 (6.8)	
Married	35,428 (64.8)	35,072 (63.3)	17,892 (60.5)	6,840 (56.4)	3,372 (52.7)	
Divorced/widowed	16,907 (30.9)	18,112 (32.7)	10,432 (35.3)	4,664 (38.4)	2,588 (40.5)	
Self-rated health						<0.001
Excellent/very good	38,149 (69.9)	33,020 (59.7)	13,978 (47.3)	4,410 (36.4)	1,852 (29.0)	
Good	13,598 (24.9)	18,096 (32.7)	12,022 (40.7)	5,508 (45.5)	2,901 (45.4)	
Fair/poor	2,851 (5.2)	4,167 (7.5)	3,563 (12.1)	2,194 (18.1)	1,632 (25.6)	
Having good social support	33,927 (62.0)	33,259 (60.0)	16,870 (56.9)	6,636 (54.7)	3,339 (52.1)	<0.001
Being active in groups	18,967 (36.1)	20,123 (38.2)	10,519 (37.4)	4,287 (37.5)	2,170 (34.9)	0.001
Having strong religious affiliation	21,385 (39.1)	23,943 (43.2)	13,122 (44.3)	5,315 (43.9)	2,714 (42.4)	<0.001
Having a pet	21,619 (39.7)	22,607 (41.1)	12,619 (42.9)	5,365 (44.6)	2,891 (45.4)	<0.001
Living alone	14,566 (29.9)	14,463 (29.4)	7,742 (29.3)	3,298 (30.4)	1,775 (30.8)	0.957
Having a caregiver role ^c	21,324 (39.1)	22,484 (40.7)	12,505 (42.3)	5,180 (42.9)	2,790 (43.6)	<0.001
Experiencing ≥ 5 negative life events	13,284 (24.7)	15,367 (28.2)	9,370 (32.2)	4,267 (36.1)	2,529 (40.3)	<0.001
Poor physical HRQOL ^d	7,731 (14.7)	11,039 (20.9)	8,487 (30.2)	4,763 (41.4)	3,305 (55.0)	<0.001

^aWeight categories are defined in terms of body mass index (kg/m²): normal weight 18.5–24.9, overweight 25–29.9, class 1 obesity 30–34.9, class 2 obesity 35–39.9, class 3 obesity ≥ 40 .

^bValues expressed as counts (%).

^cA caregiver role involves caring for someone (friend or relative) on a regular basis (e.g., once a week or more).

^dPoor physical health-related quality of life (HRQOL) is defined as a physical health composite score of <42 in the RAND-36 Health Survey.

Association of weight categories and physical HRQOL in total sample

With adjustments across the four logistic regression models, odds of poor physical HRQOL decreased from 2.6 to 1.6 among women with class 1 obesity and decreased from 8.2 to 3.7 among women with class 3 obesity compared with normal weight women (Fig. 1). Adjusting between model 2 (sociodemographics and smoking) and model 3 (emotional/psychological factors) had little effect on point estimates. For example, for women with class 1 obesity, odds of poor physical HRQOL decreased slightly from 2.64 in model 1 to 2.36 in model 3. However, further adjustment for physical health factors in model 4 caused the OR to drop considerably (from 2.36 to 1.59 in class 1 obesity and from 6.96 to 3.71 in class 3 obesity). Similar effect sizes were noted if physical health variables were included in the model before adjusting for emotional/psychological factors.

Examination of individual physical health variables (data not shown) revealed that self-rated health was the strongest predictor of physical HRQOL for all women combined. Women reporting poor/fair health were 23.7 times more likely to have poor physical HRQOL than those reporting excellent to very good health. In the fully adjusted model, weight category retained a substantial association with poor physical HRQOL, suggesting that either obesity has an independent effect or the model does not include potentially important covariates. Among comorbid conditions, greater reductions in odds of poor physical HRQOL occurred when adjustments were made first for hypertension and then for diabetes.

Association between weight categories and physical HRQOL within racial/ethnic groups

When separate models were run for each racial/ethnic group (Table 4), patterns similar to those shown in Figure 1

were demonstrated for most groups. Within each model, the odds of poor physical HRQOL increased with increasing weight category, with a similar degree of risk in most racial/ethnic groups. The risk of poor physical HRQOL was highest among class 3 obese women. With each model adjustment, the odds of poor physical HRQOL significantly decreased, except among AI/AN women with overweight, class 1 and class 2 obesity and A/PI women with class 2 obesity. Physical health factors (adjustment from model 3 to model 4) accounted for larger reductions in risk in all racial/ethnic groups. Point estimates for risk of poor physical HRQOL were largest for NHW women and A/PI women with class 3 obesity than for other groups.

In *post hoc* analyses, we included an interaction term between race/ethnicity and education (data not shown). At each educational level, there was a common pattern of increasing risk of poor physical HRQOL with increasing weight category in each racial/ethnic group. However, the degree of risk for each group dropped substantially after adjusting for pain and self-rated health. A few distinctions were notable among AA and H/L women. Compared with NHW women with a college degree, the risk of poor physical HRQOL doubled in the following groups: class 3 obese AA women with less than a college degree, H/L women with class 3 obesity and only a high school education, and AA women with class 2 obesity and advanced educational degrees. The limited number of AI/AN and A/PI women precluded reporting similar analyses in these populations of women.

Discussion

Analysis of baseline data from 161,393 older women participating in the WHI demonstrated that the odds of poor physical HRQOL increased as weight category increased in diverse racial/ethnic groups. Self-rated health showed the largest proportional change in physical HRQOL across

FIG. 1. Odds ratios for poor physical HRQOL by weight category for the total sample. Poor physical HRQOL is defined as a physical health composite score of <42 in the RAND-36 Health Survey. Weight categories are defined in terms of body mass index (kg/m^2): normal weight 18.5–24.9, overweight 25–29.9, class 1 obesity 30–34.9, class 2 obesity 35–39.9, class 3 obesity ≥ 40 . Model 1 adjusted for age. Model 2 adjusted for sociodemographic data and smoking behavior (age, marital status, education, income, employment, insurance, and current smoking). Model 3 adjusted for model 2 variables plus emotional/psychological factors (having a history of mood disorder, having good social support, being active in groups, having a strong religious affiliation, having a pet, living alone, having a caregiver role, and experiencing ≥ 5 negative life events). Model 4 adjusted for Model 3 plus physical health variables (comorbidities, pain, and self-rated health status). HRQOL, health-related quality of life.

TABLE 4. REGRESSION MODELING OF WEIGHT CATEGORY AND POOR PHYSICAL HEALTH-RELATED QUALITY OF LIFE, STRATIFIED BY RACIAL/ETHNIC GROUP

Category ^a and group	Adjustments ^b			
	Model 1	Model 2	Model 3	Model 4
American Indian/Alaska Native				
Normal weight	1.00	1.00	1.00	1.00
Overweight	2.18 (1.18-4.03) ^c	2.31 (1.20-4.44)	2.50 (1.27-4.93)	3.92 (1.52-10.15)
Class 1 obesity	2.57 (1.37-4.81)	2.34 (1.19-4.60)	2.46 (1.22-4.97)	3.27 (1.22-8.71)
Class 2 obesity	7.80 (3.64-16.73)	9.00 (3.89-20.85)	9.44 (3.89-22.91)	4.88 (1.51-15.83)
Class 3 obesity	7.55 (3.18-17.94)	6.63 (2.59-16.95)	6.60 (2.49-17.52)	5.32 (1.41-20.13)
Asian/Pacific Islander				
Normal weight	1.00	1.00	1.00	1.00
Overweight	1.69 (1.13-1.83)	1.69 (1.36-2.10)	1.68 (1.34-2.09)	1.27 (0.98-1.64)
Class 1 obesity	2.49 (1.79-3.46)	2.50 (1.79-3.50)	2.43 (1.72-3.42)	1.48 (0.99-2.22)
Class 2 obesity	3.16 (1.85-5.38)	3.34 (1.94-5.75)	3.02 (1.74-5.24)	1.65 (0.85-3.19)
Class 3 obesity	8.00 (3.93-16.26)	7.83 (3.80-16.16)	7.02 (3.30-14.92)	3.12 (1.27-7.69)
Black/African American				
Normal weight	1.00	1.00	1.00	1.00
Overweight	1.43 (1.22-1.68)	1.39 (1.17-1.64)	1.37 (1.16-1.61)	1.21 (1.00-1.47)
Class 1 obesity	2.26 (1.92-2.65)	2.13 (1.80-2.52)	2.08 (1.75-2.46)	1.56 (1.28-1.90)
Class 2 obesity	3.77 (3.15-4.50)	3.44 (2.85-4.14)	3.31 (2.75-4.00)	2.09 (1.68-2.61)
Class 3 obesity	6.85 (5.64-8.32)	6.16 (5.02-7.56)	6.06 (4.93-7.45)	3.60 (2.82-4.58)
Hispanic/Latina				
Normal weight	1.00	1.00	1.00	1.00
Overweight	1.43 (1.13-1.81)	1.35 (1.07-1.71)	1.33 (1.05-1.69)	1.17 (0.89-1.54)
Class 1 obesity	2.48 (1.95-3.15)	2.26 (1.77-2.89)	2.22 (1.73-2.85)	1.66 (1.24-2.22)
Class 2 obesity	3.83 (2.86-5.14)	3.60 (2.67-4.86)	3.58 (2.63-4.85)	2.10 (1.46-3.03)
Class 3 obesity	7.12 (4.87-10.40)	6.32 (4.28-9.33)	6.21 (4.16-9.27)	3.43 (2.14-5.50)
White, non-Hispanic				
Normal weight	1.00	1.00	1.00	1.00
Overweight	1.52 (1.37-1.59)	1.46 (1.40-1.52)	1.45 (1.39-1.51)	1.21 (1.15-1.27)
Class 1 obesity	2.58 (2.46-2.70)	2.39 (2.28-2.50)	2.34 (2.23-2.45)	1.59 (1.50-1.68)
Class 2 obesity	4.49 (4.23-4.76)	4.09 (3.85-4.34)	3.96 (3.72-4.20)	2.27 (2.11-2.45)
Class 3 obesity	7.97 (7.39-8.60)	7.16 (6.62-7.73)	6.85 (6.34-7.41)	3.82 (3.46-4.21)

Poor physical health-related quality of life is defined as a physical health composite score of <42 in the RAND-36 Health Survey 1.0.

^aWeight categories are defined by body mass index (kg/m²): normal weight 18.5–24.9, overweight 25–29.9, class 1 obesity 30–34.9, class 2 obesity 35–39.9, class 3 obesity ≥40.

^bModel 1 adjusts for age. Model 2 adjusts for sociodemographic and smoking behavior (age, marital status, education, income, employment, insurance, and current smoking). Model 3 adjusts for model 2 variables plus emotional/psychological factors (history of mood disorder, good social support, active in groups, strong religious affiliation, having a pet, living alone, a caregiver role, and ≥5 negative life events). Model 4 adjusts for model 3 plus physical health variables (comorbidities, pain, and self-rated health status).

^cValues expressed as odds ratios (95% confidence intervals).

clinical weight categories. The odds of poor physical HRQOL among women with class 3 (or extreme) obesity were substantially higher than were those among normal weight women. AA and AI/AN women had the highest prevalence of obesity and extreme obesity. However, the greatest change in adjusted odds of poor physical HRQOL was between extremely obese women and those of lower weight categories, suggesting that extreme obesity carries a particularly high burden in terms of physical HRQOL. In addition, the results confirm that extremely obese AA and H/L women with lower educational levels had even greater risk of poor physical HRQOL. Some studies support the notion that those with excess weight conditions are likely to have lower educational levels.^{23,34,35} In the context of obesity and HRQOL, a cross-sectional study found that women with lower educational level were at least 76% more likely to have lower scores in the domains of physical functioning and general health.³⁴ These findings suggest that although morbidity risk increases with the transitions from normal weight to overweight to obese, those with extreme obesity demonstrate the greatest risk.

This is particularly true for that subset of minority women who are also poorly educated. This group deserves more attention, as the steepest incline of obesity rates has occurred for the heaviest weight categories in the U.S. population.³⁷

It is important to delineate the impact of physical health and psychosocial factors on various outcomes with obesity; the relative importance that each contributes to obesity-associated physical HRQOL in women needs to be established. A recent cross-sectional study found that increasing age was associated with greater impairment in physical domains (physical functioning, work, sexual life) of weight-related QOL but lesser impairment in psychosocial domains (public distress, self-esteem).¹⁵ Likewise, one prospective study of weight change and HRQOL demonstrated a stronger connection between weight and physical health factors (e.g., physical functioning, bodily pain, vitality) than between weight and mental health factors (anxiety, depression, emotional problems, and psychological well-being) in obese women.⁶ Another examined gender differences in the association among obesity, mood disorders, and emotional well-being, with a stronger association

between obesity and mental health in women than in men,¹⁷ suggesting that weight stigmatization is more likely to upset emotional health among obese women than obese men. This analysis examined emotional/psychological factors with potentially positive and potentially negative effects to discover that there appears to be a lesser impact of emotional/psychological factors (vs. physical health factors) on physical HRQOL. Previous research has demonstrated the importance of emotional states on physical health and how positive feeling states promote good health behaviors and a more favorable outlook.²⁰ An important follow-up would be to examine mental HRQOL for probable racial/ethnic differences in how stigma or stress and social support are perceived.

Additionally, this analysis showed that as the weight category increased, women were more likely to report having at least one chronic medical condition, having lower self-rated health, or having moderate to severe pain. It also showed that of all the physical health factors measured, self-rated health was the strongest predictor of poor physical HRQOL. These findings support earlier research showing the following: (1) obesity-related comorbid diseases are prevalent across diverse racial/ethnic groups and adversely impact physical HRQOL, particularly as it relates to CHD, diabetes, osteoarthritis, and respiratory disorders,^{3,9,10,50} (2) people with higher BMIs report greater impairment of HRQOL^{31,33} and have a poorer perception of their health status,⁸ and (3) the presence of pain represents a significant covariate of obesity and has an independent effect on HRQOL.⁵¹ These results show that physical health factors exert a greater negative influence on physical HRQOL than do emotional/psychological characteristics and do so to a similar degree across diverse racial/ethnic cohorts. Accordingly, these findings would support the adverse impact of obesity on disability. A recent study examined self-reported functional impairment among older persons over a 16-year period.⁵² Findings demonstrated that obese persons had a 43% increased risk of functional impairment over time.⁵² Disability is greatest among obese older women.^{52,53} The associated reduction in HRQOL is probably mediated through lower activity states or possibly through fears related to loss of independence; the role of sedentary behavior in the association between obesity and poor HRQOL should be explored in future analyses. In the analyses presented here, however, accounting for the major weight-related physical health variables, considerable risk of poor physical HRQOL remained, suggesting an independent effect of obesity or absence of an important covariate, such as functional status, severity of comorbid conditions, and self-care ability.

The WHI is one of the first large studies to examine physical and emotional/psychological factors simultaneously in the context of BMI's impact on physical HRQOL. In addition, this study has a very large, racially/ethnically diverse sample from 40 U.S. clinical sites, which allows the unique opportunity to provide more accurate comparisons across these varied groups. However, it does have some limitations. First, the emotional/psychological health factors assessed in the WHI do not collectively comprise a standardized measure and may lack the statistical strength to detect an effect between weight and physical HRQOL. However, each factor was adopted from a validated measure. Second, a large portion of the residual effect that was found in the fully adjusted model may be accounted for by factors not measured in this study, in-

cluding mobility limitations and mental HRQOL. Third, many variables used in this analysis were self-reported data, which has response bias as an inherent limitation. Although self-rated health had a positive correlation with the PHC score, evidence has demonstrated that these two constructs are distinctly different. In a meta-analysis of health status and QOL,⁵⁴ it was determined that although self-rated health correlated with HRQOL, mental health has the greater impact on HRQOL and physical functioning has a greater impact on self-rated health from the patient's perspective. Finally, the cross-sectional nature of this study limits any causal inferences about the results. Although the trend of weight change was not examined, it is likely important in explaining the association between BMI and physical HRQOL. Furthermore, smaller proportions of racial/ethnic minority groups and the higher socioeconomic status (more educational attainment and a high proportion of insured) of this sample compared with the general population limit the generalizability of the results; however, the large numbers within these groups strengthen the detected effects of weight on physical HRQOL.

Conclusions

In all racial/ethnic groups of women aged 50–79 years, odds of poor physical HRQOL increased as weight category increased. The greatest difference was between odds of poor physical HRQOL in women with extreme obesity and odds in lower weight categories. Indeed, women with extreme obesity had at least 6 times the risk of poor physical HRQOL as women of normal weight before adjusting for physical health variables. These findings reaffirm that obesity has a substantial impact on physical HRQOL that is similar across diverse racial/ethnic groups. This impact is largely, but not entirely, explained by weight-related medical problems. Given the profound impact extreme obesity has on physical HRQOL across this large diverse group of women, this study suggests that prevention of additional weight gain, good control of chronic illnesses, and adequate treatment of pain should be the major objectives of patients and their healthcare providers. The emotional/psychological factors we evaluated here also showed a minimal impact on the association between weight and physical HRQOL, suggesting further research is needed to determine emotional/psychological factors (e.g., coping style, stigmatization, distress, religiosity/spirituality, social support, stress response) that may be distinct among different racial/ethnic groups and the role of these factors in modifying the excess weight and physical HRQOL association.

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Disclosure Statement

The authors have no conflicts of interest to report.

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