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Relationship of Race/Ethnicity, Body Mass Index, and Economic Strain with Longitudinal Self-Report of Physical Functioning: The Study of Women's Health Across the Nation

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Abstract

Purpose—This study examined progression and improvement of physical functioning limitations during the mid-life, and whether race/ethnicity, economic strain, or body mass index were associated with these changes.

Methods—Women from the Study of Women's Health Across the Nation with 1 measure of self-reported physical functioning, categorized as no, some, or substantial limitations, between study visit 4 and 12 were included (n=2497).

Results—When women were aged 56–66, almost 50% reported limitations in functioning. African American women were more likely to report substantial (OR=1.63; 95% CI: 1.06,2.52) and Chinese women were more likely to report some limitations (OR=2.03; 95% CI: 1.22,3.36) compared to Caucasian women. Economic strain and obesity predicted limitations. The probability of worsening ranged from 6 to 22% and of improving ranged from 11% to 30%. Caucasian and Japanese women had the highest probability of remaining fully functional (80% and 84%, respectively) compared to 71% of African American women.

Conclusions—Race/ethnicity, obesity, and economic strain were associated with prevalence and onset of physical functioning limitations. Functional improvement is common, even among vulnerable subgroups of women. Future studies should characterize predictors of decline and improvement so that interventions can sustain functioning even in the context of many known immutable risk factors.

Introduction

Functional limitations are often considered as mediators in the pathway to physical disability [1]. In the United States (U.S), approximately 20% of adults aged 45 and older have some form of disability [2]. The prevalence of chronic disability has declined among older adults during the late twentieth century [3,4], largely driven by the improving health and education of U.S. adults. However, it is unclear if overall declines in the prevalence of disability will continue if the growing prevalence of obesity and disparities in health and functioning persist [3].

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Acknowledging the presence of functional limitations in the mid-life is extremely important because it may represent an appropriate point for intervention and disability prevention [1]. Among individuals with severe limitations, over half report that the onset of limitations was evident before age 55 [5]. Measuring limitations among women is important because at every age, women report more limitation than men, and the 1999–2006 trends in obesity were adversely associated with trends in physical functioning limitations for women aged 40 to 64 years [6–8].

Race/ethnicity is a key social determinant of health, largely because of its long-standing association with economic strain, and may be associated with disability because differential access to health promoting or harming behaviors over the life course may accumulate in disease burden, impairments, limitations, and subsequent disability [1]. Although African Americans have poorer health outcomes for many conditions, recent data suggest that disability rates in the U.S. declined at a faster rate for blacks than for whites [3] and that black-white differences in disability were largely explained by health and socioeconomic differences [9].

Demographic factors such as race/ethnicity and socioeconomic status may contribute to the prevalence of limitations during the mid- and late-life [10, 11], but it is unclear if these factors also contribute to improvement in limitations during the mid-life as well. The purpose of this study was to determine the prevalence of physical functioning limitations during the mid-life, examine how limitations changed over a 10-year period in mid-life, and assess whether race/ethnicity, economic strain, and body mass index (BMI) were associated with these changes in a longitudinal cohort of community-dwelling women.

Methods

Study Population

The Study of Women's Health Across the Nation (SWAN) is a prospective, multicenter, multiethnic study of aging and the menopause transition. Sampling and recruitment methods have been described previously [12]. From a cross-sectional study of 16,065 women from seven locations (Boston, Chicago, Detroit, Los Angeles, New Jersey, Oakland, Pittsburgh), 3,302 women who at the 1996 baseline were aged 42–52 years, pre-menopausal, and self-identified with designated race/ethnic groups were recruited for a longitudinal study. Annual study visits between baseline and follow-up year 12 (2010) provided clinical, behavioral, and functioning data. The analytic sample for the present manuscript included participants with 1 measure of self-reported physical functioning (n=2497). Women from New Jersey (n=284), the only site to recruit Hispanic participants, did not complete in-person clinic visits after visit 6, resulting in a systematically shorter average follow-up time, so these data were excluded from our analysis. Compared to the analytic sample, excluded women were similar in baseline age ($p = 0.31$) but were more likely to have lower education ($p < 0.001$), greater economic strain ($p < 0.001$), larger body size ($p < 0.001$), and be a racial/ethnic minority ($p < 0.001$).

Of the analytic sample, 156 women (6.2%) had only one measure, 147 (5.9%) had two measures, 202 (8.1%) had three measures, 363 (14.5%) had four measures, and 1629 (65.2%) had all five measurements of physical functioning. Compared to women with all five measurements of physical functioning, women with 1, 2, 3, or 4 measurements were more likely to be obese ($p < 0.001$), less likely to have a college education ($p < 0.001$), more likely to be African American ($p < 0.001$), and more likely to have economic strain ($p < 0.001$).

Measures

Physical functioning was measured at five study visits (V): V4, V6, V8, V10, and V12. The participant reported she was limited a lot, a little, or not limited at all in vigorous or moderate activities, lifting/carrying groceries, climbing stairs (several flights and one flight), bending/kneeling/stooping, walking (more than 1 mile, several blocks, and one block), bathing, and dressing on the 10-item physical function subscale of the Medical Outcomes Survey Short Form 36 (SF-36). Responses were scored and transformed to a range of 0–100, with higher scores indicating better and lower scores indicating poorer perceived physical functioning. Previously used cutpoints [13] were employed to identify no limitations (86–100), some limitations (51–85), or substantial limitations (0–50).

Race/ethnicity was self-identified at baseline as Caucasian (reference group), African American, Japanese, or Chinese. Self-reported economic strain was determined from baseline and V6–V12: “How hard is it to pay for the very basics like food, housing, and heat?” The three-level response was not very difficult (reference group), somewhat difficult, and very difficult. Education was categorized as less than a high school education, high school diploma or GED (reference group), some college, college degree, or more than a college degree. Marital status was categorized as never married, married (reference group), or formerly married (including separated, divorced, and widowed).

At each visit, height was measured without shoes in centimeters by fixed stadiometer and weight was measured in light clothing in kilograms by balance beam scale. BMI was calculated as $\text{weight}[\text{kg}]/\text{height}[\text{m}]^2$ and categorized as underweight or normal weight (BMI $\leq 24.9 \text{ kg/m}^2$), overweight (BMI $25\text{--}29.9 \text{ kg/m}^2$) and obese (BMI $\geq 30 \text{ kg/m}^2$) for Caucasian and African American women. We used Asian-specific cut points, categorized as underweight or normal weight (BMI $<23 \text{ kg/m}^2$), overweight (BMI $23\text{--}24.9 \text{ kg/m}^2$), and obese (BMI $\geq 25 \text{ kg/m}^2$), for Japanese and Chinese women [14–16]. For all race/ethnic groups, the underweight/normal weight group was used as the reference.

Other covariates included diabetes, hypertension, depression, menopause status, arthritis, and smoking; variables were selected *a priori* based on their known associations with self-reported physical functioning and race/ethnicity, BMI, and/or economic strain [17–25]. Diabetes was defined as a self-report of a physician diagnosis of diabetes, current use of diabetes medications, and, when available, a fasting blood glucose $\geq 126 \text{ mg/dl}$. Blood pressure was measured twice at each study visit using a standardized protocol. Hypertension was defined as an average systolic blood pressure $\geq 140 \text{ mmHg}$, average diastolic blood pressure $\geq 90 \text{ mmHg}$, or current use of antihypertensive or diuretic medications. Depressive symptoms were ascertained using the Center for Epidemiological Studies Depression Scale (CES-D) and categorized as CES-D ≥ 16 and CES-D <16 [26]. Menopause status was ascertained at each annual exam based on bleeding patterns, current hormone use, hysterectomy and oophorectomy. Participants were categorized as being premenopausal (reference), early or late perimenopausal, postmenopausal, or unable to determine due to exogenous hormone use. Arthritis (yes/no) was determined by self-reported current treatment for or diagnosis with arthritis or osteoarthritis. Smoking status was defined as current smoking (yes/no).

Statistical Analysis

First, the prevalence of self-reported physical functioning limitations was examined by study visit. Second, the mutually exclusive prevalence of none, some, and substantial limitations in functioning using a participant’s “worst ever” report was calculated. Chi-square tests for categorical variables or ANOVA for continuous variables were used to describe the

bivariable relationships between worst ever functioning limitations and race/ethnicity, economic strain, and other covariates measured at visit 4.

To quantify the dynamic multi-state transitions (development or recovery) of physical functioning limitations over time, we used a mixed-effect Markov transition model to estimate the transitional probabilities of the current physical functioning level by observing the previous physical functioning level, as well as to relate this transition probability to the explanatory variables [27–32]. The first-order homogeneous Markov transition model yielded the transition probability matrix of physical functioning limitations. We calculated the overall age-adjusted probabilities and separate probabilities for race/ethnic and BMI groups.

To examine factors associated with physical functioning across time, we implemented a longitudinal analysis using generalized linear models (PROC GLIMMIX) with a random intercept. Mixed effects multinomial models were used to compare some limitations to no limitations and to compare substantial limitations to no limitations. Models were mutually adjusted for all demographic and health covariates, as well as study site. To evaluate whether or not the effects of race/ethnicity, economic strain, and BMI varied with time, we evaluated the multiplicative interaction of each variable by time.

Finally, we examined what factors were associated with worsening or improving in self-reported physical functioning over time. For each woman's current physical functioning report, we compared her previous physical functioning report to determine if she worsened to poorer levels of functioning or if she improved to better levels of functioning. We again used longitudinal multinomial models adjusted for all covariates (PROC GLIMMIX). All analyses were conducted using SAS v9.3 (SAS Institute Inc., Cary, NC, USA) and statistical significance was defined at the two-sided $\alpha=0.05$ level.

Results

Approximately 49% of women were Caucasian, 30% were African American, 10% were Chinese, and 11% were Japanese, by design. Half of the women did not have a college degree, one-third reported economic strain, and more than one-third were obese (Table 1). During study visit 4, when participants were aged 46–56 years, approximately 30% of women reported some limitations and 10% reported substantial limitations in physical functioning (Figure 1). By study visit 12, one-third of women reported some limitations and 15% reported substantial limitations in functioning (Figure 1).

In the “worst ever” analysis (Table 1), 26% ($n=648$) of women reported ever having substantial limitations, 42% ($n=1036$) of women reported ever having some limitations, and 33% ($n=813$) of women never reported a limitation. Women who ever-reported substantial limitations were proportionately more likely to be African American, have less education, greater levels of economic strain, larger body sizes, and a higher prevalence of diabetes, hypertension, arthritis, and current smoking at visit 4 (Table 1).

We evaluated visually the number of women who maintained their physical functioning status or transitioned from one state of physical functioning to another in subsequent study visits (Figure 2). When we examined the probability of transitioning from one level of physical functioning to another level of physical functioning 2 years later (Table 2), women who reported no limitations had a 72% probability of remaining fully functional, 22% probability of worsening to some limitations, and 6% probability of worsening to substantial limitations. Overall, the probability that women maintained their physical functioning status was high. The probability of worsening to a poorer level of functioning ranged from 6 to 22% and the probability of improving to a better level of functioning – from some

limitations to no limitations, or from substantial limitations to some or no limitations – ranged from 11 to 30%. Adjusted for age, Japanese and Caucasian women had the highest probabilities of remaining fully functional (84% and 80%, respectively), compared with African American women who had a much lower probability (71%). The probability that under/normal weight or overweight women would remain fully functional was >80%, while for obese women it was 68%. Once reporting substantial limitations, African American women were most likely to remain substantially limited (59%) and Japanese women were least likely to remain substantially limited (24%).

In the longitudinal analysis comparing some or substantial limitations to no limitations (Table 3), African American women were more likely to report substantial limitations (OR=1.63; 95% CI: 1.06, 2.52) and Chinese women were more likely to report some limitations (OR=2.03; 95% CI: 1.22, 3.36) compared to Caucasian women. Women with at least a college degree were less likely to report limitations than women with only a high school education. Women with substantial economic strain were nearly 5 times as likely to report substantial limitations (OR=4.73; 95% CI: 2.64, 8.47) and over 2 times as likely to report some limitations (OR=2.53; 95% CI: 1.62, 4.13) compared to women without economic strain. Obese women were significantly more likely to report substantial limitations (OR=4.77; 95% CI: 3.07, 7.41) and some limitations (OR=3.24; 95% CI: 2.49, 4.21) compared to normal weight women. The effects of race/ethnicity, BMI, and economic strain did not differ over time.

In the longitudinal analysis comparing improvement or worsening to maintaining physical functioning status (Table 4), older women were less likely to improve and were more likely to worsen compared to women at the mean baseline age of 50 years. Chinese women were more likely to worsen than Caucasian women (OR=1.49; 95% CI: 1.04, 2.12). Women with some or substantial economic strain were more likely to worsen than women without economic strain. Obese women and women with arthritis were just as likely to improve as they were to worsen.

Discussion

In the SWAN cohort, by study visit 12 when women were aged 56–66, almost 50% of women reported limitations in physical functioning. During the course of the 10-year follow-up, over 40% of women ever-reported some limitations and one-quarter ever-reported substantial limitations in functioning. Notably, although the prevalence of limitations at every study visit was high and many women maintained their physical functioning status from year to year, functioning exhibited considerable fluctuation within women over the course of the 10 year follow-up, which suggests physical functioning is a dynamic process that can be enhanced even once limitations are reported during this life-stage. In this population, the proportion of women whose functioning improved ranged from 14–55% depending on the category of race/ethnicity and body size, consistent with prior studies which indicate annual recovery rates can range from approximately 30% at age 65 to approximately 10% at age 90 [33,34]. Interventions may be more amenable during the mid-life period, prior to the onset of disability when improvement is more probable.

This analysis extends previous work from the SWAN cross-sectional screening questionnaire among women aged 40–55 where almost 20% of women reported limitations in physical functioning [35]. Similar to this analysis, older age, higher BMI, and greater economic strain were significantly associated with the prevalence of limitations. However, the cross-sectional paper reported that African American women were more likely but Chinese, Hispanic, and Japanese women were less likely to report substantial limitations compared to Caucasian women. Our work presents a more complex story whereby Japanese

and Caucasian women were most likely to remain fully functional, African American women were most likely to remain substantially limited, Japanese women were most likely to improve from substantial limitations, and Chinese women were most likely to worsen. To our knowledge, this is the first investigation to report race/ethnic-specific probabilities of change in self-reported physical functioning limitations.

Separate frameworks are likely needed to understand the onset to and recovery from limitations [36]. In SWAN, older age, greater economic strain, larger BMI, having arthritis, and current smoking were associated with reports of limitations in physical functioning. Although it has been posited that the reverse (e.g., younger age, less economic strain, etc.) may predict recovery, studies in older populations have reported few predictors and inconsistent results [33,36,37]. When we compared improvement or worsening to maintenance of physical functioning status, women who had a college degree or higher were least likely to improve or worsen. Given that college educated women were also least likely to have limitations, our findings suggest that highly educated women remain fully functional, which may be a result of increased resources and resilience over the life course.

Notably, women who were obese and women who had arthritis were significantly more likely to worsen to poorer levels of limitation as well as improve to lesser levels of limitation. Although larger body size was associated with greater limitations, the body-size-specific transition probabilities identified that the under/normal weight group and the overweight group had nearly identical transition probabilities and were relatively likely to remain fully functional. Obese women were substantially different: they were far less likely to maintain no limitations and far more likely to maintain substantial limitations. Obese women and women with arthritis were significantly more likely to change in their physical functioning status – either improve or worsen – compared to non-obese women or those without arthritis. BMI and arthritis appear to predict movement between levels of limitation, suggesting that these women could represent a particularly vulnerable population.

BMI is an important predictor of physical functioning [38]. BMI cut points are used to clinically define “high risk” individuals [39]. The use of specific race/ethnic cut points may be particularly salient since for a given BMI, Chinese and Japanese women have a higher percent body fat than Caucasians [14]. For all race/ethnic groups, obese women may be more susceptible to acute events that cause limitation; however the improvement that we observed among obese women also suggests they have the ability and opportunity to recover. Even though individuals with larger body sizes may be metabolically healthy [40], emerging evidence suggests that obesity is associated with greater incidence of cardiometabolic abnormalities over time among previously metabolically healthy overweight/obese individuals [41]. Although overweight women had similar transition probabilities to normal weight women, we hypothesize that with time, the impact of excess adiposity will become more exacerbated and physical functioning limitations may be more evident among overweight individuals as they age.

Arthritis can be a debilitating condition for lower extremity function. Our findings that arthritis is associated with greater likelihood of recovery may seem surprising; however, one possible explanation for improvement is that appropriate treatment after a diagnosis of arthritis symptoms or pain can restore functioning [42,43]. Body size and arthritis may be modifiable or manageable factors that are associated with recovery from limitations, and future work should focus on additional predictors of recovery to develop targeted interventions.

Although African Americans were disproportionately more likely than Caucasians to report limitations, this relationship was mostly explained by sociodemographic and other health

factors. Other studies have reported that disability differences among older Whites, Hispanics, and African Americans can be mostly explained by health and socioeconomic differences as well [9,44]. To our knowledge, this is the first investigation to report changes in physical functioning limitations in a multi-ethnic cohort that includes Asian women. Japanese and Chinese women are particularly under-studied groups in the United States, and more work is needed to understand our findings.

Although SWAN retention is excellent (>75%), women who were included in our analytic sample had higher education, less economic strain, and smaller body sizes than women lost to follow-up, which may have attenuated the results. Although we considered the possibility that women with substantial limitations at a previous visit were more likely to drop out, the distribution of limitations by study visit was similar when the sample was restricted to women who had complete functioning data at all 5 visits (results not shown). Furthermore, many women who reported substantial limitations or who were missing for a given study year subsequently improved to better states of functioning (Figure 2). Nevertheless, we were unable to determine the root cause of limitations. Since predictors of chronic limitations may differ from predictors of acute or transient limitations, future studies may wish to assess causation. Lastly, the association between BMI and physical functioning limitations may be mediated by physical activity, but our data collection did not allow us to account for physical activity over time. Nonetheless, SWAN is a large, well-characterized multi-racial cohort of community-dwelling mid-life women in whom we characterized predictors of limitations as well as the rates of onset and recovery.

In conclusion, supporting the process of healthy aging begins during the mid-life. The prevalence of and change in physical functioning limitations among mid-life women is high. Notably, women with large body size and with arthritis were not only more likely to worsen but also improve their physical functioning, suggesting that these women are amenable to interventions. Identification of modifiable risk factors, particularly among groups with relatively poor functioning, will help prevent disability. This paper demonstrates that improvement is observable even among the vulnerable groups – those women with known risk factors for poor functioning. Future studies should characterize predictors of improvement among these groups so that interventions can be designed to provide the most impact even in the context of many known immutable risk factors.

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Figure 1.
Self-reported limitations in physical functioning by study visit, SWAN.

Figure 2.

Dynamics of self-reported physical functioning status change in 2,497 women at 5 time points. The numbers inside each circle represent the number of women at each physical functioning status or missing for each visit. The uni-directional arrows with numbers represent the number of women transitioning from visit to visit.

Table 1

Distribution of participant characteristics at visit 4 by worst ever* self-reported limitations in physical functioning, SWAN.

	Total (n=2497)	No Limitation (n=813)	Some Limitation (n=1036)	Substantial Limitation (n=648)	P value
Demographics					
Age, years, mean (SD)	50.48(2.68)	50.57 (2.76)	50.51 (2.64)	50.57 (2.65)	0.16
Ethnicity, %					
Caucasian	49.2	53.6	51.3	39.8	
African American	30.0	24.4	25.1	45.2	<0.001
Chinese	9.8	9.1	10.3	9.8	
Japanese	11.1	13.0	13.3	5.2	
Education, %					
< High School	3.2	1.3	3.1	5.9	
High School or GED	15.6	12.1	14.5	21.8	
Some College	32.9	27.8	34.8	36.4	<0.001
College	22.4	27.8	21.8	16.5	
> College	25.9	31.0	25.8	19.4	
Economic Strain [†] , %					
None	65.5	76.1	67.1	49.8	
Some	27.1	20.8	26.8	35.5	<0.001
Substantial	7.4	3.1	6.1	14.7	
Marital Status, %					
Never Married	13.1	11.9	12.5	15.9	
Married	64.8	69.4	67.4	54.8	<0.001
Formerly Married	22.0	18.8	20.2	29.3	
Health Factors					
Body Mass Index, % [‡]					
Under or Normal weight	33.3	47.3	30.3	20.1	
Overweight	26.9	31.9	27.9	18.9	<0.001
Obese	40.9	20.9	41.8	61.9	
Diabetes, %	7.1	3.0	5.5	15.2	<0.001
Hypertension, %	14.6	10.2	12.5	24.0	<0.001

	Total (n=2497)	No Limitation (n=813)	Some Limitation (n=1036)	Substantial Limitation (n=648)	P value
Arthritis, %	30.9	14.6	33.8	47.4	<0.001
Current smoking, %	13.5	10.2	11.7	20.8	<0.001

* "Worst ever" status represents a participant's most limited physical functioning status at any time during her follow-up.

[†] Economic strain was not ascertained at visit 4; frequencies are baseline (V0) responses.

[‡] BMI was calculated as weight[kg]/height[m²] and categorized as underweight or normal weight (BMI 24.9 kg/m²), overweight (BMI 25–29.9 kg/m²) and obese (BMI ≥30 kg/m²) for Caucasian and African American women, and as underweight or normal weight (BMI <23 kg/m²), overweight (BMI 23–24.9 kg/m²), and obese (BMI ≥25 kg/m²), for Japanese and Chinese women.

Table 2

Probabilities (standard errors) of transition from one level of physical functioning (vertical axis) to the same or different level of physical functioning at the next study visit (horizontal axis), SWAN.

Unadjusted	To	None	Some	Substantial
	From			
	None	0.72 (0.01)	0.22 (0.01)	0.06 (0.003)
	Some	0.30 (0.01)	0.58 (0.01)	0.13 (0.01)
	Substantial	0.11 (0.01)	0.30 (0.01)	0.59 (0.02)
Adjusted for Age	To	None	Some	Substantial
	From			
	None	0.78 (0.01)	0.17 (0.01)	0.05 (0.01)
	Some	0.45 (0.02)	0.44 (0.02)	0.11 (0.01)
	Substantial	0.21 (0.02)	0.30 (0.02)	0.50 (0.03)
Caucasian Adjusted for Age	To	None	Some	Substantial
	From			
	None	0.80 (0.02)	0.16 (0.02)	0.04 (0.004)
	Some	0.50 (0.03)	0.42 (0.03)	0.09 (0.01)
	Substantial	0.27 (0.03)	0.32 (0.02)	0.41 (0.03)
African American Adjusted for Age	To	None	Some	Substantial
	From			
	None	0.71 (0.02)	0.21 (0.02)	0.08 (0.01)
	Some	0.38 (0.02)	0.47 (0.03)	0.16 (0.01)
	Substantial	0.16 (0.02)	0.28 (0.02)	0.59 (0.03)
Chinese Adjusted for Age	To	None	Some	Substantial
	From			
	None	0.77 (0.02)	0.19 (0.02)	0.04 (0.01)
	Some	0.45 (0.03)	0.46 (0.03)	0.09 (0.01)
	Substantial	0.24 (0.03)	0.35 (0.03)	0.41 (0.04)
Japanese Adjusted for Age	To	None	Some	Substantial
	From			
	None	0.84 (0.02)	0.15 (0.01)	0.02 (0.01)
	Some	0.55 (0.03)	0.40 (0.03)	0.04 (0.01)
	Substantial	0.37 (0.04)	0.39 (0.02)	0.24 (0.04)
BMI < 25 Adjusted for Age	To	None	Some	Substantial
	From			
	None	0.82 (0.01)	0.14 (0.01)	0.04 (0.004)
	Some	0.53 (0.03)	0.38 (0.02)	0.09 (0.01)
	Substantial	0.28 (0.03)	0.29 (0.02)	0.43 (0.03)
25 BMI < 30 Adjusted for Age	To	None	Some	Substantial
	From			

	None	0.83 (0.01)	0.14 (0.01)	0.03 (0.004)
	Some	0.55 (0.03)	0.38 (0.03)	0.07 (0.01)
	Substantial	0.31 (0.03)	0.31 (0.03)	0.37 (0.03)
BMI > 30 Adjusted for Age	To	None	Some	Substantial
	From			
	None	0.68 (0.02)	0.25 (0.02)	0.08 (0.01)
	Some	0.34 (0.02)	0.51 (0.02)	0.14 (0.01)
	Substantial	0.14 (0.02)	0.30 (0.02)	0.56 (0.03)

Table 3

Longitudinal multinomial adjusted* association between demographic and health factors and self-reported physical functioning, SWAN.

	Some vs. None			Substantial vs. None		
	OR	95% CI	P value	OR	95% CI	P value
Demographics						
Age, years	1.04	1.01, 1.07	0.004	1.09	1.04, 1.13	<0.001
Ethnicity						
Caucasian	Ref			Ref		
African American	0.94	0.70, 1.25	0.68	1.63	1.06, 2.52	0.03
Chinese	2.03	1.22, 3.36	0.01	1.76	0.76, 4.10	0.19
Japanese	0.96	0.60, 1.54	0.88	0.46	0.18, 1.18	0.11
Education						
< High School	1.80	0.90, 3.59	0.1	3.32	1.33, 8.24	0.01
High School or GED	Ref			Ref		
Some College	0.86	0.62, 1.19	0.37	0.72	0.44, 1.17	0.18
College	0.70	0.49, 0.99	0.05	0.43	0.24, 0.75	0.003
> College	0.67	0.47, 0.96	0.03	0.46	0.27, 0.81	0.01
Economic Strain						
None	Ref			Ref		
Some	1.79	1.43, 2.25	<0.001	2.15	1.53, 3.02	<0.001
Substantial	2.53	1.59, 4.04	<0.001	4.73	2.64, 8.47	<0.001
Marital Status						
Never Married	1.13	0.81, 1.57	0.48	1.37	0.83, 2.25	0.22
Married	Ref			Ref		
Formerly Married	1.03	0.81, 1.32	0.81	1.40	0.97, 2.03	0.07
Health Factors						
Body Mass Index [†]						
Under or normal weight	Ref			Ref		
Overweight	1.34	1.04, 1.74	0.03	1.01	0.63, 1.61	0.97
Obese	3.24	2.49, 4.21	<0.001	4.77	3.07, 7.41	<0.001
Diabetes	1.29	0.93, 1.77	0.12	2.27	1.47, 3.50	0.002

	Some vs. None			Substantial vs. None		
	OR	95% CI	P value	OR	95% CI	P value
Hypertension	0.97	0.75, 1.25	0.81	0.74	0.50, 1.05	0.11
Arthritis	2.97	2.41, 3.66	<0.001	5.81	4.10, 8.23	<0.001
Current smoking	1.15	0.83, 1.61	0.4	1.74	1.09, 2.79	0.02

* Model is also adjusted for menopause status, depressive symptoms, and site.

[†] BMI was calculated as weight[kg]/height[m²] and categorized as underweight or normal weight (BMI 24.9 kg/m²), overweight (BMI 25–29.9 kg/m²) and obese (BMI 30 kg/m²) for Caucasian and African American women, and as underweight or normal weight (BMI <23 kg/m²), overweight (BMI 23–24.9 kg/m²), and obese (BMI 25 kg/m²), for Japanese and Chinese women.

Table 4

Longitudinal multinomial adjusted* association between demographic and health factors and progression or improvement of physical functioning limitations, SWAN.

	Improvement vs. None			Progression vs. None		
	OR	95% CI	P value	OR	95% CI	P value
Demographics						
Age, years	0.98	0.95, 1.00	0.02	1.05	1.02, 1.07	0.002
Ethnicity						
Caucasian	Ref			Ref		
African American	0.96	0.75, 1.24	0.75	1.12	0.90, 1.40	0.30
Chinese	1.37	0.90, 2.09	0.15	1.49	1.04, 2.12	0.03
Japanese	1.01	0.66, 1.56	0.95	0.94	0.67, 1.33	0.73
Education						
< High School	1.15	0.67, 1.96	0.62	1.26	0.82, 1.93	0.29
High School or GED	Ref			Ref		
Some College	1.02	0.77, 1.35	0.89	0.88	0.70, 1.10	0.26
College	0.73	0.53, 0.99	0.04	0.63	0.49, 0.83	0.001
> College	0.83	0.61, 1.13	0.24	0.79	0.61, 1.02	0.07
Economic Strain						
None	Ref			Ref		
Some	1.28	1.03, 1.60	0.03	1.35	1.11, 1.65	0.003
Substantial	0.91	0.59, 1.40	0.68	1.46	1.02, 2.08	0.04
Marital Status						
Never Married	1.06	0.79, 1.42	0.69	0.89	0.68, 1.15	0.37
Married	Ref			Ref		
Formerly Married	1.54	1.24, 1.92	<0.001	1.14	0.94, 1.38	0.20
Health Factors						
Body Mass Index [†]						
Under or normal weight	Ref			Ref		
Overweight	1.07	0.83, 1.38	0.45	1.25	1.00, 1.55	0.04
Obese	1.63	1.28, 2.06	<0.001	1.51	1.27, 1.92	<0.001

	Improvement vs. None			Progression vs. None		
	OR	95% CI	P value	OR	95% CI	P value
Diabetes	0.90	0.68, 1.21	0.47	0.89	0.69, 1.14	0.34
Hypertension	1.53	1.20, 1.95	0.001	0.90	0.73, 1.16	0.37
Arthritis	2.03	1.67, 2.46	<0.001	1.90	1.64, 2.28	<0.001
Current smoking	1.24	0.93, 1.66	0.15	1.44	1.13, 1.85	0.004

Model is also adjusted for menopause status, depressive symptoms, and site.

Improvement is “getting better” (e.g., substantial to no limitations).

Progression is “getting worse” (e.g., none to substantial limitations).

[†] BMI was calculated as weight[kg]/height[m²] and categorized as underweight or normal weight (BMI 24.9 kg/m²), overweight (BMI 25–29.9 kg/m²) and obese (BMI ≥30 kg/m²) for Caucasian and African American women, and as underweight or normal weight (BMI <23 kg/m²), overweight (BMI 23–24.9 kg/m²), and obese (BMI ≥25 kg/m²), for Japanese and Chinese women.