Relationship Between Marital Transitions, Health Behaviors, and Health Indicators of Postmenopausal Women: Results from the Women's Health Initiative

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Abstract

Background: Historically, marital status has been associated with lower mortality and transitions into marriage were generally accompanied by improved health status. Conversely, divorce has been associated with increased mortality, possibly mediated by changes in health behaviors.

Methods: This study uses data from a prospective cohort of 79,094 postmenopausal women participating in the Women's Health Initiative Observational Study (WHI-OS) to examine the relationship between marital transition and health indicators (blood pressure, waist circumference, body mass index [BMI]) as well as health behaviors (diet pattern, alcohol use, physical activity, and smoking) in a sample of relatively healthy and employed women. Linear and logistic regression modeling were used to test associations, controlling for confounding factors.

Results: Women's transitions into marriage/marriage-like relationship after menopause were associated with greater increase in BMI ($\beta=0.22$; confidence interval [95% CI], 0.11–0.33) and alcohol intake ($\beta=0.08$; 95% CI, 0.04–0.11) relative to remaining unmarried. Divorce/separation was associated with a reduction in BMI and waist circumference, changes that were accompanied by improvements in diet quality ($\beta=0.78$, 95% CI, 0.10–1.47) and physical activity ($\beta=0.98$, 95% CI, 0.12–1.85), relative to women who remained married.

Conclusion: Contrary to earlier literature, these findings among well-educated, predominantly non-Hispanic white women suggest that marital transitions after menopause are accompanied by modifiable health outcomes/behaviors that are more favorable for women experiencing divorce/separation than those entering a new marriage.

Keywords: menopausal, health behaviors, marriage, divorce, body mass index, smoking, obesity

Introduction

THE ASSOCIATION BETWEEN marital status and health has been of interest in the medical and behavioral sciences for over a century.¹ Studies from the 1980's suggested that married individuals experienced less morbidity and lower mortality than those who were not married, whereas being single or experiencing the loss of a relationship from divorce

or death was associated with higher mortality.^{2–4} The protective effect of marriage has been hypothesized to be related to the economic and social support, as well as regulation of behaviors that marriage provides which are disrupted in divorce, thus leading to adverse health effects.⁵ Data from these earlier studies were largely cross-sectional in nature, providing limited opportunity to evaluate the impact of marital experiences on change in health. More recent reviews and meta-analyses

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provide insight into the results of prospective studies.^{1,4,6-8} In a meta-analysis of older adults by Manzoli et al., divorced/separated individuals had higher mortality than married individuals, with similar risk estimates for men and women.⁷ A meta-analysis by Sbarra et al. showed that divorced/separated individuals had a 23% higher risk of early death compared with married individuals¹ and a more recent meta-analysis identified a 30% higher mortality among divorced/separated compared with married individuals.⁴

Changes in health behaviors such as diet, physical activity, smoking, and/or alcohol use may occur during marital status transitions and could explain the relationship between these exposures and mortality. These modifiable lifestyle behaviors are important given the empirical evidence of associations with chronic disease and mortality.^{9,10} Studies evaluating weight change, particularly for women, provide conflicting evidence, and it is unclear if marital transitions affect younger and older women differently. This is of interest given the doubling of the rate of divorce in those over age 50.¹¹ A more recent review, evaluating studies published between 1990 and 2011, found new marriage generally was associated with weight gain.¹² The relationship of divorce and weight change is less clear. One study found no significant associations between divorce and weight change among women with an average age of 45.7 years who were married at baseline, but divorced 10 years later,¹³ and yet the Nurses' Health Study which focused on older women, age 46–71, found divorce to be associated with a decrease in body mass index (BMI).¹⁴ Still other research has suggested that reductions in BMI after divorce were temporary.^{12,15}

The effects of marital transitions on body weight could be related to changes in diet as suggested by Lee et al. who found new marriage to be associated with higher vegetable consumption and divorce to be associated with lower energy and vegetable intake. In this same study physical activity was not associated with either marital transition.¹⁴ A study utilizing a treadmill-based fitness test in married individuals found that marriage, relative to single status, was associated with lower fitness.¹⁶ Marital transitions also may be associated with changes in alcohol and tobacco use. An increase in alcohol intake with new marriage was demonstrated in one study,¹⁴ but not another.¹⁷ Similar inconsistencies have been reported for tobacco use.^{14,18,19}

The current study investigated the impact of marital transitions on health behaviors in the largest prospective sample of postmenopausal women to date, to identify modifiable behavioral targets for health promotion and prevention. Women who became widowed were not included in the current study, since these women had been evaluated previously by Wilcox et al.¹⁷ Similar to past research,^{14,17} it was hypothesized that postmenopausal women who entered a marriage/marriage-like relationship would demonstrate an increase in BMI/waist circumference over the 3-year study period, potentially accompanied by decreased physical activity and reduced diet quality. Change in alcohol use, tobacco use, and blood pressure were also explored.

Data and Methods

The Women's Health Initiative (WHI) is a multicenter study that began in 1992 and sought to characterize and better un-

derstand the leading causes of morbidity and mortality in postmenopausal women. Between 1993 and 1998, women were recruited from 40 clinical centers across the United States. Full details of the WHI design are reported elsewhere.²⁰ The WHI Observational Study (WHI-OS) included 93,676 women who were either specifically recruited to the OS or were identified and offered participation after being determined ineligible or uninterested in the WHI clinical trials. Inclusion criteria for the WHI-OS were age 50–79 years, postmenopausal status, and plan to reside in the study area for at least 3 years. Exclusion criteria were medical conditions with predicted survival of <3 years, severe mental illness, dementia, active alcoholism or drug dependency, or active participation in any other intervention trial. Institutional Review Boards at all study sites reviewed and approved the study protocol and all participants provided written informed consent.

Study population

Of the 93,676 women in the WHI-OS, 81,920 had known marital status at both baseline and year 3. The current analysis focused on the effects of entering marriage or a similar, self-defined relationship, or becoming divorced or separated and, therefore, considered subsamples of women in the WHI-OS. To examine the effects of becoming married or entering a marriage-like relationship, the first analytic sample included a subset of women ($n=30,108$) who were unmarried at baseline (*i.e.*, those who were divorced/separated, widowed, or never married) and either remained unmarried ($n=28,572$) or became married (including those entering self-defined marriage-like relationships) ($n=1,536$) at year 3. The second set of analyses focused on women partnered at baseline (*i.e.*, married or in a marriage-like relationship at baseline) ($n=48,986$) who either stayed partnered ($n=48,316$) or became divorced or separated ($n=670$) by year 3. Those who became widowed ($n=2,792$) were not included in the analysis since these data were previously studied by Wilcox et al.¹⁷ Also, women with inconsistent data (*e.g.*, “married” at baseline to “never married” at year 3, $n=14$) were excluded.

Demographic and marital status measures

Participants reported written demographic information, including age, race/ethnicity, education, and family income. Additionally, women were asked, “What is your current marital status?” at baseline and at the 3-year visit. Response categories were “never married,” “divorced or separated,” “widowed,” “presently married,” or “marriage-like relationship.” The category “marriage-like relationship” was left open to self-interpretation. No distinction or further questions were asked with regard to opposite/same sex relationships, or cohabitation. To study the effect of becoming married (including entering a marriage-like relationship), the categories of “never married,” “divorced or separated,” and “widowed” were combined into a “not married” at baseline group. To study the effects of divorce/separation, the categories of “presently married” and “marriage-like relationship” were combined into a “married” at baseline group.

Psychosocial measures

Psychosocial measures were identified as covariates in the analysis and included emotional well-being, social functioning,

depression, and social support. Emotional well-being and social functioning were measured from well-established scales of items from the Short Form-36.²¹ Emotional well-being was measured with five items. For example, participants were asked how often in the last 4 weeks they had felt “calm and peaceful,” with six response categories ranging from “all of the time” to “none of the time.” Social functioning consisted of two items. Participant were asked, “During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups,” with five potential responses ranging from “not at all” to “extremely.” Additionally, they were asked, “During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?” Response categories consisted of five items ranging from “all of the time” to “none of the time.” For both emotional well-being and social functioning, scale scores were recoded utilizing a 0 to 100 scale (e.g., values assigned as “0,” “25,” “50,” etc.). Items were averaged with a higher score indicating better emotional well-being or social functioning following the established Short Form-36 coding rules by Ware & Sherbourne.¹⁹

Depression was measured by a shortened version of the Center for Epidemiological Studies Depression Scale (CES-D).²² Individual items on this scale were logistically weighted resulting in an overall score that ranged from 0 to 1, with scores above 0.06 consistent with depression.²³ The sensitivity of CES-D for detecting depression or dysthymia has been reported at 86% in primary care populations and 92% in mental health populations.²³

Social support was assessed using nine items from the Medical Outcomes Study questionnaire.²⁴ Participants used a 5-point scale to rank how often different aspects of social support were available. These aspects included emotional support, affectionate relationships, tangible support, and positive interactions.

Physical measurements

Dependent variables included blood pressure, waist circumference, and BMI. Physical measurements (e.g., height, weight, waist, and blood pressure) were assessed by trained study personnel using standard protocols during in-person study visits. Height and weight measurements were taken without shoes and in light clothing. BMI was calculated based on these values as weight in kilograms divided by height in meters squared. Blood pressure was measured with standardized, study-wide protocol that included using an average of two readings taken after at least 5 minutes rest. Waist circumference was measured in centimeters at the umbilicus, again using standardized training and measurement protocols (The Women’s Health Initiative Study Group 1998).²⁰

Diet/health behaviors

Diet, alcohol consumption, physical activity, and smoking status were additional dependent variables of interest. Dietary information was summarized from the WHI Food Frequency Questionnaire (FFQ).²⁵ The FFQ includes 122 items on foods and food groups. Questions are directed at frequency of intake of a particular food/nutrient and portion

size. Participants were asked to recall their average intake of a particular food over the past 3-month period.²⁵ Dietary data that reported unreliable intake (<600 or >5,000 kcal/day) were excluded. The Alternate Healthy Eating Index (AHEI) was calculated from dietary data reported on the WHI FFQ and used as a standardized indicator of overall dietary quality in this analysis.²⁶ High index scores have been associated with decreased risk of cardiovascular disease and type 2 diabetes.^{27,28}

Physical activity was measured by several items, which asked participants how often they walked outside the home for >10 minutes without stopping; how many minutes they did this; and at what speed. Participants reported the frequency and duration of various types of strenuous and moderate exercises with examples provided. This information was used to compute a variety of recreational physical activities recorded in metabolic equivalents (MET)-hours/week.^{29,30}

Smoking status was ascertained by self-report. Participants were asked, “During your entire life, have you smoked at least 100 cigarettes?” Those responding “no” were classified as a “never” smoker. Those responding “yes” were then asked if they currently smoked cigarettes. Based on this response, participants were classified as “former” or “current” smokers.

Statistical analysis

Two distinct sets of analyses were performed. The first examined the effects of transitions from not married into marriage or a marriage-like relationship on the outcomes of interest defined above. The second focused on transitions from marriage or marriage-like relationship to divorce or separation on the same physical measurements and health behaviors. Specifically, linear regression models were developed for both analyses for change (year 3 minus baseline) in the following variables: systolic blood pressure, diastolic blood pressure, waist circumference, BMI, AHEI, alcohol intake, and physical activity. Each model calculated a β -coefficient and 95% confidence interval (CI) for the effect of marriage (or divorce) on each outcome. Results were considered significant at the $p < 0.05$ level.

Logistic regression models examined the relationships for marital transitions and smoking status. The effect of marriage (or divorce) on the transition from nonsmoking at baseline to smoking at year 3 was tested in the subgroup of women who were nonsmokers at baseline (never or former). Additionally, the effect of marriage (or divorce) on the transition from smoking at baseline to nonsmoking at year 3 was tested in the subgroup of women who were current smokers at baseline. Each model calculated an odds ratio (OR) and 95% CI on the effect of marriage (or divorce) on starting/resuming or quitting smoking. Results were considered significant at the $p < 0.05$ level.

Marital transition status was the main independent variable of interest. Based on literature review, models were further adjusted for age (continuous); baseline level of outcome measure; race/ethnicity (non-Hispanic white vs. other); income (<\$20k, \$20k to <\$35k, \$35k to <\$50k, \$50k to <\$75k, $\geq$ \$75k); education ($\leq$ high school, some college, $\geq$ college graduate); social support at baseline (continuous); emotional well-being at year 3 (continuous); social functioning at year 3 (continuous); and depression score at year 3 (continuous). Blood pressure models were further adjusted for reported use

of antihypertensive medication or beta-blockers at year 3. Marginal predictions were calculated separately for each marital status group, assuming average values of all other covariates, for each outcome variable.

For the analysis that tested the effect of new marriage, a sensitivity analysis was conducted wherein different subgroups of “not married” women (never married, widowed, or divorced) were examined separately. Additionally, for the analysis testing the effect of new divorce/separation, a sensitivity analysis was conducted wherein the categories of “marriage” and “marriage-like relationships” were exam-

ined separately. All analyses were performed using Stata 13.1 (StataCorp, College Station, TX, 2013).

Results

Demographic characteristics and baseline measures by marital transition status are displayed in Table 1. Comparisons across marital status categories were all strongly significant (all $p < 0.001$). Women who transitioned out of or into marriage tended to be younger than those who either stayed married or remained unmarried. Those who became

TABLE 1. BASELINE CHARACTERISTICS OF WOMEN'S HEALTH INITIATIVE OBSERVATIONAL STUDY PARTICIPANTS BY MARITAL TRANSITION STATUS

Characteristics	Married at baseline		Not married at baseline	
	Married at Year 3	Divorced/separated at Year 3	Not married at Year 3	Married at Year 3
<i>N</i>	48,316	670	28,572	1,536
Age (years), mean $\pm$ SD	62.6 $\pm$ 7.0	58.3 $\pm$ 6.5	65.2 $\pm$ 7.5	61.1 $\pm$ 7.2
Race/ethnicity, <i>n</i> (%)				
Non-Hispanic white	42,574 (88.3)	519 (77.7)	22,966 (80.7)	1,293 (84.3)
Black	2,070 (4.29)	74 (11.1)	3,294 (11.6)	109 (7.11)
Hispanic	1,449 (3.01)	46 (6.89)	1,010 (3.55)	78 (5.09)
Asian	1,500 (3.11)	15 (2.25)	723 (2.54)	31 (2.02)
Native American	156 (0.32)	6 (0.90)	132 (0.46)	6 (0.39)
Other	454 (0.98)	8 (1.20)	351 (1.23)	16 (1.04)
Education, <i>n</i> (%)				
$\leq$ High school diploma or GED	9,706 (20.2)	113 (17.0)	5,795 (20.4)	254 (16.6)
Some college	17,199 (35.8)	265 (39.9)	10,439 (36.8)	584 (38.2)
$\geq$ College graduate	21,159 (44.0)	286 (43.1)	12,168 (42.8)	690 (45.2)
Annual family income (\$), <i>n</i> (%)				
$<20,000$	2,331 (5.22)	67 (10.6)	8,192 (30.4)	314 (21.5)
20,000–34,999	7,936 (17.8)	97 (15.4)	8,538 (31.6)	422 (28.9)
35,000–49,999	9,183 (20.6)	123 (19.5)	5,319 (19.7)	322 (22.0)
50,000–74,999	11,339 (25.4)	161 (25.5)	3,531 (13.1)	257 (17.6)
$\geq 75,000$	13,869 (31.1)	183 (29.0)	1,408 (5.22)	147 (10.1)
Psychosocial measures, mean $\pm$ SD				
Emotional well-being (SF-36)	79.9 $\pm$ 13.6	73.3 $\pm$ 17.3	78.0 $\pm$ 15.2	78.1 $\pm$ 15.5
Social functioning (SF-36)	91.1 $\pm$ 16.7	85.5 $\pm$ 21.0	88.1 $\pm$ 19.4	89.0 $\pm$ 18.8
Depression (shortened CES-D)	0.03 $\pm$ 0.11	0.09 $\pm$ 0.20	0.05 $\pm$ 0.15	0.05 $\pm$ 0.15
Social support construct	38.2 $\pm$ 6.6	34.3 $\pm$ 7.9	32.7 $\pm$ 8.2	35.3 $\pm$ 7.7
Physical measures, mean $\pm$ SD				
Systolic blood pressure (mm Hg)	125.8 $\pm$ 17.4	121.8 $\pm$ 17.3	127.5 $\pm$ 18.0	123.5 $\pm$ 17.6
Diastolic blood pressure (mm Hg)	74.8 $\pm$ 9.1	74.7 $\pm$ 9.6	74.4 $\pm$ 9.5	74.4 $\pm$ 9.3
Waist circumference (cm)	83.3 $\pm$ 12.5	82.9 $\pm$ 12.8	85.6 $\pm$ 13.6	82.6 $\pm$ 12.7
Body mass index (kg/m ²)	26.6 $\pm$ 5.2	26.6 $\pm$ 5.2	27.4 $\pm$ 5.8	26.3 $\pm$ 5.2
Health behaviors				
Alternate Healthy Eating Index, mean $\pm$ SD	46.1 $\pm$ 10.3	45.8 $\pm$ 10.6	45.9 $\pm$ 10.4	47.1 $\pm$ 10.7
Alcohol intake (drinks/day), mean $\pm$ SD	0.45 $\pm$ 0.84	0.41 $\pm$ 0.88	0.37 $\pm$ 0.77	0.51 $\pm$ 0.85
Smoking, <i>n</i> (%)				
Never	25,478 (53.4)	309 (47.0)	13,668 (48.5)	677 (44.8)
Former	20,195 (42.3)	297 (45.1)	12,276 (43.6)	708 (46.9)
Current	2,073 (4.34)	52 (7.90)	2,238 (7.94)	126 (8.34)
Physical activity (MET-hour/week), mean $\pm$ SD	14.3 $\pm$ 14.0	14.4 $\pm$ 14.4	12.9 $\pm$ 13.6	15.3 $\pm$ 14.8

Missing data: race/ethnicity ($n=214$; 0.3%), education ($n=436$; 0.6%), income ($n=5,355$; 6.8%), emotional well-being ($n=1,082$; 1.4%), social functioning ($n=691$; 0.9%), depression ($n=1,821$; 2.3%), social support ($n=1,934$; 2.4%), systolic blood pressure ($n=6,089$; 7.7%), diastolic blood pressure ($n=6,016$; 7.6%), waist circumference ($n=7,139$; 9.0%), body mass index ($n=7,674$; 9.7%), Alternate Healthy Eating Index ($n=2,767$; 3.5%), smoking ($n=997$; 1.3%), physical activity ($n=1,411$; 1.8%). Comparisons across all four marital status categories were all strongly significant, using Kruskal–Wallis tests for continuous variables and chi-square tests for categorical variables (all $p < 0.001$).

MET, metabolic equivalents; SD, standard deviation.

TABLE 2. EFFECT OF MARRIAGE ON CHANGE IN HEALTH OUTCOMES BETWEEN BASELINE AND YEAR 3 IN THE WOMEN'S HEALTH INITIATIVE OBSERVATIONAL STUDY AMONG WOMEN WHO WERE NOT MARRIED AT BASELINE

Outcome measure	β (95% CI)		P^d	Predicted change at year 3 ^a	
	Model 1 ^b	Model 2 ^c		Not married	Married
Systolic blood pressure (mm Hg)	0.70 (−0.09, 1.49)	0.94 (0.11, 1.78)	0.027	−0.29	0.65
Diastolic blood pressure (mm Hg)	0.55 (0.10, 1.00)	0.57 (0.10, 1.04)	0.018	−1.29	−0.72
Waist circumference (cm)	0.30 (−0.30, 0.36)	0.00 (−0.35, 0.35)	0.998	1.07	1.07
Body mass index (kg/m ²)	0.21 (0.11, 0.31)	0.22 (0.11, 0.33)	<0.001	0.34	0.56
Alternate Healthy Eating Index	0.26 (−0.19, 0.70)	0.10 (−0.37, 0.57)	0.680	0.86	0.96
Alcohol intake (drinks/day)	0.09 (0.06, 0.12)	0.08 (0.04, 0.11)	<0.001	−0.02	0.06
Physical activity (MET-hour/week)	0.02 (−0.52, 0.56)	−0.20 (−0.77, 0.37)	0.492	−0.46	−0.66

^aPredictive margins based on model 2.^bLinear regression model adjusted for age (continuous) and baseline level of outcome measure (continuous).^cFurther adjusted for race/ethnicity (NHW vs. other), income (<\$20k, \$20k to <\$35k, \$35k to <\$50k, \$50k to <\$75k, ≥\$75k), education (≤high school, some college, ≥college graduate), social support at baseline (continuous), emotional well-being at year 3 (continuous), social functioning at year 3 (continuous), and depression score at year 3 (continuous). Blood pressure models were further adjusted for reported use of antihypertensive medication or beta blockers at year 3.^d P -Value for effect of marriage in model 2.

CI, confidence interval; NHW, Non-Hispanic White.

divorced had higher baseline measures of depression and lower measures of emotional well-being, social functioning, and social support than those who remained married. Health behaviors were different across marital transitions groups. Women who became married reported higher diet quality, physical activity, and alcohol intake than those who stayed single. Smoking rates were lowest in the stayed-married group.

Data for the 14,582 women excluded from the analysis due to incomplete/inconsistent marital status or divorce are not shown. Comparison of these women to those included in Table 1 revealed statistically significant differences in that fewer reported being white (73.4%); lower education and economic levels; lower scores on psychosocial measures; higher depression scores (0.06); higher BMI (27.5 kg/m²); worse dietary scores; less physical activity (12.3 MET-hours/week); less alcohol intake (0.34 drinks per day); and higher rates of current smoking (9.4%).

Table 2 displays the linear regression results for the effect of new marriage on change in physical measurements and health behaviors over 3 years. Although both groups of women gained weight over the 3-year period, in the fully adjusted model, women who became married experienced a greater increase in BMI, compared to those that remained unmarried ($p < 0.001$). Both groups of women experienced a slight increase in waist circumference, but this was not different between the groups ($p = 0.998$). Systolic blood pressure decreased in women who remained unmarried, but increased in women who became married ($p = 0.027$). Diastolic blood pressure decreased in both groups, but to a lesser extent in women who became married ($p = 0.018$). Interestingly, AHEI (dietary quality) scores improved for both groups of women without differences between groups ($p = 0.680$). Alcohol intake decreased slightly for unmarried women, but increased for women who became married ($p < 0.001$). Physical activity decreased for both groups without significant differences between the groups ($p = 0.492$).

For unmarried women who did not smoke at baseline, new marriage was not associated with starting/resuming smoking (OR, 1.07; 95% CI, 0.61–1.87; $p = 0.808$). Additionally, for unmarried women who smoked at baseline, becoming mar-

ried was not associated with smoking cessation (OR, 1.11; 95% CI, 0.71–1.72; $p = 0.646$).

The effect of transitioning from marriage to divorce/separation on health outcomes is displayed in Table 3. BMI increased for women who remained married, but decreased slightly for women who became divorced/separated ($p < 0.001$). Waist circumference followed a similar pattern with an increase for women who remained married versus a small decrease in women who became divorced/separated ($p < 0.001$). Blood pressure measures decreased for both groups of women, with greater decreases in women who became divorced/separated that was significant for diastolic ($p = 0.005$), but not systolic ($p = 0.072$) blood pressure. The mean dietary AHEI score also increased (improved) for both groups of women, with larger improvements for the divorced/separated women ($p = 0.025$). Physical activity increased in the divorced/separated women compared with a decrease in women who remained married ($p = 0.026$). Changes in alcohol intake were not significantly different between groups ($p = 0.105$).

For married women who were nonsmokers at baseline (either “never” or “former,” $n = 513$), the odds of starting/resuming smoking were significantly higher in women who became divorced/separated than those who remained married (OR, 3.72; 95% CI, 1.96–7.09; $p < 0.001$). While the majority of these women were former smokers, about 5% were new smokers. However, there was no effect of divorce/separation on smoking cessation among current smokers at baseline (OR, 1.22; 95% CI, 0.65–2.29; $p = 0.543$).

Sensitivity analyses examining the effects of new marriage, restricting the sample to women who were “never married” at baseline did not change the direction of the findings listed in Table 2, but findings previously significant for blood pressure, BMI, and alcohol intake were no longer significant. Those “never married” at baseline, who remained unmarried had significantly greater declines in physical activity level than those who became married (β -coefficient, −2.4; 95% CI, −4.49 to −0.31; $p = 0.024$) (see Supplementary Table S1; Supplementary Data are available online at www.liebertpub.com/jwh). Restricting the analyses to those “divorced” or “widowed” at baseline did not change the findings in Table 2.

TABLE 3. EFFECT OF DIVORCE/SEPARATION ON CHANGE IN HEALTH OUTCOMES BETWEEN BASELINE AND YEAR 3 IN THE WOMEN'S HEALTH INITIATIVE OBSERVATIONAL STUDY AMONG WOMEN WHO WERE MARRIED AT BASELINE

Outcome measure	β (95% CI)		P^d	Predicted change at year 3 ^a	
	Model 1 ^b	Model 2 ^c		Still married	Divorce or separation
Systolic blood pressure (mm Hg)	-0.88 (-2.00, 0.24)	-1.11 (-2.32, 0.10)	0.072	-0.40	-1.51
Diastolic blood pressure (mm Hg)	-0.70 (-1.33, -0.06)	-1.00 (-1.68, -0.31)	0.005	-1.45	-2.45
Waist circumference (cm)	-0.92 (-1.37, -0.46)	-0.93 (-1.42, -0.44)	<0.001	0.93	-0.01
Body mass index (kg/m ²)	-0.42 (-0.56, -0.28)	-0.42 (-0.57, -0.26)	<0.001	0.33	-0.09
Alternate Healthy Eating Index	0.50 (-0.14, 1.14)	0.78 (0.10, 1.47)	0.025	1.06	1.84
Alcohol intake (drinks/day)	0.02 (-0.04, 0.06)	0.04 (-0.01, 0.10)	0.105	-0.02	0.02
Physical activity (MET-hour/week)	0.41 (-0.40, 1.21)	0.98 (0.12, 1.85)	0.026	-0.25	0.74

^aPredictive margins based on model 2.

^bLinear regression model adjusted for age (continuous) and baseline level of outcome measure (continuous).

^cFurther adjusted for race/ethnicity (NHW vs. other), income (<\$20k, \$20k to <\$35k, \$35k to <\$50k, \$50k to <\$75k, ≥\$75k), education (≤high school, some college, ≥college graduate), social support at baseline (continuous), emotional well-being at year 3 (continuous), social functioning at year 3 (continuous), and depression score at year 3 (continuous). Blood pressure models were further adjusted for reported use of antihypertensive medication or beta blockers at year 3.

^d p -Value for effect of divorce in model 2.

For analyses examining the effects of new divorce or separation, baseline marriage and marriage-like relationships were examined separately. Including only those “presently married” at baseline in the analysis did not change the significance of the findings displayed in Table 3 with the exception that differences in physical activity were no longer significant (β -coefficient, 0.52; 95% CI, -0.45 to -1.48; $p=0.295$) (see Supplementary Table S2). Due to small sample size, sensitivity analysis was not performed on the smoking status logistic regression models.

Discussion

In our sample getting married between baseline and year 3 was associated with an increase in BMI and alcohol consumption compared with those who remained unmarried. These changes likely influenced the increase in systolic and diastolic blood pressure demonstrated here.⁹ The magnitude of these changes was small. For example, although both groups of women gained weight during the 3-year study period, those who became married increased BMI by 0.56 kg/m² versus 0.34 kg/m² in those who stayed single. This corresponds to a weight gain of about 1 kg (2.2 lbs.) for those who became married. Even modest increases in weight can promote an undesirable elevation in blood pressure.^{31,32}

The current study's findings are consistent with the majority of prior studies demonstrating the association of new marriage with weight gain.¹² Overall, the magnitude of weight gain demonstrated in these studies was around 2 kg, which is slightly higher than the weight gain noted in the present study. The weight gain seen in the present study, however, was not accompanied by clear changes in diet or physical activity. While imprecision in measurement for self-reported diet and activity may account for the lack of association,³³ it is possible, as others have suggested, that the shared, regular mealtimes characteristic of married life may result in larger portion sizes which, in turn, contribute to

weight increase.³⁴ The current findings point to the need for greater awareness by healthcare providers regarding the potential for weight gain with marriage. The findings support the importance of counseling women on weight maintenance strategies during times of marital transitions.

Divorced/separated women experienced weight loss relative to women who stayed married. Past research in this area has yielded mixed results.¹³⁻¹⁵ Differing ages of women studied may account for the variable findings shown here.³⁵ Specifically, the effect of new divorce/separation on body weight may be more significant for older women. Lee, using data from the Nurses' Health Study of women with average age older than 60, found that women who became divorced had a mean BMI decrease of 0.65 kg/m² relative to the BMI change in women who remained married in a follow-up period of 4 years.¹⁴ In the present study, the BMI decrease in divorced, older women was relatively small, averaging 0.09 kg/m² over 3 years; the significance of this finding was driven more by the relative increase in BMI in those who remained married. The reason for this weight loss remains unclear, but the relationship persisted after controlling for emotional well-being, social functioning, and depression. Accompanying improvements in eating patterns and physical activity level suggest that these women were actively engaged in improving their health.

Different lengths of follow-up in published studies also may have affected weight loss results. Umberson et al. in a 15-year study, found that weight loss among newly divorced women was only a short-term (3-4 year) phenomenon and is not a major contributor to adult weight gain given the tendency of adults to continue to gain weight over their lifespans.¹⁵ Also, many women will remarry and, as noted above, this is frequently accompanied by marital transition-associated weight gain.

The transition to divorce or separation was associated with other expected and unexpected findings. Divorced/separated women were more likely to start smoking than women who

stayed married, but new divorce/separation also was associated with positive health outcomes and behaviors. Compared with their counterparts who stayed married, divorced/separated women demonstrated reductions in blood pressure and increases in physical activity at least during the short-term observation period examined here.

Wilcox et al. examined marital transitions in WHI-OS participants ($n = 38,483$) with a focus on widowhood. In this study, slightly different statistical methodologies were employed and the reference group for all comparisons was women who remained married and were not widowed.¹⁷ Comparison of this study's findings to that of Wilcox provides a wider lens for understanding the impact of marital transitions on older women. Similar to the current findings, systolic blood pressure increased in widows who remarried over a 3-year period relative to those who remained married ($p < 0.01$). Widows who remarried also demonstrated a weight gain (2.3 kg) relative to those who stayed married, and newly widowed women experienced weight loss ($p = 0.04$), but this was not significant at the study's predetermined $p < 0.01$ level of significance.

Women in the WHI-OS who became married did not report changes in eating patterns or physical activity that differed from women who remained unmarried. Sensitivity analyses revealed that physical activity patterns were dependent on type of unmarried status. Never-married women who became married reported a decrease in physical activity, whereas divorced or separated women who became married did not report changes in physical activity relative to women who remained single. Additionally, newly divorced or separated women exhibited positive changes in eating patterns and physical activity relative to women who stayed married. This finding is contrary to the findings of others, including Lee who studied women of a similar age group and found no differences in physical activity levels,¹⁴ possibly reflecting differences in physical activity assessment.³⁶

Although getting married did not affect smoking initiation or cessation, newly divorced women were more likely to start smoking than those who remained single. These results, while consistent with results from the Nurses' Health Study,¹⁴ should be viewed with caution, given the small number of women who started/resumed smoking and became divorced ($n = 11$).

Limitations and strengths

This study is limited by several factors. First, the time period of evaluation is relatively short; thus, one does not know if the changes seen here continued over a longer period of time. Study questionnaires did not capture lifetime marital history, for example, number of divorces and remarriages and the relative duration of a particular marital state. Cumulative marital experiences may more strongly predict health and mortality.⁶ Furthermore, the WHI-OS women may not be representative of all women. Relevant to interpretation of our findings, WHI-OS women had higher socioeconomic status and educational attainment, scored higher on psychosocial measures, and were less likely to smoke than the population at large. Thus, these women may have been more resilient and health conscious, mitigating the effect of stressful life events like divorce.

Despite these limitations, the WHI-OS dataset provides a unique opportunity to study the prospective relationship between marital transitions and health behaviors in a large sample of postmenopausal women while controlling for a

greater array of psychosocial variables (e.g., social support, social functioning, and depression) rarely available in similar, large prospective studies. Importantly, the cohort is under ongoing observation for select health outcomes, including cardiovascular disease, cancers, and mortality. A future analysis should be performed to evaluate these marital transitions in relation to diagnostic and mortality outcomes to expand the knowledge gained from WHI. Another strength includes objective measurements (rather than self-report) of height, weight, and waist circumference at two time points and the collection of detailed information on diet and physical activity.

Conclusion

Among educated, predominantly non-Hispanic white postmenopausal women the period after divorce or separation is accompanied by several positive health behavior changes. Increased tobacco use was the exception. Alternatively, new marriage was associated with a greater increase in BMI and alcohol intake. These data suggest that health behaviors should be evaluated during marital transitions that occur after menopause and appropriate health education and support should be provided to optimize health outcomes as indicated.

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