

Effects of marital transitions on changes in dietary and other health behaviours in US women

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Background Previous studies have indicated that married people have lower mortality and are generally healthier. Most previous studies have been cross-sectional and few studies investigated the effect of marital transition on health. With a prospective design and repeated measures of variables, we sought to analyse the temporal relation between marital transition and change in health behaviours.

Methods We followed up 80 944 women aged 46–71 for 4 years (1992–1996). All information was self-reported. We used multivariate-adjusted linear and logistic regression models to examine the impact of changes in marital status on concomitant changes in health behaviours, controlling for potential confounders and baseline health behaviours.

Results Compared with women who remained married, women who divorced/widowed had body mass index (BMI) decreases of 0.65 kg/m² ($P < 0.001$) and 0.44 kg/m² ($P < 0.001$), respectively. Compared with women who remained unmarried, women who remarried had an increase in mean BMI of 0.41 kg/m² ($P < 0.001$). Women who divorced increased physical activity by 1.23 metabolic equivalent hours (MET)/week ($P = 0.07$) compared with women who stayed married. Among non-smokers and past smokers, women who divorced/widowed had more than a twofold increased risk of relapsing/starting smoking (OR = 2.47, 95% CI: 1.56, 3.89; OR = 2.08, 95% CI: 1.56, 2.76, respectively) than women who stayed married. Divorced and widowed women had decreased vegetable intake relative to women who stayed married (–2.93 servings/week [$P < 0.001$] and –1.67 servings/week [$P < 0.001$], respectively).

Conclusions These patterns suggest both health-damaging and health-promoting changes accompanying divorce and widowhood, and generally health-promoting changes following remarriage.

Keywords Alcohol drinking, body mass index, diet, mammography, marital status, physical activity, smoking, women

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Previous studies have indicated that married people have lower mortality^{1–4} and are generally healthier both physically⁵ and mentally than unmarried people.⁶ Specifically, married people are more likely to quit smoking,^{7–9} more likely to conform to the dietary guidelines,^{10,11} more likely to have mammograms,^{12–16} and less likely to drink excessively,^{17–20} although findings have not been entirely consistent on alcohol intake.^{21–23} Greater body weight^{24–26} among married people has been the exception to these findings. An association between physical activity and marital status has not been consistently reported.^{27–30} On the other hand, people who

were divorced or widowed have been reported to have worse health outcomes.^{5–7,21,24,31–35} These trends have been more consistently observed in among men than in women in most studies. Men seem to benefit more from marriage because of gender roles.^{1,2,9,10,36–40} The marital role of women is more likely to be characterized by caregiving, which is a benefit to their spouses' health.⁴¹

There may be several explanations for why married women generally exhibit healthier behaviour than women who are not married or become divorced/widowed. First, support from spouses among married people may encourage them to be healthier, and the shift from being married to being unmarried may be deleterious to health because of the absence of partner support.²⁸ Second, family relationships may provide social control over health behaviours by affecting the internalization of norms for health behaviours.⁴¹ Individuals committed to familial relationships adhere to norms such as refraining from smoking indoors. In other words, the marital relationship may serve to regulate or sanction individual behaviour, which could be either health-promoting or health-damaging. The absence of the control provided through these relationships, there is a higher probability of engaging in health-compromising behaviour.⁴¹

While a number of studies have examined associations between marital status and health outcomes, most have been cross-sectional studies evaluating current marital status^{6,7,10,11,19,26,33,36–39} and few studies investigated the effect of marital transition on health.^{18,22,24,31,34} In the present report, based on longitudinal data from the Nurses' Health Study, we examined the association of marital status on a range of health behaviours and risk factors, including change of body mass index (BMI), physical activity, smoking, alcohol intake, and food intake. With a prospective design and repeated measures of variables, we tried to analyse the temporal relation between marital transition and change in health behaviours, including food intake. In other words, we attempted to examine the potential behavioural mechanisms by which marital transitions, such as widowhood and divorce, would lead to outcomes described in the literature.

Materials and Methods

Nurses' Health Study

Study subjects were drawn from the Nurses' Health Study, an ongoing cohort of female registered nurses in the US. The Nurses' Health Study was established in 1976, when 121 700 female registered nurses aged 30–55 years completed a mailed questionnaire providing information about risk factors for cardiovascular disease, cancer, and other major health conditions. Since then, follow-up questionnaires have been mailed to the cohort every 2 years to update information on exposures and the occurrence of major illnesses.

Marital status and marital transitions

On the 1992 and 1996 questionnaires, participants reported their current marital status. Marital status was categorized as follows: married, divorced (including separated), and widowed. Thus, marital transitions were identified from 1992 to 1996 as: married to divorced, married to widowed, and unmarried to married (including both divorced to remarried and widowed to

remarried). Women who did not experience marital transitions between 1992 and 1996 were categorized as having a stable marital history (i.e. including both consistently married or unmarried during the period, including divorced or widowed for the latter).

Assessment of dietary and alcoholic beverage intake

On the 1990, 1994, and 1998 questionnaires, we included a semi-quantitative food frequency questionnaire (FFQ), and assessed frequency of intake of 130 foods, including alcoholic beverages. Participants were asked how often, on average, they had consumed each type of food during the past year. The questionnaire had nine possible responses, ranging from never or less than once per month to six or more times per day. All frequency categories were converted to units of servings per week. Specified serving sizes were based on natural portions (e.g. a slice of bread, a cup of coffee) or weight and volume measures of standard servings. We aggregated food items with similar nutrient value or usage into predefined food groups (Appendix). Further details, including reproducibility and validity of the FFQ, have been published elsewhere.⁴² Change in consumption over time was calculated as the difference in average intake between two time points (mean consumption of 1998–mean consumption of 1990). Since questions related to foods intake were not asked in the same year as questions on marital status, we used food intake data before (1990) the first marital status question (1992) and after (1998) the second marital status question (1996). We assumed that marital status stayed the same during 1990–1992 and 1996–1998.

Assessment of other health behaviour outcomes

Assessment of other health behaviours was obtained from the questionnaires of 1992 and 1996 mailed to the cohort. BMI was calculated from self-reported height and weight as weight in kg divided by height in metres squared. Information on height was obtained in 1976, on the assumption that it stays constant, and information on weight in pounds was obtained in 1992 and 1996. We acquired information on recreational physical activity in 1992 and 1996. Recreational physical activity was assessed from the responses to questions about the frequency of engagement in eight common activities. Each activity was converted to metabolic equivalent hours (MET-hours) per week. One MET-hour is equivalent to the energy expenditure during one hour of rest. For example, walking at an average pace for one hour is estimated to consume about 3.0 MET units, while jogging or bicycling is estimated to consume about 7.0 MET units. In this analysis, physical activity was divided into quintiles based on MET units. Validity of self-reported BMI and physical activity has previously been reported for this cohort, and is high.^{43,44} Subjects reported their smoking status (never, past, or current) and daily cigarette consumption, if applicable. Validity of self-reported smoking has been reported.⁴² Four-year changes in BMI, physical activity, and cigarette consumption were calculated as the differences in means between 1992 and 1996. Information on whether these women had recently had a mammogram was obtained in 1992 and 1996.

Study population

A total of 80 944 women provided data on marital status in 1992 and 1996. Since women in our study were middle-aged to

elderly, the transition from never married to married was rare, and therefore we excluded 175 never married women. Compared with non-responders in either year ($n = 23\ 120$), women who responded at both times ($n = 80\ 944$) were somewhat less likely to smoke (13.9% versus 19.2%), and somewhat more likely to engage in physical activity (19.1 MET/week versus 16.3 MET/week), to have mammograms (83% versus 74%), and to drink alcohol (5.1 servings/week versus 4.6 servings/week). However, they were similar in age (58.8 versus 59.2) and BMI (26.1 kg/m² versus 26.6 kg/m²).

In each analysis of BMI and physical activity, women who had missing information in either of the two years were excluded. The number of women in each analysis is as follows: $n = 74\ 937$ in the BMI analysis and $n = 80\ 264$ in the physical activity analysis. In the analyses of smoking, alcohol drinking, and mammography, the number of women included for analyses differed for each outcome due to the definition of outcomes (i.e. change in number of cigarettes smoked daily involved only current smokers at both times ($n = 8722$), while the odds of quitting smoking in 1996 were analysed among current smokers in 1992 ($n = 11\ 255$). (The number of women for each outcome category is explained in detail in the footnotes to Table 3.) Dietary analysis included 68 705 women, after excluding those who reported implausibly low (<600 kcal/day) or high (>3500 kcal/day) daily energy intake or who left 70 or more items blank in the FFQ.

Data analyses

We used age- and multivariate-adjusted linear regression to estimate the association between marital history during 4 years (1992–1996) and mean changes in BMI, physical activity, daily cigarette consumption, weekly alcohol consumption, and diet. Change in daily cigarette consumption was estimated only among current smokers at both times, and change in alcohol consumption was evaluated only among drinkers at both times. We determined change by subtracting the first value from the second value of each outcome variable, and respective baseline values were included in multivariate models.

We used logistic regression to obtain odds ratios (OR) of quitting and relapsing/starting smoking over 4 years, and starting to drink over 8-year periods. The case definition for quitting smoking was odds of quitting smoking over 4 years among women who were current smokers at baseline and that for resuming smoking was odds of smoking among women who were past smokers and non-smokers at baseline. The odds of starting to drink (>0 servings/week) was obtained among women who were abstainers at baseline. We also examined the OR of not getting a mammogram during 1994–1996 among women who had a mammogram in 1990–1992.

For analyses of becoming divorced, widowed, or stayed unmarried, the reference group was women who stayed married for both time points. For analyses of remarriage, the reference group was women who remained unmarried (i.e. stayed divorced or stayed widowed).

In multivariate models, we controlled for age, employment status, diagnoses of hypertension, diabetes, and hypercholesterolaemia, personal history of heart disease, stroke, cancer (excluding non-melanoma skin cancer), and gastric or duodenal ulcer, as well as for smoking, alcohol intake, BMI, and physical activity, when relevant.

Results

We present age-adjusted characteristics of women, including dietary and other health behaviours, by marital status at baseline in Table 1; 82% of women ($n = 66\ 427$) were initially married, and 93% of these women remained married through 1996. At baseline, divorced and widowed women were more likely to smoke than married women, and widowed women were less likely to drink than married or divorced women. Divorced women were most likely to be physically active, and married women were more likely to consume fruits and vegetables. Married women were more likely to have had a mammogram in the past 2 years.

Table 2 presents multivariate-adjusted relative change in BMI and physical activity for different 4-year marital histories. Divorced and widowed women had a respective mean BMI decrease of -0.65 kg/m^2 ($P < 0.001$) and -0.44 kg/m^2 ($P < 0.001$), relative to the change in women who stayed married. Women who stayed unmarried had a slight increase in BMI (0.05 kg/m^2 , $P = 0.02$) relative to women who stayed married. In contrast, remarriage was associated with an increase in BMI by 0.41 kg/m^2 ($P < 0.001$) compared with the change in women who stayed unmarried. Women who divorced during 4 years increased their physical activity by 1.23 MET ($P = 0.07$) relative to the change in women who stayed married, and women who were bereaved and remained unmarried had a slight increase in physical activity, although not statistically significant.

Table 3 presents results regarding multivariate-adjusted smoking and drinking trend. Among current smokers at baseline, women who were widowed and women who remained unmarried were less likely to quit smoking relative to women who stayed married (OR = 0.73, 95% CI: 0.59, 0.91 in widowed women, OR = 0.78, 95% CI: 0.70, 0.88 in women who remained unmarried). Compared with women who remained unmarried, women who remarried were more likely to quit smoking (OR = 1.50, 95% CI: 0.96, 2.33), although the estimate was marginally significant. Among non-smokers and past smokers at baseline, odds of relapsing/starting smoking was 2.47 times greater (95% CI: 1.56, 3.89) in women who divorced during 4 years, 2.08 (95% CI: 1.56, 2.76) in widowed women, and 1.81 (95% CI: 1.53, 2.15) in women who stayed unmarried. Analyses of change in daily cigarette consumption over 4 years among current smokers at both times showed a significant increase of 0.52 cigarettes/day ($P = 0.002$) in women who remained unmarried compared with women who stayed married for both times.

Among alcohol abstainers at baseline, women who became widowed during follow-up were more likely to start drinking (OR = 1.24, 95% CI: 1.06, 1.45) compared with women who stayed married; women who remarried during 4 years were also more likely to start drinking (OR = 1.55, 95% CI: 1.13, 2.12) compared with women who remained unmarried. Among drinkers at both times, those who became widowed and stayed unmarried had a decrease in drinking over 4 years (-0.43 servings/week [$P = 0.002$] in widowed women, -0.26 servings/week [$P < 0.001$] in women who remained unmarried) relative to women who stayed married.

The OR of not having a mammogram in 1996 among women who had a mammogram in 1992, were slightly greater for women who became divorced (OR = 1.27, 95% CI: 0.94, 1.72)

Table 1 Age-adjusted characteristics, according to marital status of study participants in 1992 (baseline: n = 80 944 for non-diet variables, n = 68 705 for diet variables^a)

Characteristics	Married	Divorced	Widowed
N (%)	66427 (82%)	6470 (8%)	8047 (10%)
Mean age (SD)	58.4 (7.0)	55.9 (6.4)	63.9 (5.7)
Full-time employment, %	34.3	62.2	46.0
Hypertension, %	33.4	32.6	37.6
High cholesterol, %	45.9	44.7	44.3
Diabetes, %	5.1	5.4	6.5
Heart disease, %	7.0	8.4	8.3
Stroke, %	0.9	1.3	1.3
Cancer, %	9.4	11.0	9.3
Gastric or duodenal ulcer, %	8.7	9.6	9.3
Current smoker, %	12.6	22.0	20.1
Alcohol consumption, mean, g/day	5.2	5.1	4.8
Body mass index, mean, kg/m ²	26.1	26.0	26.6
Physical activity, mean, MET ^b /week	19.1	19.8	18.8
Mammography in past 2 years, %	83.7	77.8	77.2
Mean, servings/week^a			
Vegetables, fruits			
Vegetables	23.6	21.7	22.3
Fruits	16.4	15.9	15.7
Fruit juices	4.7	4.6	4.7
Meats, poultry, seafood, eggs			
Red meats	5.2	4.3	5.0
Processed meats	0.7	0.6	0.7
Chicken	2.7	2.8	2.8
Fish	2.2	2.1	2.1
Seafood	2.5	2.4	2.3
Eggs	1.3	1.4	1.4
Dairy			
High-fat dairy products	5.1	5.6	5.3
Low-fat dairy products	8.2	8.5	8.0
Breads, cereal, starches			
Refined grains	7.9	7.2	7.8
Whole grains	7.2	7.5	6.8
Cold breakfast cereal	2.7	2.3	2.4
Potatoes	2.4	1.8	2.8
Snacks	4.9	4.7	4.7
Sweets, baked goods, nuts			
Sweets and desserts	7.1	6.3	6.9
Nuts	2.2	2.2	2.2
Non-alcoholic beverages			
Tea	4.8	4.3	4.8
Coffee	15.3	16.3	16.2
Low-calorie beverages	4.5	5.0	4.8
High-calorie beverages	1.6	1.7	1.7

^a Number of women included in dietary variables are fewer because of excluding women who did not answer the FFQ and women who had an implausibly low caloric intake (< 600 kcal/day) or high caloric intake (> 3500 kcal/day).

^b Metabolic equivalent hours.

or widowed (OR = 1.24, 95% CI: 1.07, 1.44), and remained unmarried (OR = 1.26, 95% CI: 1.16, 1.37) compared with women who remained married at both times.

Multivariate-adjusted analyses of 4-year changes in food intake are shown in Table 4. Overall, divorced, widowed, and remained unmarried women seemed to have a lower intake of food (in terms of overall caloric intake) relative to that of women who stayed married. Women who became divorced or widowed decreased their vegetable intake by 2.93 servings/week ($P < 0.001$) and by 1.67 servings per week ($P < 0.001$) respectively compared with the change in women who stayed married. Women who stayed unmarried during 4 years also had a moderate decrease in vegetable intake (0.95 servings/week, $P < 0.001$) relative to the change in women who were married at both times. In contrast, women who remarried during the 4 years increased their vegetable intake by 1.19 servings/week ($P = 0.009$) compared with women who remained unmarried. However, intake of fruits and fruit juices did not show a statistically significant decrease or increase according to marital status transition. Intake of red meat also showed a decreasing trend in general. Compared with women who stayed married, women who were divorced, bereaved, remained unmarried women decreased their intake of red meat by 0.91 servings/week ($P < 0.001$). Like their vegetable intake, remarried women moderately increased their intake of red meat by 0.34 servings/week ($P = 0.006$). Although on much smaller scale, intake of processed meat also decreased in divorced women (-0.14 , $P = 0.002$), widowed women (-0.12 , $P < 0.001$), and women who remained unmarried (-0.11 , $P < 0.001$). Potato intake also showed a pattern similar to that of vegetables and meat. Widowed women had a significantly reduced intake of fish, eggs, and snacks; women who remained unmarried also had a moderately reduced intake of chicken, cereal, and snacks.

Discussion

Our data indicate that divorce and widowhood are associated with several adverse changes in health behaviours. Over 4-year follow-up, we found that women who became widowed were less likely than women who stayed married to quit smoking, while women who became divorced or widowed were more than twice as likely to relapse or start smoking compared with women who stayed married. Women who became divorced or widowed also decreased their vegetable intake after marital disruption compared with women who stayed married, and were more likely to skip mammograms. Staying unmarried also adversely affected a woman's health behaviour; for example, women who remained unmarried were less likely to quit smoking, more likely to resume smoking, and more likely to decrease their vegetable intake compared with women who stayed married for both time points. They also moderately increased the number of cigarettes smoked per day compared with women who stayed married and were less likely to have been screened for breast cancer.

Marital disruption was also strongly associated with weight loss in our study. Women may skip regular meals after losing their spouses and partners through divorce or death. Among widowed women, a profound grief reaction and its impact on self-care, self-feeding, and appetite may explain their changes in

Table 2 Age-adjusted and multivariate^a mean change (SD) in body mass index (BMI) (n = 74 937) and physical activity (n = 80 264) for 4-year marital history

	Married to divorced	Married to widowed	Remarried	Remained unmarried
BMI, kg/m ²				
Age-adjusted	-0.63 [‡] (0.07)	-0.46 [‡] (0.03)	0.42 [‡] (0.07)	0.06 [‡] (0.02)
Multivariate-adjusted	-0.65 [‡] (0.07)	-0.44 [‡] (0.03)	0.41 [‡] (0.07)	0.05 [‡] (0.02)
Physical activity,				
MET ^b /week	(0.69)	(0.33)	(0.69)	-0.18
Age-adjusted	1.17	0.17	0.53	(0.18)
Multivariate-adjusted	1.23 (0.69)	0.53 (0.33)	-0.14 (0.69)	0.23 (0.18)

All estimates relative to those of women who are consistently married except 'remarried' relative to 'remained unmarried'.

^a Adjusted for age (5-year categories), smoking history (never, past, and current in categories of 1–14, 15–24, 25+ cigarettes/day), alcohol intake (0, 0.1–4.9, 5.0–14.9, 15.0+ g/day), employment status (full-time, part-time, homemaker, retired), history of hypertension, diabetes, high serum cholesterol, heart disease, stroke, cancer (except non-melanoma skin cancer), and gastric or duodenal ulcer.

^b Metabolic equivalent hours.

Body mass index and physical activity were mutually adjusted in quintiles.

[†] *P*-value < 0.05, [‡] *P*-value < 0.01.

food intake.³⁴ Alternatively, physical attractiveness may become an important issue in women who are not married compared with those who are married. However, the trend seemed rather short-lived in our study. Women who remarried experienced an increase in their BMI. Married life may bring regular meal patterns and increase in food intake through social interactions. Consistent with our results, in a study of 12 609 Finns, weight gain was common among women who married during a 6-year interval, but recently widowed subjects tended to lose weight. However, those who had been widowed longer showed some tendency to gain weight.²⁴ Another study found that widowed women were more than five times more likely to lose weight and 68% more likely to lose appetite.³⁴ Similarly, although marginally significant, we found an increase in physical activity in divorced women compared with women who stayed married, although previous literature is not consistent on this association as some studies reported no association,^{27–29} and some reported decreased physical activity after marriage.^{30,45}

Women who became widowed or who remained unmarried were less likely to quit smoking compared with women who stayed married during follow-up. Marriage may provide social support that promotes smoking cessation. Marriage could also contribute to increased smoking cessation by increasing a woman's motivation to maintain her health from a sense of obligation to preserve one's health for loved ones.^{7,8,46–48} The OR of relapsing/starting smoking among past smokers or non-smokers at baseline was more than twofold among women who became divorced or widowed (as well as those who remained unmarried) relative to women who stayed married. Our findings agree with previous studies. Khlata and colleagues reported that women who did not have a husband smoked much more than women who were married (OR = 2.0 for regular smoking and OR = 2.5 for heavy smoking) in a study of 20 416 women aged 30–49 years. Another study of 44 855 US men and 50 837 US women found that currently married women were more likely to have quit smoking than women who had never married,

divorced/separated, or were widowed.⁷ Women who were widowed were somewhat less likely to have quit smoking than women who stayed married. The prevalence of smoking was substantially higher among those who were divorced than among those who were currently married.⁷

The OR of starting to drink among abstainers at baseline increased significantly in both women who became widowed, and women who remarried. The explanation for the increase in drinking among those two groups of women are likely to be different; widowed women are more likely to drink in response to grief, while remarried women may begin drinking because of increased opportunities in social interactions. Among drinkers at baseline, women who became widowed (as well as those who remained unmarried) decreased their intake of alcohol during follow-up. The literature on this topic has not been consistent. A study of 350 widows and widowers did not support the notion that drinking increases after the stress of bereavement. Rather, for some widows who already drink, the loss of a spouse may lead to increased alcohol intake.²¹ In a study of 7731 men and women aged 51–61 over a 6-year period, widowhood was associated with increased drinking but only for a short time, and getting married or divorced was associated with both increases and decreases in drinking.²² The inconsistency of results may be due to differences in the timing of assessing alcohol intake. For example, in our study, we asked about alcohol intake two years before (1990) and after (1998) we inquired about marital status (1992 and 1996). Also, the exact date of change in marital status was not available. Thus, we were not able to detect an immediate effect of marital transition on alcohol intake.

Among women who had answered on the 1992 questionnaire that they had a mammogram in the past 2 years, the OR of not having a mammogram in the past 2 years were greater in women who became divorced, widowed, or remained unmarried compared with women who stayed married. This finding may be due to unavailability of a partner to monitor or support their health behaviour patterns²⁸ or to a decrease in

Table 3 Age-adjusted and multivariate^a odds ratios (95% CI) of change in smoking, alcohol consumption, and mammography and mean change (SD) in cigarette and alcohol consumption for 4-year marital history

	Married to divorced	Married to widowed	Remarried	Remained unmarried
Odds ratios (95% CI)				
Quit smoking ^b				
Age-adjusted	0.68 (0.42, 1.11)	0.73 (0.59, 0.91)	1.48 (0.95, 2.29)	0.78 (0.70, 0.87)
Multivariate-adjusted	0.68 (0.42, 1.11)	0.73 (0.59, 0.91)	1.50 (0.96, 2.33)	0.78 (0.70, 0.88)
Relapse smoking ^c				
Age-adjusted	2.48 (1.58, 3.91)	2.05 (1.54, 2.71)	0.91 (0.51, 1.61)	1.75 (1.48, 2.07)
Multivariate-adjusted	2.47 (1.56, 3.89)	2.08 (1.56, 2.76)	0.86 (0.49, 1.52)	1.81 (1.53, 2.15)
Drinking > 0 serving/week ^d				
Age-adjusted	1.33 (0.97, 1.84)	1.20 (1.03, 1.40)	1.56 (1.15, 2.13)	1.02 (0.93, 1.11)
Multivariate-adjusted	1.29 (0.93, 1.78)	1.24 (1.06, 1.45)	1.55 (1.13, 2.12)	0.94 (0.86, 1.04)
Skip Mammography ^e				
Age-adjusted	1.29 (0.95, 1.74)	1.28 (1.11, 1.49)	0.96 (0.71, 1.31)	1.31 (1.21, 1.42)
Multivariate-adjusted	1.27 (0.94, 1.73)	1.24 (1.07, 1.44)	1.01 (0.74, 1.37)	1.26 (1.16, 1.37)
Mean changes (SD)				
Cigarettes per day ^f				
Age-adjusted	1.70† (0.73)	0.03 (0.37)	-1.12 (0.73)	0.08 (0.19)
Multivariate-adjusted	1.06 (0.65)	0.31 (0.33)	-1.00 (0.73)	0.52‡ (0.17)
Alcoholic beverages, servings/week ^g				
Age-adjusted	-0.54 (0.30)	-0.48‡ (0.15)	0.20 (0.26)	-0.24‡ (0.08)
Multivariate-adjusted	-0.44 (0.27)	-0.43‡ (0.14)	0.20 (0.26)	-0.26‡ (0.08)

All estimates relative to those of women who are consistently married, except 'remarried' relative to 'remained unmarried'.

^a Smoking analyses are adjusted for age (5-year categories), alcohol intake (0, 0.1–4.9, 5.0–14.9, 15.0+ g/day), employment status (full-time, part-time, homemaker, retired), body mass index, physical activity, history of hypertension, diabetes, high serum cholesterol, heart disease, stroke, and cancer (except non-melanoma skin cancer). Alcohol consumption analysis also adjusted for smoking history (never, past, and current in categories of 1–14, 15–24, 25+ cigarettes/day) and gastric or duodenal ulcer.

^b Among current smokers at baseline (n = 11 255), odds of quitting smoking.

^c Among non-smokers and past smokers at baseline (n = 69 453), odds of relapse smoking.

^d Any alcohol: among abstainers at baseline (n = 25 532), odds of drinking any alcohol (excluding heavy drinkers).

^e Only among women who had a mammography in past 2 years in 1992 questionnaire (n = 80 888).

^f Only among current smokers at both times (n = 8722).

^g Only among drinkers at both times (n = 32 545).

† P-value < 0.05, ‡ P-value < 0.01.

economic resources after the loss of one's partner.⁴⁹ Bastani *et al.* also reported that being married was associated with higher levels of compliance with health-care recommendations.⁵⁰

Marital transition was not associated with changes in diet except for a few specific types of foods; women who became divorced, widowed, or remained unmarried during follow-up were more likely to decrease their intake of fresh vegetables relative to women who stayed married, whereas women who remarried increased their vegetable intake compared with women who remained unmarried. Intake of red meat and of potatoes showed a similar pattern. These may indicate a

decrease in meals at home, but it is difficult to say whether these changes are health-promoting or not. Since women in households are more likely to be those who plan meals, shop for food, and prepare food, marital transition did not alter women's diet dramatically in past studies.^{36,37} Rather, divorced and widowed women had decreased food intake overall (regardless of type of foods) compared with women who stayed married in our study. Findings from other studies suggest that women who were widowed ate more meals alone, more commercial meals per week, and fewer snacks and home-made meals, which may generally represent unhealthy eating pattern.⁵¹

Table 4 Age-adjusted and multivariate^a mean change (SD) in dietary intake for 4-year marital history (servings/week, n = 68 705)

	Married to divorced	Married to widowed	Remarried	Remained unmarried
Vegetables, fruits				
Vegetables				
Age-adjusted	-2.82(0.47) [‡]	-1.79(0.21) [‡]	1.45(0.46) [‡]	-0.84(0.12) [‡]
Multivariate-adjusted	-2.93(0.47) [‡]	-1.67(0.21) [‡]	1.19(0.46) [‡]	-0.95(0.12) [‡]
Fruits				
Age-adjusted	-0.34(0.37)	-0.35(0.17) [‡]	0.49(0.37)	-0.30(0.10) [‡]
Multivariate-adjusted	-0.34(0.37)	-0.19(0.17)	0.18(0.37)	-0.17(0.10)
Fruit juices				
Age-adjusted	-0.11(0.20)	-0.03(0.09)	0.23(0.20)	-0.06(0.05)
Multivariate-adjusted	-0.09(0.20)	0.02(0.09)	0.15(0.20)	0.02(0.05)
Meats, poultry, seafood, eggs				
Red meats				
Age-adjusted	-0.88(0.13) [‡]	-0.72(0.06) [‡]	0.23(0.12)	-0.41(0.03) [‡]
Multivariate-adjusted	-0.91(0.13) [‡]	-0.77(0.06) [‡]	0.34(0.12) [‡]	-0.50(0.03) [‡]
Processed meats				
Age-adjusted	-0.13(0.04) [‡]	-0.10(0.02) [‡]	0.03(0.04)	-0.09(0.01) [‡]
Multivariate-adjusted	-0.14(0.04) [‡]	-0.12(0.02) [‡]	0.07(0.04)	-0.11(0.01) [‡]
Chicken				
Age-adjusted	-0.02(0.10)	-0.03(0.04)	-0.03(0.10)	-0.08(0.02) [‡]
Multivariate-adjusted	-0.02(0.10)	-0.02(0.04)	-0.04(0.10)	-0.07(0.03) [‡]
Fish				
Age-adjusted	-0.07(0.06)	-0.06(0.03) [‡]	0.07(0.06)	0.01(0.01)
Multivariate-adjusted	-0.09(0.06)	-0.05(0.03) [‡]	0.05(0.06)	-0.0004(0.01)
Seafood				
Age-adjusted	-0.04(0.06)	-0.06(0.03)	0.08(0.06)	-0.01(0.02)
Multivariate-adjusted	-0.06(0.06)	-0.05(0.03)	0.06(0.06)	-0.02(0.02)
Eggs				
Age-adjusted	0.05(0.06)	-0.12(0.03) [‡]	0.03(0.06)	0.02(0.02)
Multivariate-adjusted	0.05(0.06)	-0.13(0.03) [‡]	0.05(0.06)	0.02(0.02)
Dairy				
High-fat dairy products				
Age-adjusted	0.07(0.22)	-0.03(0.10)	-0.48(0.22) [‡]	-0.03(0.06)
Multivariate-adjusted	0.04(0.22)	-0.07(0.10)	-0.40(0.21)	-0.09(0.06)
Low-fat dairy products				
Age-adjusted	-0.14(0.29)	0.24(0.14)	-0.96(0.29) [‡]	0.16(0.08) [‡]
Multivariate-adjusted	-0.13(0.29)	0.30(0.14) [‡]	-1.08(0.29) [‡]	0.21(0.08) [‡]
Breads, cereal, starches				
Refined grains				
Age-adjusted	-0.36(0.26)	-0.10(0.12)	-0.35(0.25)	-0.08(0.07)
Multivariate-adjusted	-0.35(0.26)	-0.17(0.12)	-0.19(0.25)	-0.12(0.07)
Whole grains				
Age-adjusted	0.94(0.27) [‡]	0.22(0.12)	-0.14(0.26)	0.35(0.07) [‡]
Multivariate-adjusted	0.97(0.27) [‡]	0.29(0.12) [‡]	-0.29(0.26)	0.43(0.07) [‡]
Cold breakfast cereal				
Age-adjusted	-0.09(0.12)	0.002(0.06)	0.03(0.12)	-0.15(0.03) [‡]
Multivariate-adjusted	-0.06(0.12)	0.03(0.06)	-0.02(0.12)	-0.10(0.03) [‡]
Potatoes				
Age-adjusted	0.42(0.07) [‡]	-0.47(0.03) [‡]	0.31(0.07) [‡]	-0.26(0.02) [‡]
Multivariate-adjusted	-0.41(0.07) [‡]	-0.48(0.03) [‡]	0.32(0.07) [‡]	-0.26(0.02) [‡]

Table 4 Continued

	Married to divorced	Married to widowed	Remarried	Remained unmarried
Snacks				
Age-adjusted	-0.27(0.19)	-0.21(0.09) [†]	-0.31(0.19)	-0.17(0.05) [‡]
Multivariate-adjusted	-0.28(0.19)	-0.21(0.09) [†]	-0.31(0.19)	-0.18(0.05) [‡]
Sweets, baked goods, nuts				
Sweets and desserts				
Age-adjusted	-0.24(0.28)	0.10(0.13)	0.13(0.28)	-0.07(0.07)
Multivariate-adjusted	-0.16(0.28)	0.08(0.13)	0.21(0.28)	-0.01(0.07)
Nuts				
Age-adjusted	-0.002(0.13)	0.03(0.06)	-0.13(0.13)	-0.01(0.03)
Multivariate-adjusted	0.004(0.13)	0.03(0.06)	-0.14(0.13)	-0.002(0.03)
Non-alcoholic beverages				
Tea				
Age-adjusted	-0.09(0.29)	-0.19(0.13)	-0.24(0.28)	-0.05(0.07)
Multivariate-adjusted	-0.08(0.29)	-0.12(0.13)	-0.36(0.28)	0.01(0.07)
Coffee				
Age-adjusted	0.34(0.33)	-0.19(0.16)	0.69(0.33) [†]	-0.10(0.09)
Multivariate-adjusted	0.28(0.34)	-0.19(0.15)	0.68(0.33)	-0.17(0.09)
Low-calorie beverages				
Age-adjusted	0.28(0.19)	-0.05(0.09)	-0.003(0.19)	0.08(0.05)
Multivariate-adjusted	0.28(0.19)	-0.11(0.09)	0.10(0.19)	0.02(0.05)
High-calorie beverages				
Age-adjusted	-0.26(0.17)	0.12(0.08)	-0.14(0.17)	0.09(0.04) [†]
Multivariate-adjusted	-0.23(0.17)	0.07(0.08)	-0.03(0.17)	0.06(0.04)

All estimates relative to those of women who are consistently married, except that 'remarried' is relative to 'remained unmarried'.

^a Adjusted for age (5-year categories), smoking history (never, past, and current in categories of 1–14, 15–24, 25+ cigarettes/day), alcohol intake (0, 0.1–4.9, 5.0–14.9, 15.0+ g/day), employment status (full-time, part-time, homemaker, retired), body mass index, physical activity, history of hypertension, diabetes, high serum cholesterol, heart disease, stroke, cancer (except non-melanoma skin cancer), gastric or duodenal ulcer.

[†] *P*-value < 0.05. [‡] *P*-value < 0.01.

A limitation of our study is that information on the exact timing of marital transition and behavioural changes were not precise. Such information might have produced stronger associations. If changes in health behaviours occurred immediately after marital transitions, we may not have captured the full impact of marital transition, particularly for food and alcohol intake, which we asked about in different years from questions about marital status. This may have resulted in misclassification of marital status. If non-differential, such misclassification would have biased findings in the direction of the null. On the other hand, we captured potentially longer-lasting effects of marital transitions on behavioural outcomes.

Assessment of dietary intake may have individual under- or over-reporting of diet, which may attenuate the results. However, FFQ covers past one year of intake, which would attenuate the day-to-day fluctuation. In addition, examining difference of intake for each person between 1990 and 1998, instead of examining absolute intake may be affected less by that kind of bias.

As expected, the effects of marital transition on women's health were not as dramatic as those previously reported in men.^{1,2,9,10,36–40} In particular, we found a weaker association with diet. We also found somewhat weaker effects on alcohol intake, which was not unexpected, considering the lower

consumption of alcohol among women in general. The benefits of marriage are known to affect men and women differently. Impacts of social ties are greater for men than for women because of gender roles. The marital role of women is more likely to be characterized by caregiving, which is more likely to be beneficial to their spouses' health. Men may benefit more in the transition from unmarried to married status because they gain a care provider in the process.⁴¹

In conclusion, these patterns suggest behavioural changes accompanying divorce and widowhood among middle-aged to elderly women are both health damaging (smoking relapse, increased drinking, and poorer diet) and health promoting (increase in exercise). Conversely, remarriage is associated with generally health-promoting behaviours. Our findings point to potential mechanisms underlying the previously observed relationships between marital transitions and other health outcomes such as mortality.

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KEY MESSAGES

- Previous studies have indicated that married people have lower mortality and are generally healthier. However, most previous studies have been cross-sectional and few studies investigated the effect of marital transition on health. With a prospective design and repeated measures of variables, we sought to analyse the temporal relation between marital transition and change in health behaviours.
- Our findings indicate that behavioural changes accompanying divorce and widowhood among middle-aged to elderly women are both health damaging (smoking relapse, increased drinking, and poorer diet) and health promoting (increase in exercise). Conversely, remarriage is associated with generally health-promoting behaviours.
- Our findings point to potential mechanisms underlying the previously observed relationships between marital transitions and other health outcomes such as mortality.

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Appendix

Food Groupings

Foods or food groups	Food items
Vegetables (includes legumes)	Broccoli, Brussels sprouts, carrots, cauliflower, celery, coleslaw and cabbage, corn, eggplant, kale, lentils or beans, lettuce, mixed vegetables, mustard and chard greens, peas, spinach, string beans, tofu or soybeans, tomatoes, tomato juice, tomato sauce, yams or sweet potatoes, yellow (winter) squash, zucchini
Fruits	Apples, apricots, bananas, blueberries, cantaloupe, grapefruit, grapes, oranges, peaches, pears, plums, raisins, strawberries
Fruit juices	Apple juice or cider, orange juice, grapefruit juice, other fruit juice
Red meats	Beef, pork, lamb, hamburger
Organ meats	Beef, calf, and pork liver, chicken and turkey liver
Processed meats	Processed meats, bacon, hot dogs
Poultry	Chicken, turkey
Fish and other seafood	Canned tuna fish, dark-meat fish, other fish, shrimp, lobster, scallops
Eggs	Eggs
High-fat dairy products	Whole milk, cream, sour cream, ice cream, cream cheese, other cheese
Low-fat products	Low-fat or skim milk, sherbet or ice milk, yogurt
Refined grains	White bread, English muffins, bagels, rolls, muffins, biscuits, white rice, pasta, pancakes, waffles
Whole grains	Cooked oatmeal, other cooked breakfast cereal, dark bread, brown rice, Other grains, bran added to food, wheat germ
Cold breakfast cereal	Cold breakfast cereal
Potatoes	Potatoes
Snacks	Potato chips or corn chips, crackers, popcorn
Sweets and desserts	Chocolate bars or pieces, candy bars, cookies, brownies, doughnuts, cake, pie, sweet roll, coffee cake, pastry
Nuts	Peanuts, other nuts, peanut butter
Tea	Tea
Coffee	Coffee
Low calorie beverages	Low calorie cola, other low calorie carbonated beverages
High sugar beverages	Cola with sugar, other carbonated beverages with sugar, fruit drinks
Alcoholic beverages	Beer, wine, liquor