Numerous studies have shown that married persons have lower risk of mortality, and enjoy better physical and mental health than their unmarried counterparts. Moreover, marital termination by death or divorce has been prospectively linked to decline in health and increased mortality risk, with more pronounced effects among men. Health behavioural factors may underlie health and mortality differentials by marital status. Generally, married persons have healthier lifestyles than unmarried persons. Cross sectional evidence shows that married persons are more likely to quit smoking and less likely to drink excessively than unmarried persons. Marriage has also been associated with higher body weight and levels of physical activity, but not consistently. Unmarried persons, particularly solitary men, have poorer quality of diet including lower consumption of fruits and vegetables. Most of the longitudinal studies examining the effect of marital transition on health behaviour have focused exclusively on alcohol consumption or body weight. People entering wedlock seem to reduce their alcohol consumption while marital break up may result in higher alcohol intake. Entry into marriage has been related to weight gain and marital termination to weight loss. Loss of the marital bond may also be coupled with increased cigarette consumption. Findings on marital transition and change in physical activity are limited and inconsistent. To our knowledge, the effect of marital transition on diet has not been previously examined using a longitudinal design. There are several underlying mechanisms by which change in marital status may affect health behaviours. It has been hypothesised that the marital relationship provides social control over health behaviours. Social support from a spouse may also be a key mediating factor in the establishment and maintenance of a healthy lifestyle. Psychological factors (for example, depression), stress levels, and economies of scale represent additional pathways.

In this study, we examined change in dietary and other health behaviours among men who experienced marital transition using a longitudinal design. We predicted that marital dissolution (including divorce and widowhood) would lead to deterioration of health behaviours, including poorer diet, weight loss, decreased physical activity, and increases in smoking and alcohol intake. Conversely, entry into marriage would have an ameliorative effect on these lifestyle factors. We also compared trajectories of health practices among men who maintained their marital states. We predicted that men who remained unmarried (that is, divorced or widowed) would suffer more adverse trends than continuously married men. Using repeated measures of marital status as well as of dietary and other health behaviours, we sought to clarify the temporal relation between marital transition and change in health practices. By studying a number of health behaviours, the impact of marital transition on health may be more wholly understood.

**METHODS**

**The health professionals follow up study**

The health professionals follow up study is a longitudinal investigation of chronic disease among 51 529 US male health professionals aged 40 to 75 years old in 1986. Cohort members are dentists (58%), veterinarians (20%), pharmacists (8%), optometrists (7%), osteopaths (4%), and podiatrists (3%). Baseline data on risk factors and medical history were obtained from the participants by mailed questionnaire. Every two years, follow up questionnaires have been sent to update information on risk factors and newly diagnosed diseases. Collection and analysis of data were approved by the Institutional Review Board at the Harvard School of Public Health. Additional details of the study have been published elsewhere.

**Study population**

Between 1986 and 1994, 39 731 men provided data on marital status for at least two consecutive time points spaced four years apart. Compared with non-respondents, respondents were similarly aged (54.8 versus 55.0 years) but more likely to be married in 1986 (91.4% versus 86.2%, p < 0.001). Proportions of heavy drinkers were comparable between groups but respondents were less likely to smoke (8.9% versus 12.0%, p < 0.001).

**Abbreviations:** BMI, body mass index; FFQ, food frequency questionnaire; MET, metabolic equivalent
Mean physical activity levels were higher among the respondents while body mass index means were similar between the response groups. We excluded 65 subjects who experienced inconsistent transitions between consecutive time points. Because the cohort was middle aged to elderly, transitions from never married to married states were scarce; hence we excluded men who were single in 1986 (n = 801). A total of 38 865 men were included in the analyses.

Marital status and marital transitions
Subjects reported their current marital status on each biennial questionnaire. Marital status was categorised as follows: married, divorced (includes separated), and widowed. We assumed that marital status assessed in a particular year reflected marital status during the previous year. Because we hypothesised that incumbent marital status would have the largest impact on concurrent behaviour, we examined marital status at the same time as health behaviour (1986, 1990, or 1994). Thus, we focused on marital status change between two measured points, 1986 and 1990, or 1990 and 1994, and not on interim marital changes between two measured points (1986 and 1990). Marital transitions of interest included both terminations (change in status from married to divorced or married to widowed) and remarriage (divorced to married; widowed to married).

Table 1  Age adjusted characteristics, according to marital status, of study participants in 1986

<table>
<thead>
<tr>
<th></th>
<th>Married</th>
<th>Divorced</th>
<th>Widowed</th>
</tr>
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<tbody>
<tr>
<td>Number of subjects (%)</td>
<td>36285 (93.3)</td>
<td>2050 (5.3)</td>
<td>530 (1.4)</td>
</tr>
</tbody>
</table>

Demographics
Age, mean (SD), y
54.9 (9.8)  51.4 (8.5)  63.7 (8.2)

Full time employment, %
80.2  80.8  77.6

Medical conditions
Hypertension, %
21.9  21.8  25.4

High serum cholesterol, %
12.9  13.1  9.5

Diabetes, %
2.9  2.9  4.1

Myocardial infarction, %
4.1  4.2  4.5

Stroke, %
0.7  0.6  0.6

Cancer excluding non-melanoma skin cancer, %
3.7  3.4  3.0

Gastric or duodenal ulcer, %
7.8  8.2  6.1

Health behaviours
Current smoker, %
8.7  16.1  13.5

Alcoholic beverages, mean (SD), servings/week
6.1 (8.3)  8.4 (10.4)  6.5 (8.6)

Body mass index, mean (SD), kg/m²
25.5 (3.1)  25.2 (3.1)  25.3 (4.3)

Physical activity, mean (SD), METs/week
20.0 (25.7)  23.3 (27.8)  19.3 (21.4)

Dietary behaviour
Vegetables, fruits

Vegetables*  21.8 (12.9)  19.4 (12.8)  18.6 (13.0)

Fruits*  10.9 (9.0)  9.7 (9.1)  9.9 (9.5)

Fruit juice
5.5 (6.0)  5.6 (7.3)  5.2 (7.2)

Meats, poultry, seafood, eggs

Red meats*  4.4 (3.4)  3.9 (3.5)  4.0 (3.0)

Organ meats*  1.5 (2.5)  1.7 (2.6)  1.6 (2.4)

Processed meats
2.6 (3.1)  2.6 (3.6)  2.5 (4.1)

Poultry
2.4 (2.0)  2.5 (2.2)  2.3 (2.1)

Fish and other seafood*
2.7 (2.4)  3.0 (2.9)  2.8 (2.5)

Eggs*  2.3 (2.9)  2.6 (3.4)  2.2 (2.8)

Dairy

High fat dairy products*  6.3 (7.1)  6.9 (7.9)  7.6 (9.8)

Low fat dairy products*  6.2 (7.3)  5.6 (7.4)  6.1 (8.5)

Breads, cereals, starches

Refined grains*  8.1 (7.4)  7.0 (7.0)  7.1 (7.4)

Whole grains*  7.8 (9.0)  7.9 (9.7)  6.6 (8.2)

Cold breakfast cereal*
2.9 (3.4)  2.4 (3.0)  2.6 (3.0)

Potatoes*
2.3 (2.0)  1.9 (1.9)  2.0 (2.4)

Snacks*
4.0 (5.1)  3.5 (5.2)  3.7 (4.8)

Sweets, baked goods, miscellaneous

Sweets and desserts*  8.1 (9.0)  6.7 (8.6)  7.7 (10.2)

Nuts
3.5 (5.0)  3.6 (5.8)  3.9 (5.8)

Non-alcoholic beverages

Tea*
3.1 (4.0)  2.6 (5.8)  2.9 (5.8)

Coffee
13.5 (12.5)  13.8 (13.3)  14.5 (12.4)

Low calorie beverages
3.4 (6.4)  3.5 (7.5)  3.0 (5.6)

High sugar beverages*
2.4 (4.3)  2.6 (5.3)  2.8 (3.9)

Mean (SD), frequency/week

Fried foods

Fried food at home*
1.3 (1.4)  1.1 (1.3)  1.3 (1.3)

Fried food away from home*
1.1 (1.3)  1.3 (1.5)  1.2 (1.3)

* p Value for age adjusted one way analysis of variance F test < 0.05.
were mutually adjusted. All covariates except age were time varying. Smoking (current compared with never or past smoker) and alcohol intake (servings/week) were mutually adjusted. Alcohol intake analysis was also adjusted for diagnosis of gastric/duodenal ulcer. Cigarette intake (servings/week) were mutually adjusted. Alcohol intake analysis was also adjusted for diagnosis of gastric/duodenal ulcer. Cigarette intake (servings/week) were mutually adjusted. Alcohol intake analysis was also adjusted for diagnosis of gastric/duodenal ulcer. Cigarette intake (servings/week) were mutually adjusted. Alcohol intake analysis was also adjusted for diagnosis of gastric/duodenal ulcer. Cigarette intake (servings/week) were mutually adjusted. Alcohol intake analysis was also adjusted for diagnosis of gastric/duodenal ulcer. Cigarette intake (servings/week) were mutually adjusted. Alcohol intake analysis was also adjusted for diagnosis of gastric/duodenal ulcer. 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widowed men who remarried), based on comparability of effects as determined by likelihood ratio tests. Specific marital transitions and stable marital patterns were coded as indicator variables. We controlled for age in 1986, time period (1986–90, 1990–94), covariates that could potentially change health behaviour including employment status and medical diagnoses (hypertension, diabetes, and hypercholesterolaemia, history of myocardial infarction, stroke, gastric or duodenal ulcer, cancer (excluding non-melanoma skin cancer), and when relevant, cigarette consumption, alcohol intake, body mass index (kg/m²), physical activity (METs/week), employment status (full time compared with part time, retired, or disabled), history of hypertension, diabetes, high serum cholesterol, diagnosis of myocardial infarction, stroke, cancer (except non-melanoma skin cancer), gastric or duodenal ulcer. *p value <0.05; **p value <0.01.

**RESULTS**

In table 1, we present age adjusted characteristics, including dietary and other health behaviours, by marital status in 1986. The majority (93.3%) of men were initially married, and of these men, 80.9% reported that they were married in 1994. At baseline, divorced men were most likely to smoke and drank more alcohol, but were also more active. In terms of diet, married men consumed more fruits and vegetables. Figure 1 gives the results from multivariate analyses of relative change in cigarette and alcohol consumption by four year marital history. Among ever smokers in 1986, men who became divorced increased their daily consumption by 0.32 cigarettes relative to change in stably married men although the difference in trends was not significant (p=0.18); this association was limited to men less than 65 years old who comprised the majority of divorce transitions. Men who remained divorced or widowed had decreased consumption compared with married counterparts (−0.42 cigarettes, p = 0.0023). Decreased cigarette consumption over time was observed among younger and older unmarried men (−0.40 cigarettes, p = 0.015 and −0.65 cigarettes, p = 0.0067, respectively). Becoming widowed was associated with an increase of 0.51 servings of alcohol per week (p = 0.03), relative to change in men who stayed married; similar effects were observed among men aged less than 65 years old and men aged 65 years old or more. Becoming divorced was also modestly associated with an increase in alcohol consumption that was not statistically significant; as with cigarette consumption, this association was observed among younger men only in age stratified analyses. In contrast, men who remained unmarried decreased their weekly intake of alcoholic beverages by 0.21 servings (p = 0.051); both younger and older men who remained unmarried experienced decreases over time. In age stratified analyses, remarriage was associated with a non-significant decrease in alcohol consumption among younger men (−0.41 servings per week, p=0.065) but an increase among older men (1.28 servings, p = 0.03).

In Figure 2, we present adjusted relative change in BMI and physical activity for different four year marital histories. Men who became divorced or widowed had respective BMI decreases of −0.31 (p<0.0001) and −0.35 kg/m² (p<0.0001), relative to change in men who stayed married.
Compared with men who remained unmarried, divorced and widowed men who remarried experienced increase in BMI (0.25 kg/m²; p<0.0001) coupled with decreased level of physical activity (–2.00 METs/week; p = 0.027). These effects on BMI and physical activity were observed in both age groups.

In multivariate analyses of four year change in dietary behaviour (table 2), men who became widowed decreased their weekly intake of vegetables by 2.91 servings (p<0.0001). The decrease in vegetable intake associated with widowhood was more pronounced among younger than older men (–4.22 servings; p<0.0001 compared with –1.73 servings; p = 0.034). Men who became divorced lowered their vegetable intake by 2.05 servings per week (p=0.0001), compared with married men; the association was more pronounced among younger men. In additional analyses differentiating unmarried subgroups (that is, divorced or widowed), remarriage was particularly beneficial for widowers. For formerly widowed and divorced men, respective relative increases were 4.05 (p<0.0001) and 1.28 servings per week (p = 0.012). Remarriage among younger widowed men was associated with a larger increase in vegetable intake (4.63 servings, p = 0.0003) than remarriage among older widowers (3.32 servings, p = 0.051).

In terms of other dietary change (table 2), men who became widowed increased their frequency of eating fried foods away from home and decreased their consumption at home. They also increased their consumption of both organ meats and fish. Over time, men who experienced divorce had decreased consumption of fruits and poultry but also of red meats. Intake of refined grains and potatoes declined among men who became divorced or widowed, relative to change in married men. Consumption of whole grains, cereal, snacks, and sweets and desserts also decreased though declines were not generally significant. Remarriage seemed to have an overall salutary effect on diet, as suggested by increases in intake of vegetables and chicken and turkey in combination with relative decline in consumption of high sugar content beverages. However, men who remarried increased their intake of refined grains relative to men who did not remarry. Aside from a modest increase in snack consumption, dietary quality of unmarried men did not seem to worsen over time compared with the dietary quality of married men.

DISCUSSION

These longitudinal findings provide support for the hypothesis that marital termination is linked to adverse change in health behaviours. Alcohol consumption increased among men whose wives died. Former spouses suffered relative weight loss with marital break up. In contrast, men who remarried experienced increases in BMI along with decreases in physical activity compared with men who remained unmarried (that is, divorced or widowed). Loss of the marital relationship had detrimental effects on diet particularly in terms of decreased vegetable intake while remarriage was tied to increased vegetable consumption.

Among younger men, becoming widowed or divorced were each linked to more pronounced decrease in vegetable intake. Becoming divorced was also associated with increased cigarette and alcohol consumption among younger men although these latter relationships were not statistically significant and should be interpreted with caution.

Previous research

These results concur with previous reports linking marital dissolution with higher cigarette and alcohol consumption. In a national panel survey, men who became unmarried increased their cigarette consumption. A recent birth cohort study assessed marital status and drinking habits at ages 23 and 33 years, and found that divorced men had twice the odds of heavy drinking as continuously married men; newly divorced men had even greater risks. It is probable that changes in both social support and stress levels underlie the observed relations with marital termination. Smoking and heavy drinking are each related to high levels of stress and low social support. In fact, spousal support may buffer against stress and thereby lead to reductions in smoking and drinking. High levels of partner support have been prospectively associated with smoking cessation in treatment programmes. Although we did not have information on exact dates of transitions or duration of marital states, men who remained unmarried over four years reduced their use of alcohol and cigarettes relative to married men. Therefore, relative consumption may have increased because of the stress of initial marital break up, and then decreased over time, reflecting stabilisation.

Key points

- Marital termination may have an impact on health by adversely affecting health and dietary behaviours.
- Alcohol consumption increased among men whose wives died.
- Loss of the marital relationship had detrimental effects on diet particularly in terms of decreased vegetable intake while remarriage was linked to increased vegetable consumption.
Strengths and limitations of the study
Based on repeated measures, the effects of marital transition were independent of key time varying confounders. Validation studies have found dietary and alcohol intake, BMI and physical activity levels to be accurately reported by the cohort. Self reports of smoking habit are generally accurate in population studies of adults. However, there are several limitations to our findings. Only 77.1% of the cohort provided marital status data for at least two consecutive time points. As serial non-responders were more likely to be unmarried and have poorer health behaviours at baseline, it is plausible that non-respondents included a disproportionate number of men adversely affected by marital dissolution. Hence, loss to follow up may have biased effect estimates toward the null. While it is possible that newly divorced and bereaved men were less precise in reporting health behaviours, increased random error would merely inflate standard errors, and not affect point estimates. It seems unlikely that marital dissolution affected accuracy of self reported behaviours in a systematic way. We used marital status as a proxy measure for spousal support recognising that non-spousal cohabitating partners can provide similar support to unmarried men. As well, some men who reported being married may in fact be separated from their wives and live alone. Resulting non-differential misclassification would attenuate rather than exaggerate estimates. We used only incumbent marital status at four year intervals rather than interim changes to define marital transitions; any resulting misclassification would be random with respect to the outcome and lead to an underestimation of behaviour effects. We lacked information on psychological states such as depression that could potentially confound or mediate the association between marital history and change in health practices. However, if psychological health were in fact a mediator, controlling for its effects in multivariate analysis would not be appropriate. We cannot rule out the possibility that health behaviour, particularly alcohol use, led to marital transition. However, we did not find that health behaviours predicted marital transitions (data not shown). Finally, among our cohort of male health professionals of high socioeconomic status, we observed effect sizes of very modest magnitude. Men of lower income and education levels may experience more pronounced effects. Limits to generalisability apply to younger and older cohorts. Moreover, it is unclear whether effects may be particularly increased among older men of lower socioeconomic status. Generalisability limitations also apply to women who may be differentially affected.

Conclusions
Although linked to lowered intake of unhealthy starches, marital break up had a negative overall impact on healthy lifestyle. While comparatively modest effects were noted for individual behaviours (for example, alcohol consumption), aggregated effects on a range of health behaviours could appreciably affect health on a population level. The benefits of remarriage were most clearly related to dietary quality. Whereas dietary advantages may be obtained passively with cohabitation, positive modification of other lifestyle factors (for example, smoking) may involve slower and more complex motivational processes. As discussed, it is also likely that increased stress attributable to marital break up contributed to negative changes, most probably for cigarette and alcohol consumption. Future studies should collect information on levels of spousal support and stress to identify mechanisms. Furthermore, it should be emphasised that negative health behaviours do not fully explain the link between marital status and mortality; other pathways including neuroendocrine mechanisms should be considered.

In summary, we conclude that marital termination may have an impact on health by adversely affecting a range of health and dietary behaviours in men. Clinicians and other health professionals should be attentive to marital transitions in their patients’ lives as they could change diet and other health behaviours. Continued focus on the social context of health behaviour may improve the effectiveness of prevention and intervention programs. Studies of different combinations of age and socioeconomic groups, minorities, and women are needed to target public health efforts efficiently.

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