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Marital status changes and body weight changes: a US longitudinal analysis

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Abstract

The role of spouse is associated with better health. The dynamics of spousal roles can be represented by marital trajectories that may remain stable or may change by entry into marriage, dissolution of marriage, or death of a spouse. Body weight is an important health-related characteristic that has been found to have mixed relationships with marital status. This analysis examined changes in marital status and body weight in 9043 adults in the US National Health and Nutrition Epidemiological Follow-up Survey (NHEFS), a longitudinal national study that interviewed and measured adults in a baseline assessment and reassessed them again in a follow-up approximately 10 years later. Men's and women's weights were differently associated with marital changes. Women who were unmarried at baseline and married at follow-up had greater weight change than those who were married at both times. Analysis of weight loss and weight gain separately revealed that sociodemographic variables, including marital change, were more predictive of variation in weight loss than weight gain. Unmarried women who married gained more weight than women married at both times. Men who remained divorced/separated and men who became widowed lost more weight than men married at both baseline and follow-up. These findings suggest that changes in social roles, such as entering or leaving marriage, influence physical characteristics such as body weight. © 2002 Elsevier Science Ltd. All rights reserved.

Keywords: Marital status; Weight change; Obesity; USA

Introduction

Incumbency in social roles influences a variety of health-related characteristics. Being a spouse is a consistent predictor of good health, with married persons having lower morbidity and mortality than unmarried individuals, although the health benefits may be stronger for men than for women (Gove, 1973; Gove, Style, & Hughes, 1983, 1990; Hahn, 1993; Hu & Goldman, 1990; Verbrugge, 1979, 1983; Wyke & Ford, 1992). Role changes, such as entering or leaving the spousal role, are important life course transitions associated with health changes (Moen, Dempster-McClain, & Williams, 1992). Some investigations report

that change in marital status, rather than marital status per se, is the important influence on health (Fenwick & Barresi, 1981), although marital transitions themselves are stressful life events (Hobson et al., 1998; Holmes & Rahe, 1967; Miller & Rahe, 1997).

Marital status transitions can be conceptualized as establishing marital trajectories (Barrett, 2000), which during any given time period can take several major forms by remaining stable or by changing due to entry into marriage, dissolution of marriage, or death of a spouse. Most studies of marriage and health examine mortality, self-reported health status, or psychological well-being (e.g. Gove, 1973; Hahn, 1993), and the effects of marriage may or may not apply to other health characteristics. This study examined the relationship between changes in marital status and the physical attribute of body weight.

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Body weight and marital status

Body weight is a salient issue in post-industrial societies, where thinness is positively valued and fatness is stigmatized (Sobal, 1999; Sobal & Maurer, 1999a, b). The prevalence of overweight has been increasing in the US and other post-industrial societies in recent decades (Flegal, Carrol, Kuczmarski, & Johnson, 1998; Kuczmarski, Flegal, Campbell, & Johnson, 1994; Mokdad et al., 1999; Mokdad, Bowman, Ford, Vinicor, Marks, & Koplan, 2001). Obesity is associated with several forms of morbidity (National Institutes of Health, 1998) and with mortality (Troiano, Frongillo, Sobal, & Levitsky, 1996), and on a population level even small weight changes may have epidemiological and clinical significance (National Institutes of Health, 1998). Obese individuals experience socioeconomic consequences through stigmatization and discrimination in employment, education, health care, and everyday relationships (DeJong, 1980; Sobal, 1999). Emphasis and concern about weight is greater among women than men, although weight is an important risk factor for both men's and women's chronic disease health problems (Ross & Bird, 1994; Ross & Mirowsky, 1983). Weight gain occurs for most adults until a decline after about age 60 (Meltzer & Everhardt, 1995), with continuous weight changes throughout their lives (Heitmann & Garby, 1999). The majority of adults have attempted to become thinner at some point in their lives (Williamson, Serdula, Anda, Levy, & Byers, 1992). Two major motivations for weight control are appearance and health concerns about being overweight (Ferraro & Yu, 1995; Hayes & Ross, 1986, 1987; Cockerham, Kunz, & Lueschen, 1988).

Relationships between appearance, health, and body weight lead to complex associations between marital roles and weight. Body weight is a key aspect of appearance (Hayes & Ross, 1987), making it a focal issue in attempts to attract desirable marital partners (Kallen & Doughty, 1984; Sobal, Nicolopoulos, & Lee, 1995). People who are married no longer need to attract a partner, and face marital role obligations that often encourage them to eat and discourage them from exercising (Craig & Truswell, 1988a, b, 1990, 1994; Kemmer, Anderson, & Marshall, 1998a, b; Sobal, 1984). Individuals who end their marriages are frequently depressed, which is characteristically associated with weight loss (Ross, 1994). People who exit from marriage may also be more concerned about their weight as they return to being in the marriage market, and may not eat as well without the social facilitation of a spouse to share cooking and eating (de Castro & de Castro, 1989; de Castro, Brewer, & Elmore, 1990; Sobal, 2000). This suggests that marital transitions into the role of spouse may lead to weight gain, and marital transitions out of the role of spouse may lead to weight loss.

Behaviors involved in body weight changes include caloric intake, physical activity, and smoking cigarettes. Caloric intake is directly associated with body weight (Katzeff, 1997), but is difficult to measure in epidemiological surveys (Gibson, 1990). Entering marriage has been associated with higher food intake (Craig & Truswell, 1988a). Physical activity from occupational and household work as well as recreational sports and exercise expends energy and is associated with lower body weight (Bouchard, 2000). Some studies report married people are more active (King, Kiernan, Ahn, & Wilcox, 1998), others find never married individuals more active (Aldana & Stone, 1992; Myers, Weigel, & Holliday, 1989; Verhoef, Love, & Rose, 1992), and others find no relationship between marital status and activity (Hirvensalo, Lintunen, & Rantanen, 2000; Umberson, 1992; Van den Hombergh, Schouten, van Staveren, van Amelsvoort, & Kok, 1995). Smoking cigarettes is associated with slightly lower body weights (Klesges, Meyers, Klesges, & LaVasque, 1989). Married individuals are less likely to smoke than those who are not married, and divorced/separated individuals are most likely to smoke compared to those in other marital categories (Venters et al., 1986; Waldron and Lye, 1989). People who enter marriage are more likely to cease smoking (Schuman, 1977; Waldron & Lye, 1989; Wee, Rigotti, Davis, & Phillips, 2001).

Studies of marriage, marital change, and body weight

Prior studies of marriage and weight have used both cross-sectional and longitudinal research designs. Several cross-sectional analyses of marital status and weight report that for both men and women, married and previously married individuals weigh more than those who have never married (Hahn, 1993; Sobal, Rauschenbach, & Frongillo, 1992), although other investigations report different patterns (Jeffery et al., 1989; Stam-Moraga, Kolanowski, Dramaix, Backer, & Kornitzer, 1999) or no marital differences (Register & Williams, 1990). Additionally, married men have been reported to be more likely to be obese, but there is no difference in obesity between married and unmarried women when other variables are controlled (Sobal et al., 1992). Cross-sectional analysis of marital incumbency, however, does not provide the temporal insights offered by longitudinal investigations of marital trajectories.

Several longitudinal studies of varying duration have examined marital status changes and body weight, and they present mixed findings. A 1-year US study of 2536 men and women revealed that women who entered marriage lost less weight than married women, but this was not true among men (Rauschenbach, Sobal, & Frongillo, 1995). Another 1-year analysis of 1896 US men's and women's weight changes reported that divorce/separation was associated with weight loss

among women, and being never married, divorced/separated, or widowed was related to weight loss among men (Meltzer & Everhart, 1995). A 2-year US study of 3552 men and women found women gained weight after they married but men did not (French et al., 1993). After two and a half years of marriage among 60 Australian couples, more men and women gained weight than lost weight (Craig & Truswell, 1990). Over 3 years 3617 US men and women who exited from marriage had lower weights than those who remained married (Umberson, 1992). During a 6-year study, 12,669 Finnish men and women who became married gained weight and those who were widowed lost weight (Rissanen, Heliövaara, Knekt, Reunanen, & Aromaa, 1991). One 10-year analysis of 3747 US women reported no association between marital change and weight (Rumpel, Ingram, Harris, & Madans, 1994). Over a 10-year period another series of analyses of 4836 US adults reported that both men and women age 25–45 gained weight when they married and lost weight when they left marriage (Kahn & Williamson, 1990, 1991; Kahn, Williamson, & Stevens, 1991). Married women in the US were more likely than unmarried women to report continuous lifetime weight gain, rather than weight loss and maintenance of that loss (French, Jeffery, Folsom, McGovern, & Williamson, 1996) and to report less adult weight variability (Folsom, French, Zheng, Baxter, & Jeffery, 1996). While marital changes may influence overall weight change, marital status changes in the US have been reported to be unrelated to change in body fat distribution (Kahn, Tatham, & Heath, 1997). Subjective reports in US samples found that men claim weight gain occurs as a result of becoming married (Egger & Mowbray, 1993), while women attribute weight gains to marital breakdown (Bradley, 1985).

These past studies provide some mixed evidence suggesting that entry into marriage may be associated with weight gain and exit from marriage may be related to weight loss. However, there are exceptions to that pattern, some gender variations within and between studies, little examination of different types of marital exit separately (as divorce/separation versus widowhood), analysis of limited age ranges, and little differentiation of weight gain and weight loss in relationship to marital changes.

To more intensively examine marital changes and body weight changes, we analyzed data from a 10-year follow-up of a nationally representative sample of US adults across a range of ages. Based on prior studies of role changes we hypothesized that for both men and women: (1) marital trajectories that are stable are related to stable body weights, (2) marital trajectories involving entering marriage are related to weight gain, (3) marital trajectories involving dissolving marriage are related to weight loss, and (4) marital trajectories involving death of a spouse are related to weight loss.

Methods

Data for this analysis were collected by the National Center for Health Statistics (NCHS), and this analysis extends earlier reports using these data (Kahn & Williamson, 1990, 1991; Kahn et al., 1991; Rumpel et al., 1994). Baseline information was collected in the National Health and Nutrition Examination Survey (NHANES I), a nationally representative probability sample of residents of the contiguous 48 states age 17–74 from 1971 to 1975, and its 10-year follow-up, the National Health and Nutrition Epidemiological Follow-up Survey (NHEFS). From the baseline cohort of 14,407 adults assessed in NHANES I, NCHS traced 13,383 people about 10 years later in the follow-up, among whom were 2022 who had died and 11,361 who were still living. Of those, 10,149 participated in personal interviews (Cornoni-Huntley et al., 1983; Madans et al., 1986). This analysis of baseline NHEFS data in the 1970s and its follow-up in the 1980s was unique in including comparable body weights that were actually measured, rather than self-reported, at both baseline and follow-up, thereby giving more accurate assessments of weight change. Detailed descriptions of the design, sample, and measurement procedures are available in NCHS publications (NCHS 1973, 1978, 1987a, b).

The analytical sample for the current analysis excluded respondents who were pregnant at the time of the baseline or follow-up assessment, who were missing height at baseline or missing baseline or follow-up weight, whose responses about marital status were missing or inconsistent from baseline to follow-up (e.g. never married at follow-up but married, divorced/separated, or widowed at baseline), who indicated their race as “other” (and represented disparate backgrounds such as Chinese, Indian, etc.), and who had missing values for other variables used in the complete statistical models (e.g. income, etc.). This produced a total analytical sample of 9043, including 3500 men and 5543 women.

A personal interview and physical examination were performed at baseline, and the follow-up included a personal interview. Weighing was performed using regularly re-calibrated scales at baseline and follow-up (NCHS, 1973). Three dependent variables were derived from measured weights at baseline and at follow-up using the procedures described by Rauschenbach et al. (1995). Weight change was calculated as the weight at follow-up minus weight at baseline. Weight gain was calculated as the weight difference for all respondents with weight change of 0 or greater. Weight loss was calculated as the negative of the weight difference for all respondents with a weight difference of 0 or less. Thus we analyzed the magnitude of weight loss and weight gain. Zero weight change occurred for only 2.9% of the men and 2.7% of the women, who were included in both

the loss and gain analyses because no standards or criteria exist for deciding which weights constitute an insignificant or minimum weight change.

Marital status was self-reported at baseline and follow-up, and did not explicitly assess co-habitors. The independent variable was marital status change, which was grouped into seven groups that represented different marital trajectories: A reference category and six comparison categories were used as dummy variables in regression analysis. The reference category was married at both baseline and follow-up, and the other categories of marital status change were (1) never married at both times, (2) divorced/separated at both times, (3) widowed at both times, (4) married or never married at baseline, divorced/separated at follow-up, (5) married or never married at baseline, widowed at follow-up, and (6) never married, divorced or separated, or widowed at baseline, married at follow-up. There were 66 respondents who were divorced/separated at baseline and widowed at follow-up and 21 who were widowed at baseline and divorced/separated at follow-up; these were omitted from the analysis because there were so few of them that estimates for those groups for men and women would be unstable, and because it was not clear to which other marital change group they could be unambiguously assigned (Weaver, 2000). Overall, the seven marital trajectory groups analyzed here represented four groups with stable marital status at baseline and follow-up (never married, married, divorced/separated, and widowed), and three groups with changed marital status from baseline to follow-up (becoming married, dissolving a marriage, or death of a spouse).

Because the importance of weight change differs between taller and shorter people, body mass index (BMI) was calculated as weight at baseline divided by height at baseline squared (in kilograms and meters) to adjust for height (Gibson, 1990) and was used as a control variable for overall body size. Length of follow-up for the interviewed respondents averaged 9.5 years, ranging from 5 to 12 years (Madans et al., 1986), and was entered as a control variable for the duration of opportunity for weight change.

Demographic control variables included race (black, with white as the reference category), age, age squared to adjust for the curvilinearity of the relationship between body weight and age, and major lifetime residence area (urban, rural, suburban). Other socioeconomic controls included education (13 categories), family income (six categories), and employment (employed, not employed), and, for women, parity (number of children born to the woman). Lifetime residence and parity were measured at follow-up and all other control variables were measured at baseline to examine prospective change. Parity effects may occur both because of childbearing and childrearing (Williamson et al., 1994) and the follow-up value represents both. Change in work status was also

included by coding 1 if a change had taken place and a 0 if not. Change in income was not included because there were differences in coding between the two time points and almost 1000 respondents had missing values for income at the follow-up. Age, education, and baseline income were centered at meaningful values near their means to make regression coefficients more interpretable (Kleinbaum, Kupper, & Muller, 1988). The centering values were 40 years for age, 12 years for education, and \$12,000 for income.

To examine how change in marital status was related to change in weight, four weight-related behavior variables were included as controls. Current smoking status (smoker, not smoker) and quit smoking (quit within last 12 months, did not quit) were measured at follow-up. Self-reported smoking questions have adequate validity for epidemiological studies (Navarro, 1999). Two measures of physical activity were included in the NHEFS data: Recreational exercise, indicated by responses to the question, "In things you do for recreation, for example, sports, hiking, dancing, etc., do you get much exercise, moderate exercise, little or no exercise?"; and other exercise, indicated by responses to the question, "In your usual day, aside from recreation, are you physically very active, moderately active, or quite inactive?" For each question two dummy variables were created with the inactive group as the comparison group. Energy expenditure questions can provide valid measures (Schechtman, Barzilai, Rost, & Fisher, 1991) and self-reported physical activity can validly represent overall patterns of energy expenditure (LaPorte, Montoyne, & Casperson, 1985). Caloric intake was collected on only a very small group of the baseline NHEFS sample, so it could not be included in the analyses presented here, and prior studies of baseline NHEFS data reported that caloric intake was not associated with body weight (Braitman, Adlin, & Stanton, 1985).

Because of gender differences in both weight and marriage, men and women were analyzed separately as they are in most research on the social epidemiology of obesity (Kahn & Williamson, 1991; Sobal et al., 1992). Analysis involved three steps. First, bivariate analysis was used to calculate mean weight changes for marital status change groups. Second, multiple regression analysis was used to analyze the effect of changes in marital status on changes in weight, controlling for sociodemographic variables and interactions between the control variables and marital status change. The interactions between the control variables and marital status change were not found to be statistically significant given the number of tests performed, did not contribute substantially to the explained variance, and revealed no consistent patterns. Therefore, interaction results are not presented here. Third, behavior variables were included in regression models in addition to the sociodemographic controls to examine how these

variables may operate as mediating factors between marital status change and weight change. Prior research suggested that weight loss and weight gain may be a result of different processes (Rauschenbach et al., 1995), so separate regression models were examined for (1) overall weight change, (2) magnitude of weight loss for those who had lost weight, and (3) magnitude of weight gain for those who had gained weight. An alpha level of $p < 0.05$ was used to identify statistically significant relationships for single variables in the regression models, but we report p values at 0.05, 0.01, and 0.001 so readers can consider the role of multiple hypothesis testing in interpreting alpha values. Because of differences in missing values for some variables, N 's varied slightly among models.

Statistical analyses were performed using the statistical package SUDAAN (Shah, LaVange, Barnwell, Killinger, & Wheelless, 1989) to deal with the multilevel NHEFS sampling procedures. Sample weights were used to provide nationally representative results and the standard errors were adjusted for the stratified complex clustering sampling design of the survey (Lee, Forthofer, & Lorimor, 1986).

Results

Sociodemographic, behavioral, and weight characteristics

The baseline sample of women had a mean age of 45.7, was 9% black, averaged a parity of 2.8, 67% had a high school education or more, the modal income category was \$5–10,000, 39% were working, and 33% had spent most of their life in a rural area, 28% in a suburban area, and 38% in an urban area. The baseline sample of men had a mean age of 44.6, was 8% black, 68% had a high school education or more, the modal income category was \$5–10,000, 85% were working, and 34% had spent most of their life in a rural area, 30% in a suburban area, and 36% in an urban area. These data are nationally representative and their distributions are congruent with other US national samples of this age group.

The mean BMI at baseline was 25.9 for men, and 25.2 for women. Weight-related behavior variables included physical activity and smoking. Among women, 14% reported much and 50% moderate recreational activity, while 26% stated they were very active and 58% moderately active in other activity. For men, 21% reported much and 52% moderate recreational activity, and 32% stated they were very active and 53% moderately active in other activity. Among these women, 27% said they currently smoked cigarettes and 2% had quit within the last 12 months, and among men 32% were current smokers and 3% had quit within the last 12 months.

Marital change groups and body weight changes

The majority of the sample (86% of men and 80% of women) reported the same marital status at baseline and follow-up (Table 1). This included 77% of men and 59% of women who at both times were married, 5% of men and 4% of women never married, 2% of men and 6% of women divorced/separated, and 2% of men and 11% of women widowed. The three marital change groups included dissolution of marriage for 6% of men and 6% of women who were never married or married at baseline and divorced/separated at follow-up, death of spouse for 5% of men and 10% of women who were never married or married at baseline and widowed at follow-up, and entry into marriage for 4% of men and 3% of women who were unmarried at baseline and married at follow-up.

Table 1 also reveals that mean weight change, weight gain, and weight loss varied among the marital change groups. Mean weight change was almost always smaller than either mean weight gain or mean weight loss (except for men unmarried at baseline and married at follow-up), indicating that some individuals gain weight and others lose weight over time. For all the marital status change groups except those involving widowhood, mean weight gain was larger than weight loss.

Multivariate analysis of marital changes and weight changes

Two multiple regression models examined relationships between marital status changes and body weight changes: The first controlled for only sociodemographic variables, and the second controlled for both sociodemographic variables and behaviors related to body weight changes (Table 2). These models included ten sociodemographic variables, six marital status change groups, and six behavior variables. The four regressions explained 14–16% of the variation in weight change.

Men who went from married to divorced had an average weight change of about -2.5 lbs. (-1.1 kg) more than men who remained married, but that change was reduced and was no longer statistically significant when behavior variables were controlled. Women who went from unmarried to married had an average weight change of almost $+5$ lbs. ($+2.3$ kg) more than those who remained married, which remained significant even when women's smoking and exercise were included in the regression model.

Multivariate analysis of marital changes and weight gain

Multiple regression models of marital status changes and weight gain controlled for sociodemographic variables and then controlled for both sociodemographic variables and weight-related behaviors among the

Table 1
Body weight by marital status change groups for men and women

Marital change group	Weight variable	Men (<i>N</i> = 3500)					Women (<i>N</i> = 5543)				
		<i>N</i> ^a	Mean		SE		<i>N</i> ^a	Mean		SE	
			lbs	kg	lbs	kg		lbs	kg	lbs	kg
Total	Change	3500	5.4	2.4	0.4	0.2	5543	6.0	2.7	0.3	0.1
	Gain	2219	13.2	6.0	0.3	0.1	3722	14.4	6.5	0.3	0.1
	Loss	1381	9.6	4.3	0.4	0.2	1970	11.5	5.2	0.4	0.2
Married–married	Change	2707	5.3	2.4	0.4	0.2	3284	7.1	3.2	0.4	0.2
	Gain	1745	12.7	5.8	0.3	0.1	2383	14.2	6.4	0.3	0.1
	Loss	1044	9.1	4.1	0.3	0.2	1007	10.4	4.7	0.5	0.2
Never mar.–never mar.	Change	158	5.2	2.4	1.6	0.7	247	5.7	2.6	1.4	0.6
	Gain	103	14.2	6.4	1.4	0.6	166	14.9	6.7	1.3	0.6
	Loss	56	13.1	5.9	2.9	1.3	84	13.8	6.3	1.5	0.7
Div./sep.–div./sep.	Change	84	5.3	2.4	2.7	1.2	355	8.4	3.8	1.4	0.6
	Gain	48	17.4	7.9	2.4	1.1	249	16.0	7.2	1.1	0.5
	Loss	38	13.0	5.9	2.5	1.1	109	11.7	5.3	1.8	0.8
Widowed–widowed	Change	59	0.3	0.1	3.2	1.4	594	−1.5	−0.7	1.0	0.4
	Gain	30	13.5	6.1	2.9	1.3	281	11.3	5.1	1.1	0.5
	Loss	30	15.3	6.9	1.9	1.9	331	14.2	6.4	0.9	0.4
Married–div./sep.	Change	200	5.5	2.5	1.1	0.5	336	8.1	3.7	1.4	0.6
	Gain	133	14.1	6.4	1.0	0.5	238	16.4	7.4	1.2	0.5
	Loss	71	10.4	4.7	1.3	0.6	103	11.5	5.2	1.3	0.6
Married–widowed	Change	159	−1.5	−0.7	1.8	0.8	541	−0.1	−0.0	0.9	0.4
	Gain	62	13.2	6.0	1.5	0.7	251	12.2	5.5	0.9	0.4
	Loss	101	13.4	6.0	1.6	0.7	302	12.5	5.7	0.7	0.3
Unmarried–married	Change	133	11.2	5.0	2.1	1.0	186	13.9	6.3	1.6	0.7
	Gain	98	16.3	7.4	2.3	1.1	154	19.1	8.7	1.6	0.7
	Loss	41	6.3	2.9	1.0	0.4	34	9.0	4.1	1.2	0.5

^aThe *N*'s for weight loss and weight gain do not sum to equal those for weight change for some marital change groups because those with zero change were included in both weight gain and weight loss analyses.

portion of the sample who gained weight or had no weight change (Table 3). These regressions explained 5–9% of the variation in weight gain.

Among men, none of the marital status change groups were significantly different in weight gain from the reference group of men married at both baseline and follow-up. Women who went from unmarried to married gained about +4 lbs (+1.8 kg) more than women married at both baseline and follow-up, which remained significant even with smoking and exercise in the regression model.

Multivariate analysis of marital changes and weight loss

Multiple regression models of relationships between marital status changes and weight loss first included sociodemographic variables, and second included both

sociodemographic variables and weight-related behaviors among the portion of the sample who lost weight or had zero weight change (Table 4). These regression models explained 22–27% of the variation in weight loss.

Men who were divorced/separated at both baseline and follow-up and also those who went from married to widowed were more likely to lose weight, and both of those relationships persisted when behavior variables were controlled. Women who were never married at both baseline and follow-up lost 3.4 lbs (1.5 kg) more than consistently married women between baseline and follow-up when behavior variables were controlled. Women who went from unmarried to married lost about 1.0 lb (0.5 kg) less than women married at both times, but this relationship was no longer significant when the behavior variables were controlled.

Table 2

Regression coefficients for models examining marital change and weight change, controlling for sociodemographic variables and behavior variables

Marital change group	Men (N = 3432)								Women (N = 5467)							
	Sociodemographic ^a				Behavior ^b				Sociodemographic ^a				Behavior ^b			
	b		SE		b		SE		b		SE		b		SE	
	lbs	kg	lbs	kg	lbs	kg	lbs	kg	lbs	kg	lbs	kg	lbs	kg	lbs	kg
Never married to never married	-1.4	-0.6	1.4	0.6	-1.0	-0.5	1.4	0.6	0.0	0.0	1.3	0.6	-0.5	-0.2	1.3	0.6
Divorced/separated to divorced/separated	-1.6	-0.7	2.8	1.3	-0.5	-0.2	2.8	1.3	0.9	0.4	1.4	0.6	1.2	0.5	1.3	0.6
Widowed to widowed	0.6	0.3	2.8	1.3	0.9	0.4	2.0	0.9	-1.1	-0.5	1.2	0.5	-1.2	-0.5	1.2	0.5
Married to divorced/separated	-2.5*	-1.1	1.1	0.5	-1.8	-0.8	1.1	0.5	-1.8	-0.8	1.5	0.7	-1.3	-0.6	1.4	0.6
Married to widowed	-2.7	-1.2	1.9	0.9	-2.3	-1.0	1.8	0.8	-1.5	-0.7	1.0	0.5	-1.6	-0.7	1.0	0.5
Unmarried to married	2.3	1.0	2.3	1.0	2.4	1.1	2.2	1.0	4.7**	2.1	1.7	0.8	4.7**	2.1	1.7	0.8
Multiple R-squared	0.14				0.16				0.14				0.15			

^aSociodemographic variables included as controls in these models: Baseline body mass index, age, age squared, education, income, race, employment, rural, follow-up parity, duration of follow-up.

^bBehavior variables included as controls in these models in addition to sociodemographics include: Currently smoking, quit smoking last year, recreational exercise, usual day activity.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

Table 3

Regression coefficients for models examining marital change and weight gain,^acontrolling for sociodemographic variables and behavior variables

Marital change group	Men (N = 2189)								Women (N = 3682)							
	Sociodemographic ^b				Behavior ^c				Sociodemographic ^b				Behavior ^c			
	b		SE		b		SE		b		SE		b		SE	
	lbs	kg	lbs	kg	lbs	kg	lbs	kg	lbs	kg	lbs	kg	lbs	kg	lbs	kg
Never married to never married	0.5	0.2	1.4	0.6	0.4	0.2	1.4	0.6	1.6	0.7	1.4	0.6	1.4	0.6	1.5	0.7
Divorced/separated to divorced/separated	3.6	1.6	2.4	1.1	4.3	1.9	2.4	1.1	1.7	0.8	1.1	0.5	1.3	0.6	1.0	0.5
Widowed to widowed	2.9	1.3	2.9	1.3	3.6	1.6	3.0	1.4	1.1	0.5	1.4	0.6	1.3	0.6	1.4	0.6
Married to divorced/separated	-0.2	-0.1	1.0	0.5	0.3	0.1	1.0	0.5	0.6	0.3	1.3	0.6	0.7	0.3	1.2	0.5
Married to widowed	2.3	1.0	1.5	0.7	2.3	1.0	1.4	0.6	0.5	0.2	1.0	0.5	0.3	0.1	1.0	0.5
Unmarried to married	2.2	1.0	2.4	1.1	2.3	1.0	2.4	1.1	4.1*	1.9	1.6	0.7	4.2*	1.9	1.6	0.7
Multiple R-squared	0.05				0.07				0.08				0.09			

^aThis table only includes those who had weight gain or zero weight change.

^bSociodemographic variables included as controls in these models: Baseline body mass index, age, age squared, education, income, race, employment, rural, follow-up parity, duration of follow-up.

^cBehavior variables included as controls in these models in addition to sociodemographics include: Currently smoking, quit smoking last year, recreational exercise, usual day activity.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

Discussion

These findings provide some support for the hypotheses presented earlier, with differences by gender. (1) Stable marital trajectories were not associated with significant weight changes, except for weight loss among men who remained separated/divorced. (2) Marital

trajectories involving entry into marriage were associated with weight gain among women, but not among men. (3) Marital trajectories involving dissolving marriages were associated with weight loss among men, but not women. (4) Marital trajectories involving death of a spouse were associated with weight loss among men, but not women. Another substantive finding that also

Table 4

Regression coefficients for models examining marital change and weight loss,^acontrolling for sociodemographic variables and behavior variables

Marital change group	Men (N = 1342)								Women (N = 1932)							
	Sociodemographic ^b				Behavior ^c				Sociodemographic ^b				Behavior ^c			
	b		SE		b		SE		b		SE		b		SE	
	lbs	kg	lbs	kg	lbs	kg	lbs	kg	lbs	kg	lbs	kg	lbs	kg	lbs	kg
Never married to never married	0.5	0.2	2.4	1.1	0.7	0.3	2.7	1.2	2.4	1.1	1.6	0.7	3.4*	1.5	1.5	0.7
Divorced/separated to divorced/separated	6.8**	3.1	2.1	1.0	5.1**	2.3	1.7	0.8	2.0	0.9	1.5	0.7	1.4	0.6	1.5	0.7
Widowed to widowed	3.4	1.5	2.0	0.9	2.8	1.3	2.2	1.0	1.4	0.6	1.1	0.5	1.7	0.8	1.0	0.5
Married to divorced/separated	2.1	1.0	1.2	0.5	1.6	0.7	1.2	0.5	2.5	1.1	1.4	0.6	2.0	0.9	1.4	0.6
Married to widowed	4.7**	2.1	1.7	0.8	4.1*	1.8	1.7	0.8	0.1	0.0	0.9	0.4	0.4	0.2	0.8	0.4
Unmarried to married	0.3	0.1	1.5	0.7	0.0	0.0	1.5	0.7	-1.0***	-0.5	0.1	0.0	-0.5	-0.2	1.2	0.5
Multiple R-squared	0.22				0.24				0.25				0.27			

^aThis table only includes those who had weight loss or zero weight change.

^bSociodemographic variables included as controls in these models: Baseline body mass index, age, age squared, education, income, race, employment, rural, followup parity, duration of followup.

^cBehavior variables included as controls in these models in addition to sociodemographics include: Currently smoking, quit smoking last year, recreational exercise, usual day activity.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

emerged in this analysis was that marital and other demographic characteristics were better predictors of weight loss than weight gain.

This analysis went beyond prior investigations by examining a larger sample that provided more statistical power to examine more specific marital changes than most prior studies, considering weight loss and weight gain separately, differentiating marital role exit separately as divorce/separation versus widowhood, and examining the influence of behavior variables. The findings support some earlier analyses (Craig & Truswell, 1990; Kahn & Williamson, 1990, 1991; Kahn et al., 1991; Rissanen et al., 1991; Umberson, 1992) that found entering marriage was associated with weight gain and exit from marriage with weight loss, but were different than other past studies that reported different patterns or no relationships between marital change and weight (French et al., 1993; Rauschenbach et al., 1995; Rumpel et al., 1994).

The results can be interpreted in terms of role changes in marital trajectories within the life course (Barrett, 2000; Moen et al., 1992). Entry into marriage provides role obligations with respect to eating, leading to more regular meals (Craig & Truswell, 1988a, b; Kemmer et al., 1998a, b; Worsley, 1988). Marital role obligations also compete with the more individualistic activity of involvement in exercise and sport (Craig & Truswell, 1990). People getting married are less likely to smoke and more likely to quit smoking, which can lead to some weight gain (Klesges et al., 1989; Schuman, 1977). All of

these changes related to entering the marital role generally lead to weight gain. Entry into the marital role may have had greater effects on weights of women because they are more influenced by changes such as more regularly eating larger portions of "couple foods" (Craig & Truswell, 1994; Worsley, 1988), sharing food during marital commensality (Kemmer et al., 1998a, b), greater responsibilities for parenthood (Williamson et al., 1994; Wolfe, Sobal, Olson, & Frongillo, 1997a, b), and having less time to exercise (Craig & Truswell, 1990).

Exit from the marital role is a stressful life event (Hobson et al., 1998; Holmes and Rahe, 1967; Miller & Rahe, 1997) that leads to a decline in everyday social support and social control and is associated with depression. Obesity is lower among depressed individuals (Ross, 1994), with loss of appetite and anorexia a distinguishing characteristic of depression. Elderly men without spouses eat less regularly and consume less healthy foods (Davis, Randall, Forthofer, Lee, & Marger, 1985; Horwath, 1989). These factors appear to contribute to weight loss after leaving marriage.

Exit from marriage by dissolution through divorce/separation and widowhood both appear to influence body weight, but not in the same way for the two genders. Divorce/separation and widowhood were an influence on weight for men, but not women. This may be due to the greater support that men gain from being in the marital role. Exit from marriage may be more of a change for men than women in food roles because women are often the primary provisioners and providers

of food in families (Charles & Kerr, 1988; DeVault, 1991), and exiting from a marital relationship may not be as great a change for women as for men. Men's weight loss when marriages end is consistent with research that finds that men gain more from being married than women do (Gove, 1973; Gove et al., 1983; Verbrugge, 1979).

Marital role changes appear to lead to many behavior changes, including those that influence body weight. The immediate influences upon body weight are eating which provides caloric energy input (Katzeff, 1997), activity which influences caloric energy expenditure (Bouchard, 2000), and smoking which has pharmacological effects that raise metabolic rates slightly to cause weight loss and prevent weight gain (Klesges et al., 1989). Controlling for these weight-related behaviors reduced the strength of some of the marriage–weight relationships and changed the direction of one. This suggests that these two behaviors may not have been measured precisely enough to reveal a larger role in the relationship between marital changes and weight, they had very small effects on the relationship, or that most of the effect is from dietary changes that could not be assessed using these data.

A novel finding in this analysis was that these regression models explained about one-fourth of the variation in weight loss but could only explain less than one-tenth of the variation in weight gain. While there is no obvious interpretation for this difference, perhaps there are clear individual reasons for weight loss that are captured by standard sociodemographic variables (including marital status), while contextual and environmental factors (French, Story, & Jeffery, 2001) not measured here are more important for weight gain (such as cultural differences, food system variations, or effects of the built environment, Sobal, 2001). Future research should continue to examine weight gain and weight loss separately and seek explanations for differences between them.

Several limitations exist in this analysis. The baseline sample was nationally representative, but the data cannot be fully generalized to individuals who could not be traced in follow-up or were excluded because data were not available on the variables in this analysis. The baseline data were collected in the US in the 1970s and followed up in the 1980s, and these findings may not be applicable in other places or times. Marriage and other demographic and behavior variables were self-reported without separate validation, and must be accepted as having face validity subject to possible socially desirable responses and selective memory. Some variables, such as caloric intake, were not available for this analysis.

This analysis assumes that social causation was occurring, where marital changes lead to weight outcomes, rather than social selection, where weight leads to marital changes (Goldman, 1994; Waldron, Hughes,

& Brooks, 1996). Assumption of social causation is supported by findings of other longitudinal investigations of marital status and body weight (Fu & Goldman, 1996; Kahn & Williamson, 1990; Kahn et al., 1991; Rauschenbach et al., 1995), studies showing that weight does not lead to marital separation or divorce (Fu and Goldman, 2000), and that a person's weight does not lead to the death of their own spouse. However, this assumption is not congruent with evidence that obese people have difficulty in getting married (Gortmaker, Must, Perrin, Sobol, & Dietz, 1993; Sobal et al., 1995). The longitudinal design used in this study and the inclusion of baseline weight as a control variable support the focus on social causation in this analysis.

Longitudinal data offer analytical opportunities not available in cross-sectional data (Frongillo & Rowe, 1999, Chapter 6). However, the data in this analysis included two assessments about 10 years apart and have several design limitations. During the 10-year follow-up period some individuals may have changed marital status multiple times in ways that would not be captured with data at only two points in time. Also, it is not known when marriage changes occurred during the 10-year interval, with some individuals incumbent in a marital role almost 10 years at follow-up while others may have recently changed marital status.

This 10-year follow-up in the NHEFS data did not ask about multiple marital changes during the period between the two measurements, nor did it assess marital changes before the baseline. This prevented examination of full marital trajectories but did provide information about 10-year changes. The average interval from divorce to remarriage is about 4 years in the US, and widowhood to remarriage is about 4 years for men and about 6 for women (Wilson & Clarke, 1992), which makes multiple marital changes likely for some individuals during the 10-year follow-up in the data used in this analysis. Multiple marital status changes are related to poor health (Barrett, 2000; Hibbard and Pope, 1993), but it is not known how they may be related to body weight. Barrett (2000) reports that only a small minority of adults in the US experience multiple marital changes, finding that from age 30 to 65 only 18% had multiple marital changes over a period averaging over 30 years of aging, which suggests that about 5% would be expected to undergo multiple marital changes within a 10-year period such as the one used in this analysis. Such a small percentage of multiple marital changes is expected to contribute random variation in these data and lead to univariate and multivariate underestimation of any differences that do occur because of the inability to account for complete marital trajectories, adding noise to the data to create a more conservative analysis of marital changes and weight than would exist with complete measurement of all marital changes over a 10-year observation period. Additionally, this analysis

focused on the effect of role incumbency at two time points, so that even if a person married, divorced, and remarried they would be experiencing the body weight effects of the marital role at baseline and follow-up.

Future research is needed to provide greater understanding of the patterns and processes involved in marital role changes and body weight. Event history data are required to provide more exact estimates of the trajectories and rates of weight changes after marital role changes. Qualitative research would also prove useful to provide deeper insights into expectations and interpretations of marital role changes and body weight.

Most existing research reports that marriage enhances health, particularly for men (Gove et al., 1983, 1990; Hahn, 1993; Hu & Goldman, 1990; Verbrugge, 1979, 1983; Wyke & Ford, 1992), but increased body weight among some people who enter marriage may be an exception to that pattern. The US National Institutes of Health (1998) cautions that even small weight increases may have substantial clinical effects at the population level (although not all weight gain is unhealthy and not all weight loss healthy). Other beneficial aspects of marriage such as social support, social control, and increased resources may be sufficiently powerful to overshadow any deleterious effects of weight gains (Sobal et al., 1992). Alternatively, small changes in body weight may not be as hazardous to health as many have claimed (Troiano et al., 1996), and the modest weight changes associated with changes in marital trajectories in these data may be within the range of relatively benign weight-related health effects and may not be clinically significant.

In conclusion, marital role changes are important life course transitions, and marital trajectories have significant consequences for the physical characteristic of body weight. Because of the great concern about body weight that is motivated by both appearance and health, understanding factors such as marital transitions and trajectories may provide knowledge about basic social processes as well as provide insights people may find useful in dealing with weight throughout their life course and identifying times in their lives when they are likely to gain or lose weight.

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