

# How Cohabitation, Marriage, Separation, and Divorce Influence BMI: A Prospective Panel Study

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**Objective:** This study examines how changes in cohabitation or marital status affect Body Mass Index (BMI) over time in a large representative sample. **Method:** Participants were 20,950 individuals (50% female; 19 to 100 years), representative of the German population, who provided 81,926 observations over 16 years. Face-to-face interviews were used to obtain demographic data, including cohabitation and marital status, height, body weight, and weight-relevant behaviors (exercise, healthy eating, and smoking). Control variables included age, notable changes in status (life events such as having children or change in employment status), perceived stress, and subjective health. **Results:** Cohabitation led to significant weight gain in men and women—after four years or longer, about twice the gain associated with marriage (controlling for weight-related behaviors, age, children, employment, stress, and health). BMI after separation was largely comparable to BMI before starting cohabitation; women lost some weight in the first year, men gained some weight after four or more years of separation. Divorce generally predicted weight gain. Changes in exercise, healthy eating, and smoking did not attenuate the effect of changes in relationship status on BMI. **Conclusions:** This is among the first longitudinal studies to directly compare the effects of key changes in relationship status on BMI. The findings extend and qualify previous results by showing that the benefits of marriage or cohabitation do not necessarily include a healthier BMI. They also suggest that relationship transitions—particularly moving in with a partner and divorce—may be important time windows for weight gain prevention.

**Keywords:** obesity, relationship, relationship transition, health, longitudinal

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Social relationships influence body weight and obesity (Christakis & Fowler, 2007). Two major relationship transitions that most adults experience are moving in with a partner and getting married (Kreider & Ellis, 2011). Several longitudinal studies suggest that particularly getting married (e.g., Gallo, Troxel, Matthews, & Kuller, 2003; Kiecolt-Glaser & Newton, 2001), but also starting to cohabit (Kohn & Averett, 2014; Musick & Bumpass, 2012), is beneficial for general health. In contrast, separating from a partner

or divorcing has detrimental health effects (e.g., Sbarra, Law, & Portley, 2011). However, less is known about how these relationship transitions affect body weight, an important indicator of general health.

According to the *marriage market* hypothesis, individuals who are no longer on the marriage market, and thus no longer concerned with attracting a mate, gain weight (e.g., Meltzer, Novak, McNulty, Butler, & Karney, 2013). Following the same logic, divorcees strive to lose weight when they reenter the marriage market (Averett, Sikora, & Argys, 2008; Lundborg, Nystedt, & Lindgren, 2007). This hypothesis makes no explicit predictions about the effects of starting or ending cohabitation. Some authors suggest that cohabitation has similar effects on health as marriage (Kohn & Averett, 2014; Musick & Bumpass, 2012); others suggest qualitatively different effects (e.g., Marcussen, 2005).

Most empirical studies on the relation between marital transitions and BMI support the marriage market hypothesis. A review of longitudinal studies examining marital transitions and changes in BMI (Dinour, Leung, Tripicchio, Khan, & Yeh, 2012) found that six of 13 studies reported weight increases for both genders after marriage, five reported increases for one gender only, and

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two reported no weight change. Three of four studies examining weight changes after starting cohabitation showed increased risks of weight gain. Findings for weight changes after divorce were mixed: Two of 12 studies reported weight loss in both genders, eight reported weight loss in one gender, and two reported no weight change. Only one study has examined the effects of ending cohabitation (in a male sample); its findings showed weight loss (Fogelholm, Kujala, Kaprio, & Sarna, 2000). Studies published since the 2012 review by Dinour et al. largely confirm the previous findings (Averett, Argys, & Sorkin, 2013; Oliveira, Rostila, de Leon, & Lopes, 2013).

The marriage market hypothesis does not specify the mechanisms that lead to increases in BMI when couples move in together or get married. One potential underlying mechanism is a change in weight-related behaviors. For example, the *negative-protection* explanation proposes that marriage (and potentially cohabitation) entails reciprocal spousal obligations such as regular family meals (Sobal & Rauschenbach, 2003) and more frequent meals in company. Eating in company is associated with consuming more calories than is eating alone (Herman, 2015). In addition, the poor eating habits of one spouse can migrate to the other (Hartmann, Dohle, & Siegrist, 2014). Lastly, married individuals exercise less than those who have never married (Mata, Frank, & Hertwig, 2015; Rapp & Schneider, 2013).

In contrast, the *marriage-protection* explanation proposes that marriage (or cohabitation) is advantageous for a healthy weight: Spouses can monitor and encourage each other to eat healthily or be physically active (Khan, Stephens, Franks, Rook, & Salem, 2013). They also spend more time on cooking than singles or unmarried couples, which is associated with a healthier diet (Monsivais, Aggarwal, & Drewnowski, 2014). Married couples tend to have more financial resources (Averett et al., 2008) and are thus better able to afford a healthier lifestyle. People in a relationship are also more likely to stop smoking if their partner does not smoke (Klein, Rapp, & Schneider, 2013). However, smoking cessation increases the chance of weight gain (Aubin, Farley, Lycett, Lahmek, & Aveyard, 2012).

This study examines the influence of changes in cohabitation and marital status on the development of BMI over 16 years, considering the potential role of weight-related behaviors. It contributes to existing research in at least four important ways: (1) It is the first study to explicitly compare long-term effects of key relationship transitions—cohabitation, marriage, separation, and divorce—on BMI. Further, research into how separation and divorce affect BMI is lacking. (2) The panel data used in this study come from Germany. To date, few relevant studies have been conducted outside the United States. (3) Few longitudinal studies have considered the potential role of weight-related behaviors (but see Oliveira et al., 2013, who controlled for physical activity). To help fill this gap, this study investigates to what extent exercise, healthy eating, and smoking can help explain weight changes after relationship transitions. (4) Finally, this study controls for important influences on BMI that have often been ignored in previous research, including life events such as having children, changes in employment status, perceived stress, and health issues (Dinour et al., 2012).

Based on the marriage market hypothesis, the following predictions were formulated for both men and women: (1) starting to cohabit or getting married leads to weight gain; (2) weight gain is

more pronounced after getting married than after starting to cohabit; (3) separating or getting divorced leads to weight loss; (4) weight loss is more pronounced after divorce than after separation. Hypotheses 5 and 6 make contrasting predictions about behavioral changes that could affect BMI: (5) Changes in BMI after starting to cohabit or getting married are at least partly explained by exercising less, eating less healthily, or smoking more than when single (negative protection hypothesis) versus (6) changes in BMI after starting to cohabit or getting married are at least partly explained by exercising more, eating more healthily, or smoking less than when single (marriage protection hypothesis). The present analyses test whether one of these two hypotheses is supported by the data. Given the scarcity of work on the effects of ending cohabitation or getting divorced on changes in weight-related behaviors, no specific hypotheses are proposed for these transitions. Sex differences in the effects of relationship transitions on BMI and effects of weight-related behaviors are explored.

## Method

### Data

The data were drawn from the German Socio-Economic Panel (SOEP; Version 31; German Institute for Economic Research), an ongoing, nationally representative longitudinal study of private households in Germany initiated in 1984 with several refreshment samples thereafter. Comprehensive information about design, participants, and measures is reported in Wagner, Frick, and Schupp (2007). All participants provided informed consent; the Institutional Review Board of the German Institute for Economic Research approved the study.

The data analyzed in the present study were collected over 16 years (1998 to 2014, subsamples A to H; later subsamples lack relevant information on relationship status). The total sample comprised 31,831 adults living in Germany. Respondents were excluded if they did not provide any valid body weight assessments ( $n = 1053$ ) or provided fewer than five years of observations ( $n = 4,522$ ); respondents who were widowed ( $n = 2,563$ ) or remarried ( $n = 4,095$ ) were excluded to avoid confounding effects of previous marriages. Importantly, the sum of excluded and included respondents is higher than the total sample, because excluded participants can simultaneously belong to more than one category (e.g., be widowed and not report body weight). Observations of participants who remarried or became widowed during the study period were included up to this relationship transition. The remaining sample consisted of 20,950 individuals providing 81,926 observations. The original sample was comparable to the final sample with regard to the variables of interest (see Table S1 in the online supplementary material). Over the entire study period, the drop-out rate was 10.8% (based on observations). Continuers differed minimally from drop-outs (as tested using data from the last available observation) in that drop-outs paid less attention to healthy eating (Cohen's  $d = 0.07$ ), exercised less ( $d = 0.17$ ), and were older ( $d = 0.12$ ). There were no significant differences in smoking, gender, or BMI. General information on drop-out rate and refreshment sampling in the Socio-Economic Panel can be found in Kroh, Kühne, and Siegers (2017).

Only relationship transitions experienced for the first time over the study period were included in the models. For example, if a

participant started to cohabit, got married, separated, and then divorced, all of those transitions would be included. If she then remarried, her data after remarriage would be excluded to avoid confounding the effects of this remarriage with the influence of all previous relationship transitions on BMI (see Table 1 for a transition coding scheme). One exception was made to avoid losing a significant proportion of the sample: The reference category (i.e., not cohabiting) for estimating the effects of cohabitation status was defined as including both respondents who had never lived with a partner and respondents who had not done so in the past four years. Importantly, including the latter group makes the estimate of cohabitation effects on weight change more conservative.

Marital and fertility history data from a retrospective life course questionnaire, administered at the start of SOEP participation and updated yearly, were combined with additional data from the 1998 to 2001 surveys to build indices of relationship status and childbirth. Respondents were interviewed every year. Employment was assessed yearly; body weight, height, perceived stress, and subjective health were assessed biennially starting in 2002. Weight-related behaviors were measured biennially; exercise since 2001, smoking since 2002, and healthy eating since 2004. Yearly estimates for effects of relationship status and weight-related behaviors on BMI can be reported because some participants had moved, for example, from no relationship to the first year of a relationship when BMI was assessed; others had moved to the second year. The person-specific effects after the first, second, third, and so forth, year of a relationship transition on BMI were averaged over all valid observations.

**Measures**

Body weight and height were self-reported by respondents. To reduce measurement error, body weight was treated as missing if it deviated from the respondent’s median body weight by a factor greater than 1.5 or lower than 0.66. Consequently, 86 observations were deleted. If the reported height in centimeters was below 100, 100 was added ( $n = 3$  observations). If participants reported different heights over time, the median was taken (29.6% of observations; mean variation = 2.17 cm; 75% of this subsample varied by  $\leq 2$  cm). Importantly, for participants with varying height reports, all BMI values

were calculated with the same median height; BMI was thus not influenced by this variation. Moreover, the results of analyses excluding all participants with varying height reports were comparable with those reported here.

Duration of cohabitation or marriage/time since separation or divorce were determined by reference to both (a) the life course questionnaire administered to participants entering the SOEP, and (b) three questions administered every year: First, respondents were asked to state their marital status. Second, respondents who were unmarried or permanently separated from their spouse were asked whether they were in a committed relationship. Third, individuals in a committed relationship were asked whether their partner lived in the same household (see Table 1 for coding details). Same-sex couples in cohabitation or civil union (coded as married) are included; however, they represent only 0.04% of all observations in this study.

Weight-related behaviors were assessed by three questions: “How often do you exercise?” with responses on a 4-point scale (“daily” to “never”); “How much attention do you pay to healthy eating?” (4-point scale “very much” to “none at all”); “Do you currently smoke cigarettes, a pipe, or cigars?” (response options “yes” and “no”).

**Control variables.** Age was calculated based on the birth date. The child-related events *pregnancy*, *recent birth*, and *having children* were assessed and coded as follows: if a child was born (a) up to eight months after an interview, *pregnancy* was coded “1”; (b) up to 18 months before an interview, *recent birth* was coded “1”; (c) more than 18 months before an interview, *having children* was coded “1.” These three predictors were mutually exclusive; priority was given to the most recent child-related event. *Employment status* was assessed by the question “Are you currently employed? Which of the following best describes your status?” The response options “employed full-time,” “voluntary military service,” and “voluntary social year” were coded as full-time employment. “Employed part-time,” “completing in-service (re-) training,” and “marginal or irregular employment” were coded as part-time employment. Attending school or university and “not employed” were coded as “not working.” *Perceived stress* was measured by the question “During the last weeks, how often did you feel rushed or pressed for time?” (5-point scale “always” to “never”); *subjective health* by the question “How

**Table 1**  
*Coding Scheme for the Dummy Variables for Duration of Cohabitation, Separation, Marriage and Divorce*

Measurement	Cohabitation	Marital status	c1	c2	c3	c4+	s1	s2	s3	s4	m1	m2	m3	m4+	d1	d2	d3	d4+
1	no	single	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	yes	single	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	yes	single	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	yes	married	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
5	yes	married	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
6	yes	married	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
7	no	married	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
8	no	married	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
9	no	married	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0
10	no	divorced	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0

*Note.* c1 to c4+ = Cohabiting in the first, second, third, or fourth year; s1 to s4 = separated in the first, second, third or fourth year; m1 to m4+ = married in the first, second, third, fourth or more years; d1 to d4+ = divorced in the first, second, third, fourth or more years.

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would you describe your current health?” (5-point scale “very good” to “bad”).

**Statistical Analyses**

As the data are nested within the same person, a multilevel framework was employed (Raudenbush, & Bryk, 2002). Within-person variation was modeled to estimate the impact of relationship transitions on BMI, that is, each person was compared with him- or herself before and after relationship transitions. This approach has the advantage that the results are not confounded by time-constant unobserved heterogeneity (e.g., social origin). The influence on within-person change (i.e., change in BMI) can be modeled only if change in this variable is observed. Only 946 persons in the entire sample, that is, 3% of all observations, did not report any change in BMI; these respondents were excluded from the analyses. When these 946 persons were assigned an artificial within-person change in BMI (i.e., a mean of 0.0 and a SD of 0.0001) and included in the analyses, the results were identical with those of the sample reporting a change in BMI (results not shown). Given the high variability in the outcome variable BMI, the within-person modeling approach is adequate. The data were analyzed by estimating the following model:  $Y_{it} = X_{it}\beta + D_i\hat{\gamma} + \epsilon_{it}$ , where the dependent variable  $Y_{it}$  is the BMI of person  $i$  at time  $t$ ;  $X_{it}$  indicates the matrix of covariates containing values on the current situation of person  $i$  (e.g., whether they experienced a transition such as getting married);  $\beta$  represents the vector of the regression weights;  $D_i$  is a matrix containing dummy variables for every single person; and the vector  $\hat{\gamma}$  refers to the estimation of every person’s mean BMI.  $\epsilon_{it}$  is the error term (Bruederl & Ludwig, 2015). As there were several observations per person, standard errors were corrected using a clustered sandwich estimator. Analyses were conducted in Stata Version 12, using the *areg* command.

Analyses were conducted separately for men (see Table 3) and women (see Table 4) because BMI is a more important indicator of attractiveness in women (Weeden & Sabini, 2005 for a review). Further, effects of pregnancy on body weight differ between men and women (Brennan, Ayers, Ahmed, & Marshall-Lucette, 2007), and women pay more attention to their nutrition (Kiefer, Rathmanner, & Kunze, 2005), but exercise less (Mata et al., 2015; Rapp & Schneider, 2013). Additional tests of how sex differences in relationship transitions affected BMI are reported in Table 2.

Six models were calculated (see Tables 3 and 4), each model building on the previous one by adding new variables: Model 1a estimates the effects of changes in marital status on BMI; Model 1b estimates the effect of changes of cohabitation status on BMI. Separate analyses were conducted for changes in marital versus cohabitation status because cohabitation can be less stable and have different health consequences than marriage (Horwitz & White, 1998). Model 2a estimates the effects of changes in both marital and cohabitation status. Including changes in marital and cohabitation status in the same model makes it possible to estimate the effect of one while controlling for the other. For example, by comparing the beta values of Model 2a with Model 1a, one can determine the influence of getting married on BMI, controlling for cohabitation (Model 2a shows the “net” influence of changes in marital status on BMI, independent of any premarriage effects of cohabitation), relative to the influence of getting married on BMI, not controlling for cohabitation (Model 1a). Model 3 additionally includes weight-related behaviors as predictors. As these data are available for only a subsample of participants,

**Table 2**  
*Descriptive Sample Statistics (Mean, SD in Brackets)*

	Men						Women					
	Never married not cohabiting	Never married cohabiting	Married not cohabiting	Married cohabiting	Divorced not cohabiting	Divorced cohabiting	Never married not cohabiting	Never married cohabiting	Married not cohabiting	Married cohabiting	Divorced not cohabiting	Divorced cohabiting
Age in years	33.57 (12.69)	35.74 (9.47)	51.97 (13.46)	55.12 (14.22)	53.31 (10.43)	51.95 (10.25)	35.16 (15.65)	33.16 (9.04)	46.91 (11.85)	52.40 (14.09)	54.90 (13.18)	48.05 (9.89)
Smoking (0–1)	.39 (.49)	.41 (.49)	.41 (.49)	.26 (.44)	.50 (.50)	.40 (.49)	.32 (.47)	.34 (.47)	.40 (.49)	.18 (.39)	.38 (.49)	.37 (.48)
Exercise (1–4)	2.74 (1.25)	2.68 (1.23)	2.44 (1.29)	2.28 (1.29)	2.36 (1.30)	2.35 (1.28)	2.73 (1.26)	2.72 (1.24)	2.56 (1.33)	2.41 (1.34)	2.28 (1.34)	2.52 (1.31)
Eating (1–4)	2.24 (.74)	2.26 (.69)	2.36 (.70)	2.45 (.72)	2.36 (.76)	2.40 (.72)	2.58 (.75)	2.59 (.70)	2.65 (.71)	2.73 (.69)	2.63 (.76)	2.58 (.72)
BMI	25.12 (4.31)	25.77 (3.74)	26.77 (4.47)	27.22 (3.95)	26.50 (3.97)	27.63 (3.85)	23.52 (4.65)	24.05 (4.60)	24.68 (4.87)	25.78 (4.78)	25.33 (4.70)	25.00 (4.55)
Body weight in kg	81.10 (15.14)	84.16 (14.25)	85.37 (16.41)	85.62 (13.87)	83.84 (13.96)	88.41 (13.59)	65.93 (13.40)	67.60 (13.35)	67.98 (13.42)	70.16 (13.45)	68.96 (13.58)	68.61 (12.83)
Observations	7,703	2,423	477	27,936	1,622	728	6,218	2,675	547	28,128	2,771	741
Respondents	2,797	1,153	288	7,068	515	275	2,364	1,272	365	7,199	812	292

*Note.* The sum of persons in the bottom line of Table 2 is larger than the  $N = 20,971$  respondents reported in the Methods section because the same person can simultaneously belong to two categories (e.g., cohabiting and married) and one and the same person might shift from one category to another over time (e.g., from never married to married). The numbers in brackets next to Smoking, Exercise, and Eating represent the scale anchors.

Table 3  
Estimates Predicting Body Mass Index in Men (Unadjusted Betas)

	Model 1a: marital status	Model 1b: cohabitation status	Model 2a: marital and cohabitation status, all participants	Model 2b: marital and cohabitation status, participants reporting weight- related behaviors	Model 3: marital and cohabitation status, weight- related behaviors	Model 4: marital and cohabitation status, weight- related behaviors, control variables
Age	.073*** (.002)	.078*** (.002)	.072*** (.002)	.073*** (.003)	.071*** (.003)	.071*** (.003)
Age-squared	-.006*** (.001)	-.006*** (.001)	-.005*** (.001)	-.006*** (.001)	-.006*** (.001)	-.006*** (.001)
Marital status (reference: BMI before first marriage)						
Married, first year	.532*** (.089)		.291** (.092)	.298** (.100)	.303** (.100)	.255* (.101)
Married, second year	.566*** (.091)		.263** (.095)	.222* (.103)	.215* (.102)	.138 (.105)
Married, third year	.629*** (.093)		.289** (.098)	.322** (.108)	.317** (.107)	.224* (.110)
Married, four or more years	.833*** (.069)		.509*** (.077)	.478*** (.086)	.466*** (.086)	.325*** (.093)
Divorced, first year	.683*** (.154)		.679*** (.155)	.685*** (.173)	.688*** (.172)	.557** (.175)
Divorced, second year	1.049*** (.158)		.977*** (.160)	.990*** (.175)	.979*** (.175)	.840*** (.178)
Divorced, third year	.971*** (.163)		.919*** (.164)	.975*** (.179)	.946*** (.179)	.803*** (.182)
Divorced, four or more years	1.222*** (.118)		1.163*** (.119)	1.198*** (.137)	1.191*** (.137)	1.056*** (.140)
Cohabitation (reference: BMI when living without a partner)						
Cohabiting, first year		.282*** (.078)	.299*** (.080)	.291** (.089)	.307*** (.089)	.289** (.089)
Cohabiting, second year		.534*** (.078)	.535*** (.080)	.512*** (.086)	.518*** (.086)	.484*** (.087)
Cohabiting, third year		.624*** (.090)	.636*** (.094)	.648*** (.102)	.627*** (.102)	.586*** (.103)
Cohabiting, four or more years		.795*** (.059)	.723*** (.068)	.760*** (.075)	.745*** (.074)	.685*** (.076)
Separated, one year		-.172 (.090)	-.126 (.093)	-.102 (.103)	-.092 (.103)	-.116 (.103)
Separated, two years		.128 (.102)	.150 (.105)	.207 (.112)	.220* (.112)	.183 (.112)
Separated, three years		-.029 (.100)	-.014 (.102)	.010 (.111)	.023 (.110)	-.004 (.111)
Separated, four years		.229* (.111)	.209 (.114)	.283* (.120)	.289* (.120)	.264* (.120)
Weight-related behaviors						
Smoking (1 = yes)					-.312*** (.038)	-.311*** (.038)
Exercise					-.046*** (.010)	-.043*** (.010)
Eating					-.167*** (.017)	-.164*** (.017)
Control variables						
Partner pregnant (1 = yes)						.247* (.106)
Recent birth (1 = yes)						.270** (.092)
Having children (1 = yes)						.358*** (.095)
Employment: Transition from not working to working fulltime (1 = yes)						.128*** (.037)
Employment: Transition from not working to working part-time (1 = yes)						.077 (.047)
Stress						-.020 (.012)
Health						-.024 (.014)
Constant	26.125*** (.051)	26.170*** (.046)	25.810*** (.060)	25.828*** (.068)	26.449*** (.083)	26.434*** (.104)
Observations	40,867	40,867	40,867	35,496	35,496	35,423

Note. Table 3 can be read as follows: To differentiate the effects of changes in marital versus cohabitation status, Model 1a (which includes only changes in marital status), Model 1b (only changes in cohabitation status), and Model 2a are presented next to each other. Including changes in cohabitation and marital status in the same model makes it possible to estimate the effect of one while controlling for the other. For example, by comparing the beta values of Model 1a with Model 2a, one can see that the influence of getting married on BMI is roughly halved when the effects of cohabitation are controlled (as is done in Model 2a). However, the effects of moving in together on BMI stay about the same when the effects of getting married are controlled. Importantly, Model 2a includes all participants, whereas Model 2b includes only participants for whom smoking, exercise, and eating were assessed. Due to the lower number of cases, only the results of Model 2b can be directly compared with the results of Models 3 and 4. Please note that despite diverging case numbers, Models 2a and 2b yield comparable results. Analogous comparisons can be made with Models 3 and 4. Model 3 includes weight-related behaviors. Here, a negative beta shows that starting to smoke resulted in a lower BMI, to quit smoking lead to a higher BMI. Model 4 includes the control variables (i.e., children, change in employment status, stress, and health). BMI before first marriage is used as the reference BMI for the effects of both marriage and divorce on BMI. The same reference is used to make the effects of marriage and divorce comparable. However, the beta weights in Table 3 can be used to understand whether divorce leads to weight loss relative to post-marriage BMI (i.e., being married for four years or more): The beta-weight of “divorced, four or more years” (e.g., from Model 4) minus the beta-weight of “married, four or more years” shows the weight change; here, 1.056 – .325 = .731. The value is positive; this means that men have gained weight (increased their BMI by .731 kg/m<sup>2</sup>) after a divorce relative to their BMI after four years or more of being married. If the value was negative, they would have lost weight; if the value was zero, their weight would not have changed. Standard errors in parentheses. BMI = body mass index.

\*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$ .

Table 4  
*Estimates Predicting Body Mass Index in Women (Unadjusted Betas)*

	Model 1a: marital status	Model 1b: cohabitation status	Model 2a: marital and cohabitation status, all participants	Model 2b: marital and cohabitation status, participants with weight behaviors	Model 3: marital and cohabitation status, weight behaviors	Model 4: marital and cohabitation status, weight behaviors, control variables
Age	.088*** (.003)	.093*** (.002)	.088*** (.003)	.087*** (.003)	.086*** (.003)	.085*** (.003)
Age-squared	-.006*** (.001)	-.006*** (.001)	-.006*** (.001)	-.006*** (.001)	-.006*** (.001)	-.006*** (.001)
Marital status (reference: BMI before first marriage)						
Married, first year	.737*** (.096)		.506*** (.098)	.602*** (.105)	.546*** (.105)	.330** (.106)
Married, second year	.519*** (.098)		.274** (.102)	.338** (.109)	.287** (.109)	.086 (.111)
Married, third year	.762*** (.099)		.461*** (.104)	.447*** (.112)	.398*** (.112)	.171 (.115)
Married, four or more years	.690*** (.073)		.419*** (.082)	.451*** (.090)	.407*** (.090)	.220* (.096)
Divorced, first year	.543*** (.151)		.654*** (.155)	.615*** (.173)	.594*** (.172)	.390* (.175)
Divorced, second year	.761*** (.158)		.748*** (.159)	.816*** (.170)	.802*** (.170)	.600*** (.173)
Divorced, third year	.474** (.165)		.496** (.166)	.404* (.184)	.369* (.183)	.179 (.186)
Divorced, four or more years	.995*** (.122)		.956*** (.123)	.927*** (.140)	.897*** (.140)	.702*** (.143)
Cohabitation (reference: BMI when living without a partner)						
Cohabiting, first year		.376*** (.079)	.371*** (.081)	.241** (.089)	.235** (.089)	.171 (.089)
Cohabiting, second year		.419*** (.088)	.414*** (.090)	.342*** (.097)	.341*** (.096)	.261** (.096)
Cohabiting, third year		.649*** (.090)	.630*** (.093)	.494*** (.101)	.480*** (.101)	.374*** (.101)
Cohabiting, four or more years		.732*** (.061)	.672*** (.071)	.563*** (.079)	.570*** (.079)	.460*** (.079)
Separated, one year		-.299** (.092)	-.279** (.096)	-.295** (.106)	-.258** (.106)	-.273** (.106)
Separated, two years		-.024 (.098)	-.007 (.102)	-.012 (.108)	-.011 (.108)	-.046 (.107)
Separated, three years		-.071 (.102)	-.065 (.105)	-.144 (.110)	-.104 (.110)	-.107 (.109)
Separated, four years		.022 (.106)	.037 (.108)	.071 (.114)	.076 (.113)	.060 (.113)
Weight-related behaviors						
Smoking (1 = yes)					-.616*** (.046)	-.539*** (.046)
Exercise					-.028** (.011)	-.024* (.011)
Eating					-.180*** (.018)	-.186*** (.018)
Control variables						
Pregnant (1 = yes)						1.390*** (.107)
Recent birth (1 = yes)						.803*** (.096)
Having children (1 = yes)						.403*** (.097)
Employment: Transition from not working to working full-time (1 = yes)						-.054 (.042)
Employment: Transition from not working to working part-time (1 = yes)						-.020 (.035)
Stress						-.009 (.012)
Health						-.064*** (.015)
Constant	24.755*** (.057)	24.769*** (.049)	24.441*** (.067)	24.490*** (.075)	25.213*** (.094)	25.359*** (.120)
Observations	41,059	41,059	41,059	35,729	35,729	35,629

*Note.* Table 4 can be read as follows: To differentiate the effects of changes in marital versus cohabitation status, Model 1a (which includes only changes in marital status), Model 1b (only changes in cohabitation status), and Model 2a are presented next to each other. Including changes in cohabitation and marital status in the same model makes it possible to estimate the effect of one while controlling for the other. For example, by comparing the beta values of Model 1a with Model 2a, one can see that the influence of getting married on BMI is clearly reduced when the effects of cohabitation are controlled (as is done in Model 2a). However, the effects of moving in together on BMI stay about the same when the effects of getting married are controlled. Importantly, Model 2a includes all participants, whereas Model 2b includes only participants for whom smoking, exercise, and eating were assessed. Due to the lower number of cases, only the results of Model 2b can be directly compared with the results of Models 3 and 4. Please note that despite diverging case numbers, Models 2a and 2b yield comparable results. Analogous comparisons can be made with Models 3 and 4. Model 3 includes weight-related behaviors. Here, a negative beta shows that starting to smoke resulted in a lower BMI, to quit smoking lead to a higher BMI. Model 4 includes the control variables (i.e., children, change in employment status, stress, and health). *BMI before first marriage* is used as the reference BMI for the effects of both marriage and divorce on BMI. The same reference is used to make the effects of marriage and divorce comparable. However, the beta weights in Table 3 can be used to understand whether divorce leads to weight loss relative to *post-marriage BMI* (i.e., being married for four years or more): The beta-weight of “divorced, four or more years” (e.g., from Model 4) minus the beta-weight of “married, four or more years” shows the weight change; here, .702 – .220 = .482. The value is positive; this means that women have gained weight (increased their BMI by .482 kg/m<sup>2</sup>) after a divorce relative to their BMI after four years or more of being married. If the value was negative, they would have lost weight; if the value was zero, their weight would not have changed. Standard errors in parentheses. BMI = body mass index.

\*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$ .

Model 2b reports the same predictor variables as Model 2a, but only for those participants for whom data on weight-related behaviors are available. Thus, by comparing Model 2a and Model 2b, one can identify potential differences between the main sample and the subsample that reported weight-related behaviors; moreover, Model 2b and Model 3 can be compared directly. Model 4 additionally contains control variables that have often been ignored in previous research, namely, having children, changes in employment status, perceived stress, and subjective health.

**Results**

In both men and women, body weight was higher for cohabiting and married respondents than for those without a partner (see Table 2 for demographic characteristics). The multilevel estimates

for BMI in men and women are presented in Tables 3 and 4, respectively. Figure 1 presents the predicted changes in BMI by relationship transition, with all control variables included in the analyses.

**Effect of Relationship Transitions on Men’s BMI**

**Effects of marriage and divorce on BMI.** When only the effects of marital status were considered (Table 3, Model 1a), both marriage and divorce led to significant weight gain in men. The longer the marriage lasted, the larger the weight increase: up to 0.833 kg/m<sup>2</sup> after four or more years. Analogous results emerged for the effects of divorce on weight gain relative to premarriage BMI (+1.222 kg/m<sup>2</sup> four or more years after divorce). Being divorced for four years or longer thus led to about 0.4 kg/m<sup>2</sup> more

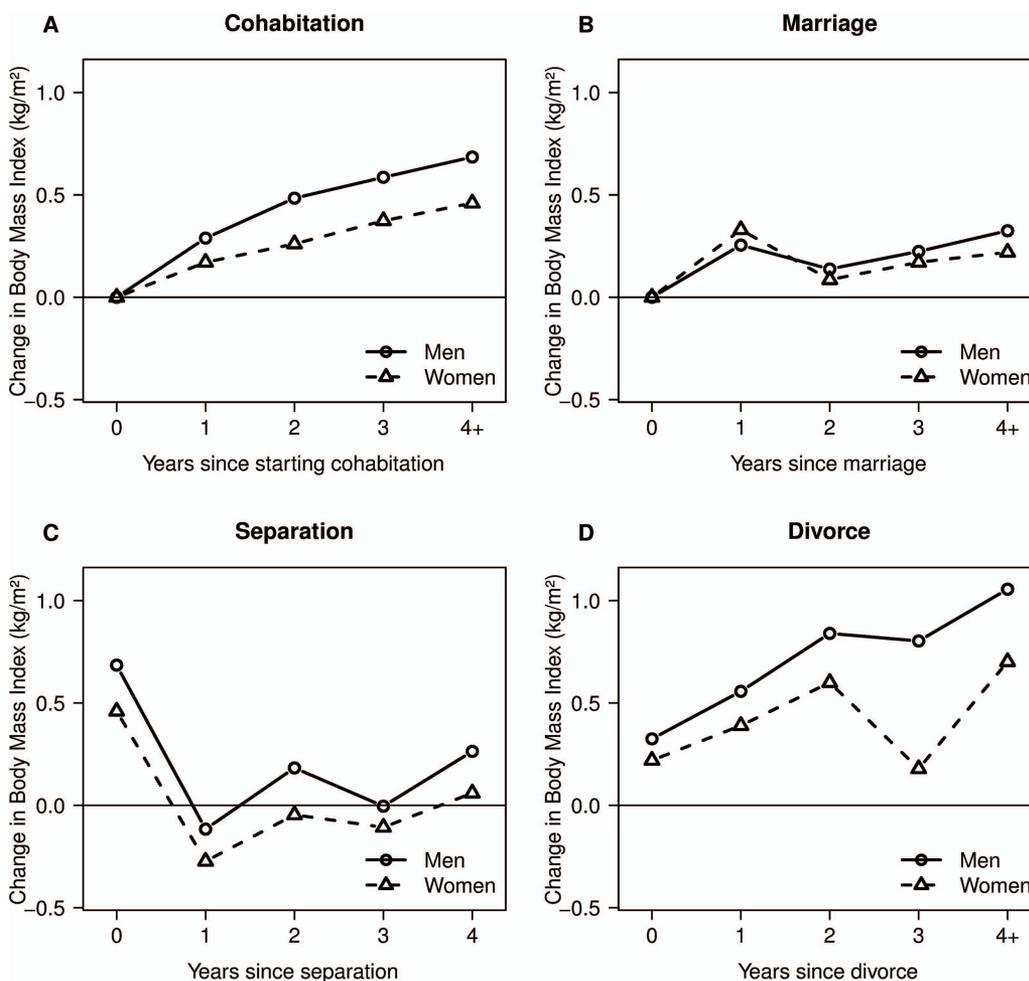


Figure 1. Predicted changes in BMI by relationship transitions (based on Model 4 in Tables 3 and 4). The “0.0” on the y-axis represents the reference point. For Figures A and C, the reference point is “weight when living without a partner”; for Figures B and D, the reference category is “weight before first marriage”. The models presented in Figures A–D control for all other predictors: age, age-squared, weight-related health behaviors (smoking, exercise, and eating), children (pregnancy, recent birth, and having children), transitions in employment status, perceived stress, and subjective health. Figure A shows effects of cohabitation on BMI, additionally controlled for effects of marriage, separation, and divorce on BMI; Figure B shows effects of marriage on BMI, additionally controlled for effects of cohabitation, separation, and divorce. Figures C and D show analogous results for separation and divorce.

weight gain than a marriage of the same duration ( $1.222 - 0.833 = 0.389 \text{ kg/m}^2$ ).

**Effects of cohabitation and separation on BMI.** Moving in with a partner led to weight gain (Model 1b). The longer cohabitation lasted, the larger the effect on weight gain. In contrast, the BMI of men who had separated from their partner in the last three years did not differ significantly from their BMI prior to cohabitation. After four or more years' separation, a small weight gain of  $0.229 \text{ kg/m}^2$  occurred.

**Relative effects of relationship transitions.** When both marital and cohabitation status were included in the analysis (Model 2a), the effects of cohabitation, separation, and divorce on BMI remained similar in size to those estimated by the models examining only marital (Model 1a) or cohabitation status (Model 1b). In contrast, the effects of marriage on BMI were significantly weaker in Model 2a than in 1a (e.g., married, first year:  $t = 10.25$ ,  $p < .001$ ).

**Weight-related behaviors.** Model 2a includes all participating men; Model 2b, only those for whom data on weight-related behaviors were available. Importantly, in both models, the effects of marital and cohabitation status on BMI were comparable in direction and size. In Model 3, three weight-related behaviors—smoking, exercise, and healthy eating—were included. Although an increase in any of the three weight-related behaviors led to significant weight loss (from about  $-0.046 \text{ kg/m}^2$  for exercise to  $-0.312 \text{ kg/m}^2$  for smoking), and a decrease led to weight gain, including them in the model did not reduce the predictive value of marital or cohabitation status on BMI.

**Control variables.** Pregnancy, birth, and having children led to significant weight gain in men (about  $0.3$  to  $0.4 \text{ kg/m}^2$ ; Model 4). Transitioning to a full-time job led to an increase in BMI. Changes in perceived stress or health were not related to BMI. Controlled for children, employment transitions, stress, and health, the sole effect of marriage and divorce was slightly reduced, but remained significant (exception: married, second year). Similarly, the effects of cohabitation and separation on BMI remained significant, albeit slightly smaller (exception: separated, second year no longer significantly predicted weight gain).

### Effect of Relationship Transitions on Women's BMI

**Effects of marriage and divorce on BMI.** When only the effects of marital status were considered (Table 4, Model 1a), both marriage and divorce led to significant weight gain in women. Being divorced for four years or longer led to more weight gain than being married for four years or longer ( $0.995 - 0.690 = 0.305 \text{ kg/m}^2$ ).

**Effects of cohabitation and separation on BMI.** Moving in together also led to weight gain (Model 1b). The longer cohabitation lasted, the larger the effect on weight gain. In contrast to men, women lost significant weight in the first year after separating from their partner: on average, their BMI fell below the pre-cohabitation BMI ( $-0.299 \text{ kg/m}^2$ ). When women had been separated for two years or more, their BMI did not differ significantly from their pre-cohabitation BMI.

**Relative effects of relationship transitions.** Examining the effects of marital and cohabitation status in the same model (Model 2a) revealed comparable effects of cohabitation, separation, and divorce on BMI. The effects of marriage on weight gain

were significantly weaker than when only marital status was used as predictor (Model 1a; e.g., married, first year  $t = 10.24$ ,  $p < .001$ ).

**Weight-related behaviors.** Including smoking, exercise, and healthy eating in the analyses (Model 3) did not change the predictive value of marital or cohabitation status on weight change. However, an increase in any of these behaviors led to significant weight loss (from  $-0.024 \text{ kg/m}^2$  for exercise to  $-0.539 \text{ kg/m}^2$  for smoking), a decrease led to weight gain.

**Control variables.** Pregnancy, birth, and having children significantly predicted weight gain; not surprisingly, the coefficients were up to about five times larger than in men. Better subjective health predicted a lower BMI in women. Neither change in employment status nor perceived stress was related to changes in BMI. Controlling for the effects of children, employment, health, and stress (Model 4) weakened the effects of marriage and divorce on BMI. In fact, BMI in the second and third year of marriage was no longer significantly different from premarriage BMI. The effects of divorce and cohabitation on weight gain generally remained significant (except for cohabitation in the first year and divorce in the third year), albeit noticeably weaker. A recent separation still led to weight loss.

### Sex Effects of Relationship Transitions, Children on BMI

To test for differences between men and women, we reran Models 2a and 4 (cf., Tables 3 and 4), this time including the interaction between sex, predictor variables, and control variables. There were generally no sex differences in the effects of relationship transitions on BMI, with the exception that women gained less weight than men three years after a divorce and four or more years into cohabitation (Model 4). Women gained more weight than men after a recent birth; however, this difference vanished by the time the child was 18 months or older. There were no sex differences in the effects of engaging in weight-related behaviors on BMI, except that women who started smoking lost more weight than men doing the same. The only sex difference in the control variables assessed was that women transitioning to full-time employment gained less weight than men doing the same (see Table S2 in the online supplementary material).

### Effects of Relationship Transitions on BMI in First Marriages and Remarriages

To test whether the observed patterns of BMI change after relationship transitions generalized to remarriages, all models were rerun including all participants who had ever been married, independently of how often (see Table S3 and Table S4 in the online supplementary material). When all marriages were considered, the effects on BMI of getting married and getting divorced were weaker in both men and women (see Table S3 and Table S4 in the online supplementary material). However, the effects of cohabitation and separation remained generally stable.

### Discussion

Particularly in men, cohabitation was overall associated with much more pronounced and stable weight gain than was marriage

(controlling for weight-related behaviors, age, children, employment, stress, and health). In women, this effect was most visible after longer cohabitation and marriage. BMI after separation was generally comparable to BMI before cohabitation; women lost some weight in the first year, men gained some weight after four or more years of separation. In contrast, divorce led to considerable weight gain over time, especially in men. Changes in weight-related behaviors did not explain the distinct effects of cohabitation, marriage, separation, and divorce on BMI. The effect of relationship transitions on BMI was reduced but mostly held when controlling for the effects of children, changes in employment status, perceived stress, and subjective health. Pregnancy and children considerably increased BMI, and in women, better subjective health predicted lower BMI. These results are largely consistent with the marriage market hypothesis: Transitions into cohabitation and marriage were followed by weight gain. However, the weight gain after four or more years of cohabitation was much larger—in fact, double the size—of that occurring after four or more years of marriage.

This is one of the first longitudinal studies to compare the effects of cohabitation and marriage on BMI. Most studies examining how marriage affects BMI have not directly compared it with cohabitation (Dinour et al., 2012). This may have led to an overestimation of the effect of marriage on BMI. Why is cohabitation a stronger predictor of weight gain than marriage? One possible reason is chronological order. Cohabitation usually precedes marriage (e.g., married and cohabiting participants in this study were about 20 years older than never married cohabiting participants, see Table 2) and—given that most cohabiting couples eventually marry (Goodwin, Mosher, & Chandra, 2010)—most of the weight change may occur during cohabitation.

Partly consistent with the marriage market hypothesis and its implication that people lose weight again after separation or divorce, respondents who separated generally showed BMIs similar to those they had when living alone. Again, the chronology of events (separation commonly precedes divorce) may explain why separation and divorce predict different changes in BMI. Separation from a partner is often associated with lower well-being (Ezzati, Martin, Skjold, Vander Hoorn, & Murray, 2006), loss of appetite, and subsequent weight loss (American Psychiatric Association, 2013; see Wilcox et al., 2003). Importantly, the present findings showed weight gain in the wake of divorce. In fact, men gained more weight after their divorce than during their first marriage. The few previous studies examining weight change after divorce have reported mixed findings, potentially stemming from inconsistent control for the effects of cohabitation, a shorter post-divorce follow-up time, and not excluding participants who remarried (Dinour et al., 2012).

Changes in exercising, healthy eating, and smoking behavior did not account for changes in BMI after relationship transitions. Thus, the present findings contradict both the respective hypotheses formulated here and previous findings indicating that weight-related behaviors change after cohabitation or marriage (Meyler, Stimpson, & Peek, 2007); they do not support either the negative protection hypothesis or the marriage protection hypothesis. However, using a single item (as done here) to assess weight-related behaviors might make it more difficult to detect their influence on BMI. For example, cohabitation could increase the amount of calories consumed per meal (Sobal & Rauschenbach, 2003) or the

frequency of meals (Herman, 2015). Neither of these explanations was captured by the item used, which assessed the attention paid to healthy eating. Additionally, it is possible that the item in question measures an attitude rather than an actual behavior (e.g., Mata, Dallacker, Vogel, & Hertwig, in press). However, other studies using similar items detected differences in physical activity between individuals who were married versus cohabiting (Rapp & Schneider, 2013). Clearly, future studies need to probe a wider range of behavioral mechanisms that may underlie weight changes in the wake of relationship transitions.

This is the first longitudinal study in Germany to compare the effects of cohabitation and marital status on BMI. By analyzing within-person changes across time, it was possible to eliminate potentially confounding between-person factors. The analyses explicitly compared the effect of changes in marital status versus cohabitation status and showed that, overall, cohabitation has a stronger influence on BMI than marriage. This finding has important implications, suggesting that research that does not consider the influence of cohabitation on BMI is likely to overestimate the influence of marriage. Second, cohabitation has a substantially larger long-term influence on BMI than marriage does.

Going beyond previous research, this study also analyzed what transitions *out* of cohabitation and marriage mean for individuals' BMI. The timespan of 16 years made it possible to compare the effects of cohabitation with those of marriage. Lastly, the models included other factors contributing to weight gain that are frequently neglected, including children, employment status, perceived stress, and subjective health. The available data do not allow the role of alcohol consumption for changes in BMI after relationship transitions to be meaningfully explored. Future research should include this potentially relevant behavior.

One limitation of the study is that weight and height were self-reported, potentially leading to an underestimation of BMI (Gorber, Tremblay, Moher, & Gorber, 2007). However, asking people to report height and weight in a face-to-face interview, as was done here, yields more accurate responses than, for example, do telephone interviews (Ezzati et al., 2006). Moreover, research with overweight participants has found the differences between self-reported weight and measured weight to be either insignificant or very small (Christian, King, Yanovski, Courcoulas, & Belle, 2013). Importantly, this investigation focused on weight change within a person. Thus, even if there was systematic bias in self-reported weight, it is likely that it had a similar effect across time. Thus, bias in self-reported weight probably had little effect on the present results. A second limitation is that about a third of the original sample was excluded for theoretical or statistical reasons. Nevertheless, the original sample was almost identical to the final sample with regard to the variables of interest. Finally, the present results do not clarify *how* cohabitation and marriage led to weight gain. One possible mechanism can be excluded, however: The weight-related behaviors examined did not explain changes in weight above and beyond the influences of relationship transitions.

The present findings show that changes in people's relationship status affect their BMI. Transitioning to a shared life, especially moving in together, is associated with a significant increase in BMI, but so is leaving behind a shared life, especially divorce. These findings are important for several reasons. First, they qualify the view that living with a partner is invariably good for health. Rather, depending on a person's BMI prior to relationship transi-

tions, relationship effects on BMI can either decrease or increase the risk of mortality (Aune et al., 2016). Second, divorcees do not return to their premarriage weight: Summing up the observed relationship effects on BMI from four years each of cohabitation, marriage, separation, and divorce (and controlling for weight-related behaviors as well as children, change in employment status, stress, and health) reveals that men and women gained around 2.3 and 1.4 kg/m<sup>2</sup>, respectively. For men of average height (about 180 cm), this represents a difference of about 7.5 kg. Given that 25% of unmarried, noncohabiting men in the current sample have a BMI of 27.0 kg/m<sup>2</sup> or higher, an increase of 2.3 kg/m<sup>2</sup> would increase their risk of all-cause mortality by up to about 13% (Aune et al., 2016). The present results suggest that transitions into and out of cohabitation or marriage are periods of special vulnerability for weight gain, and social factors contributing to weight gain are often overlooked (Vartanian, Herman, & Wansink, 2008). Importantly, being married generally decreases mortality (Rendall, Wenden, Favreault, & Waldron, 2011). Being married and having a healthier BMI could additively decrease mortality and not only add years to life but life to years by decreasing morbidity and increasing quality of life. Of course, relationship transitions are one among many factors influencing BMI—but today's population levels of obesity do not afford the luxury of ignoring any contributing factor.

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