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Marital history from age 15 to 40 years and subsequent 10-year mortality: a longitudinal study of Danish males born in 1953

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Background The aims of the present study are to analyse the association between marital status at age 24, 29, 34, and 39 years and subsequent mortality in a cohort of men born in 1953 (sensitive period); to study the impact of number of years married, number of years divorced/widowed, and number of marital break-ups on mortality (cumulative effect), and to examine whether these effects were independent of marital status at age 39 (proximity effect).

Methods Prospective birth cohort study with follow-up of mortality from 1992 to 2002. Participants were 10 891 men born within the metropolitan area of Copenhagen, Denmark. Marital status in 1992 as well as start and termination of all previous marital status events from 1968 to 1992 were retrieved from the Danish Civil Registration System. Main outcome measures were hazard ratios (HR) for all-cause mortality from age 40 to 49 years.

Results We found a strong protective effect of being married compared with never being married or divorced/widowed at every age. The association increased in strength with increasing age. Number of years divorced was associated with increased mortality risk in a dose-dependent manner at age 34 and 39 years. One or more marital break-ups was associated with higher mortality, whereas increasing number of years married was associated with lower mortality. Inclusion of current marital status attenuated the strength of the associations but most of them remained statistically significant.

Conclusions Marital status and cumulated marital periods, especially cumulated periods divorced/widowed are strong independent predictors of mortality among younger males.

Keywords Marital history, mortality, longitudinal study, men, life course

Marital status is an obvious and commonly used measure of close social relations. The protective effects of marriage on male survival are well established in a large number of population studies,[1–6] although some studies have failed to demonstrate an association.[7–10] However, most studies have comprised middle-aged or elderly people and have only measured marital status once at baseline.[1,5,6,8–10]

Few studies have attempted to study marital status changes across the life course as a predictor of mortality. Lillard and Waite analysed all marital changes during a 17-year follow-up period from 1968 to 1985 as predictor of mortality among 11 112 individuals. They found that among both women and men the benefits from marriage appear to accumulate with the length of the marriage.[11] Other studies have attempted to study marital status changes over shorter periods without cumulating marital status periods. Tucker *et al*. included a measure of being inconsistently married as of midlife (i.e. had experienced marital break-up at some time) to measure marital history, rather than marital history across the life span. They found that being inconsistently married was significantly associated with an almost doubled mortality compared with those consistently married.[12] Ebrahim *et al*. found that middle-aged British men who had divorced within the last 5 years showed a statistically significant increased mortality compared with those

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consistently married.[13] A further understanding of the influence of marital history across the life span on health and mortality is needed.

The potential health effects of socioeconomic and psychosocial environment measured over the life course have been described by several models: the cumulative model, the sensitive period model, and the proximity hypothesis, but it has seldom been applied to studies of the effect of marital history on health outcomes. The model of cumulative effects states that the intensity and duration of exposure to unfavourable environments adversely affects health status in a dose–response like manner.[11,14–16] Applying this model on marital status, the length of single status, and number of status changes should be associated with mortality as suggested by the studies of Tucker *et al*.[17] and Lillard and Waite.[11] On the other hand, the sensitive period model implies that some periods in life are more sensitive to harmful effects of single status and divorces. The health effects of marital status among younger people where marital history takes its beginning are relatively undescribed. Early adulthood may be regarded as a particularly sensitive period because decisions about marital partners and other important life transitions take place during this time which may act as a key link in causal chains of risk factors over the life course.[18] A number of studies of early and recent predictors of adult health have suggested that the effect of current living conditions are far more important than the effect of early factors.[19,20] According to this model current marital status would have a relatively stronger effect than prior marital status exposures. In the following we will refer to this model as the proximity effect model.

The aims of the present study were (1) to analyse the association between marital status at different ages (24, 29, 34, 39 years) and subsequent mortality (the sensitive period model); (2) to study the cumulative effects of number of years married, number of years divorced, and number of marital break-ups (divorces, becoming a widower) respectively from age 15 to 39 years on mortality from age 40 to 49 years (the cumulative effect model), and (3) to examine whether the impact of each of these three cumulated measures of mortality was dependent on current marital status (the proximity effect model).

Material and Methods

Study population

According to the official statistics 12 270 boys were born within the metropolitan area of Copenhagen during 1953. It was on this basis the Danish longitudinal study called Project Metropolit was founded by Svalastoga and his associates in the early 1960s.[21] In 1968 the Civil Registration System (CRS) was established and a unique identification number which indicates the day, month, and year of birth, was allocated to everyone alive and living in Denmark at that time. This register holds various updated information including marital status, vital status, and immigration. In total, 11 532 members of the male birth cohort from 1953 were identified in the CRS, and in January 2002 they were followed up for information on marital and vital status. In all 156 subjects were excluded because they had requested the CRS not to pass on any information for research purposes. Of the remaining 11 376 cohort members, 384 had immigrated, and 31 had disappeared or changed identity. These 415 subjects were followed until censoring, contributing follow-up time until the date of their status change. Four men with missing and 19 with incomplete marital status were excluded, leaving 10 891 subjects for analyses. The outcome measure in the present study was deaths occurring from 1993 to 2002. During this period 401 men died. Individuals dying before 1993 were excluded. Cause of death was obtained from the National Cause of Death Register, which is updated until 1998 for 250 deaths. This register is based on official death certificates coded using the Eighth Revision for 1970–1993 and the Tenth Revision for 1994–1998. Cause of death was classified into the following selected endpoints: cirrhosis of the liver (codes 581;571; K70), violent deaths (codes 800–949;V01–Y89 minus suicide codes), suicide (codes 950–959, 871;X60–X85), and other causes (all other codes). Cardiovascular heart disease was not analysed because of too few deaths due to this cause.

Marital status and cumulative measures

Information on current marital status (recorded as never married, married, divorced, widowed) as well as time of start and termination of all previous marital status events were retrieved for all subjects from the CRS from 1968 to 1992. On this basis we were able to ascertain marital status at age 24 (1978), 29 (1982), 34 (1988), and 39 years (1992). In order to study cumulative effects we also calculated the number of years married or divorced up to the same ages as well as cumulated number of marital break-ups i.e. divorces or becoming a widower and coded: 0, 1, 2+. Very few men experienced being a widower during the ages 24–39 years, therefore periods of widowhood and divorce were pooled in all analyses.

Covariates

The following covariates were included in the multivariate analyses: psychiatric admission in the age interval 16–22 years, as a proxy for severe mental disease which is predictive of increased mortality[22] and of being not married;[23] low birthweight as an early health status measure which is associated with adult illness and mortality[24] and with being not married;[25] low parental social position in 1953 which is associated with higher risk of not being married[26] and higher mortality in the offspring;[27,28] and if the Metropolit male had children of his own which is known to lower mortality and to be positively associated with being married.[12]

In Denmark, all births and details are entered into registers and documented by birth certificates. When Project Metropolit was established in 1953, all available information from certificates and registers was obtained for all cohort members.[21] Information included date and place of birth, weight and height measured at birth, mothers' marital status, and paternal social class at time of birth. In the present study we used information on birthweight, and the two available indicators of parental social position: the social class based on father's job in 23 categories re-coded into five categories (non urban self-employed; urban self employed; white collar employees; blue collar workers; unknown) and mother's marital status at the time of birth in three categories (married, unmarried, divorced/widowed). Birthweight was grouped in three categories: <2500; 2500–3499; 3500+ g. Information on

admissions to psychiatric wards was retrieved from the Psychiatric Central Registry for the period 1969–1975 coded as never versus ever.

Statistical methods

Associations between marital history, other covariates and mortality were analysed using Cox's proportional hazards regression models with age as the underlying time scale and age at 1 January 1993 as time of entry. The proportional hazards assumption was evaluated for all variables by comparing estimated -ln(-ln)survivor curves over the different categories of the variables being investigated versus ln(analysis time)(log log plots) and by tests based on the generalization of Grambsch and Therneau.[29] Statistical analyses were performed using STATA version 7 and SAS version 8. In the multivariate analyses of cumulated years married, divorced/widowed, and cumulated number of marital break-ups model 1 included early life course factors as mothers marital status, fathers social class and birthweight, model 2 included the variables from model 1 and psychiatric admission, and model 3 included the variables from model 2 and having a biological child. The analyses of the influence of most recent marital status on the association between cumulated marital periods and mortality included an interaction term between marital status at age 39 and the relevant cumulative measure.

Results

At age 24 years, 30% of the men were or had been married, and 15 years later this percentage had increased to 68%. The participants were more likely to be married themselves if they had married mothers at birth, had higher birthweights and had no psychiatric admissions (data not shown). The relations of each covariate with mortality is presented in Table 1. All the covariates (mothers marital status, and fathers social class at time of birth, birthweight, and any psychiatric admission age 16–22 years, having a biological child at age 29, 34, and 39 years respectively) were significantly associated with mortality from age 40 to 49 years.

At age 24 years being never married was significantly associated with increased mortality. Relatively small differences in mortality between the married and divorced/widowed were seen (Table 2); however, the latter estimates were based on only six cases. At the ages 29, 34, and 39 years men who were never married or divorced/widowed had significantly higher mortality risks compared with those married, and the magnitude of the estimates only attenuated slightly after adjustment for covariates.

Table 3 shows the relation of the number of years married during young adulthood to subsequent mortality at age 40–49 years among ever married. After age 34 years a protective effect of being married for 10 years or more compared with being married less than 5 years was seen. The protective effect seemed to increase with the length of the marriage, but attenuated after adjustment for covariates especially after control for being a father. Similarly, analyses with number of years married as a continuous variable showed a significant protective effect on survival, presumably due to the larger power in these analyses.

The hazard ratios (HR) for mortality increased with number of years divorced (Table 4). At every age there was a deleterious effect of being divorced for just a short time and the effect increased with number of years divorced. At ages 34 and 39 years we found a strong dose–response like association, effects which persisted in the analyses with number of years divorced as a continuous measure. Adjustment for covariates attenuated the association but it remained statistically significant.

Among those ever married the number of marital break-ups at age 39 was positively associated with mortality. Thus, the adjusted risk estimates for one marital break-up was 2.33 (95% CI: 1.71, 3.15), and 2.25 (95% CI: 1.19, 4.25) for more than one episode. At younger ages the number of subjects experiencing a marital break-up at some time were too low to allow meaningful comparisons.

In order to study a possible proximity effect of current marital status on the cumulative effects until age 39 years we added marital status at age 39 years (divorced or married) to our regression models as presented in Table 5. The effect of number of years married was fully explained by current marital status. The effects of number of years divorced/widowed and of number of marital break-ups attenuated slightly after adjustment for most proximate marital status, and remained statistically significant.

The analyses of cause-specific deaths were based on a limited number of cases resulting in estimates with broad CI. However, an association between being divorced in 1988 or 1992 and risk of suicide: HR_{age39}: 3.49 (95% CI: 1.13, 10.71) (23 deaths), and death from cirrhosis of the liver: HR_{age39}: 5.77(95% CI: 1.17, 28.52) (41 deaths) was seen. Number of years divorced until 1992 was also positively associated with both suicide and cirrhosis. Never being married was positively associated with violent death, but the estimates attenuated markedly when other covariates were controlled for. The effect of number of years married during the ages 15–24 on mortality from 40 to 49 leaves us without information on mortality at ages 24–39, i.e. our analyses were restricted to those who survived until the age 39. In additional analyses we explored whether inclusion of the deaths in these periods changed our results. The general picture was that the associations between measures of marital history and mortality increased slightly in the younger age groups when the early deaths were included, but our conclusions were essentially unchanged (data not shown).

Discussion

Main results

In this birth cohort study we found a strong protective effect of being married compared with never being married or divorced in men aged 24, 29, 34, and 39 years. The strength of this association increased from age 24 to 39 years. Thus, we suggest that men are more vulnerable to being out of marriage in their early middle-age than when they are younger. However, events in the youngest age groups were too few to identify any particularly sensitive period. Simultaneous adjustment for marital status at all ages might have given us a more precise answer about the possible sensitive period. However, this is problematic because of the large multicollinearity between these variables.

Our study supported the model of cumulative effects over the life course. Number of years divorced was strongly associated with increased mortality in a dose-dependent manner at ages 34

Table 1 The distribution of covariates and crude hazard ratios (HR) for all-cause mortality at age 40–49 (N = 10 891)

	Total no.	No. of deaths age 40–49 years	HR (95% CI)
All	10 891	401	
Mothers marital status at birth			
Married	9630	340	1.00
Divorced/widowed	202	12	1.71 (0.96, 3.15)
Unmarried	669	34	1.45 (1.02, 2.06)
Unknown	390	15	1.10 (0.65, 1.84)
Father's social class			
Self employed, non-urban	250	5	0.67 (0.2, 1.65)
Self employed, urban	986	33	1.18 (0.80, 1.75)
White collar worker	3577	102	1.00
Blue collar worker	5037	211	1.46 (1.15, 1.85)
Unknown	1041	50	1.70 (1.21, 2.80)
Birthweight (g)			
>3499	4793	150	1.00
2500–3499	5186	210	1.29 (1.05, 1.60)
<2500	529	27	1.64 (1.09, 2.47)
Unknown	369	14	1.17 (0.68, 6.43)
Psychiatric admission			
No	10 452	335	1.00
Yes	439	66	5.45 (4.39, 6.78)
Child at age 24			
No	8277	313	1.00
Yes	2614	88	0.87(0.69–1.10)
Child at age 29			
No	5882	248	1.00
Yes	5009	153	0.70 (0.57, 0.86)
Child at age 34			
No	3778	211	1.00
Yes	7113	190	0.45 (0.31, 0.55)
Child at age 39			
No	3189	198	1.00
Yes	7702	203	0.40 (0.31, 0.55)

and 39 years. One or more marital break-ups were associated with higher mortality, whereas increasing number of years married was associated with lower mortality, however not in a clear dose–response pattern.

We found some support for the so-called proximity model since the effect of number of years married was explained by most recent marital status. There was less obvious support for this model for the cumulated measures of years divorced/widowed and of marital break-ups. Thus, the estimates for these two measures attenuated after control for most proximate marital status, but remained statistically significant.

The analyses for cause-specific mortality were based on few cases but revealed results in the expected direction with higher suicide and cirrhosis mortality risk among those divorced/widowed.

Strengths and weaknesses of the study

With this study we tried to distinguish between three different hypotheses: the hypotheses of a sensitive period and of cummulative effects and the proximity model. However, there might be several problems in differentiating between them, especially when the strong effects are found among the oldest group. Does this finding imply that older people have had more years of marriage (divorce/widowhood) change to accumulate, or that the sensitive period is restricted to the oldest age group, or that the proximity model holds? Probably the three models

Table 2 Marital status at different ages during young adulthood and risk of all-cause mortality in men at age 40–49

	Total no.	Deaths 40–49 years (n = 401)	Crude HR[a] (95% CI)	Adjusted[b] HR (95% CI)
Marital status age 24				
Never married	7621	308	1.47 (1.16, 1.87)	1.41 (1.08, 1.85)
Married	3102	87	1.00 (ref.)	1.00 (ref.)
Divorced/widowed	168	6	1.27 (0.56, 2.90)	0.89 (0.38, 2.04)
Marital status age 29				
Never married	5829	265	1.96 (1.57, 2.45)	1.72 (1.33, 2.22)
Married	4517	108	1.00 (ref.)	1.00 (ref.)
Divorced/widowed	545	28	2.19 (1.44, 3.31)	1.83 (1.20, 2.78)
Marital status age 34				
Never married	4072	226	2.95 (2.35, 3.69)	2.11 (1.63, 2.74)
Married	5746	113	1.00 (ref.)	1.00 (ref.)
Divorced/widowed	1073	62	2.99 (2.19, 4.07)	2.48 (1.84, 3.35)
Marital status age 39				
Never married	3466	215	3.52 (2.80, 4.43)	2.40 (1.84, 3.12)
Married	6090	113	1.00 (ref.)	1.00 (ref.)
Divorced/widowed	1335	73	3.05 (2.99, 4.01)	2.43 (1.80, 3.28)

[a] Hazard ratio.

[b] Mothers marital status, fathers social class, birthweight, psychiatric admission, and being a father at the relevant age 24, 29, 34, or 39.

Table 3 Number of years married at different ages during young adulthood and all cause mortality in men from age 40 to 49. Never married excluded

	Total no.	Deaths 40–49 years	Crude HR[a] (95% CI)	Model 1	Model 2	Model 3
No. of years married at age 24						
0–4	2933	83	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
5–10	337	10	1.04 (0.54, 2.01)	1.02 (0.53, 1.96)	1.02 (0.53, 1.97)	1.07 (0.54, 2.09)
No. of years married			0.93 (0.82, 1.05)	0.92 (0.81, 1.04)	0.92 (0.81, 1.04)	0.92 (0.80, 1.05)
No. of years married at age 29						
0–4	2671	72	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
5–15	2391	64	0.99 (0.70, 1.38)	0.95 (0.68, 1.33)	0.99 (0.71, 1.39)	1.05 (0.73, 1.50)
No. of years married			0.99 (0.70, 1.38)	0.99 (0.92, 1.05)	0.99 (0.93, 1.06)	1.00 (0.94, 1.08)
No. of years married at age 34						
0–4	1900	57	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
5–9	2514	62	0.82 (0.57, 1.18)	0.81 (0.57, 1.17)	0.85 (0.59, 1.21)	0.90 (0.62, 1.30)
10–20	2405	56	0.77 (0.53, 1.11)	0.74 (0.51, 1.07)	0.78 (0.53, 1.14)	0.84 (0.57, 1.25)
No. of years married			0.97 (0.93, 1.00)	0.96 (0.93, 1.00)	0.97 (0.93, 1.00)	0.98 (0.94, 1.02)
No. of years married age at 39						
0–4	1431	46	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
5–9	2136	59	0.67 (0.58, 1.26)	0.87 (0.59, 1.27)	0.90 (0.61, 1.33)	0.96 (0.64, 1.42)
10–14	2177	47	0.67 (0.45, 1.00)	0.67 (0.45, 1.00)	0.71 (0.47, 1.06)	0.79 (0.51, 1.19)
15–25	1681	34	0.62 (0.40, 0.97)	0.60 (0.39, 0.94)	0.66 (0.42, 1.03)	0.75 (0.46, 1.18)
No. of years married			0.97 (0.94, 0.99)	0.96 (0.94, 0.99)	0.97 (0.94, 1.00)	0.98 (0.95, 1.01)

[a] Hazard ratio.

Model 1: mothers marital status, fathers social class, birthweight.

Model 2: Model 1 + psychiatric admission.

Model 3: Model 2 + having a biological child.

Table 4 Number of years divorced at different ages during young adulthood and all cause mortality in men from age 40 to 49. Never married excluded

	Total no.	Deaths 40–49 years	Crude HR[a] (95% CI)	Model 1	Model 2	Model 3
No. of years divorced at age 24						
0	3107	87	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
1–10	163	6	1.33 (0.58, 3.04)	1.31 (0.57, 2.99)	0.99 (0.42, 2.32)	0.99 (0.42, 2.33)
No. of years divorced			1.16 (0.78, 1.79)	1.15 (0.74, 1.76)	0.98 (0.62, 1.51)	0.97 (0.62, 1.51)
No. of years divorced at age 29						
0	4439	108	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
1–15	623	28	1.87 (1.23, 2.83)	1.78 (1.18, 2.71)	1.58 (1.04, 2.42)	1.57 (1.02, 2.40)
No. of years divorced			1.15 (1.02, 1.29)	1.14 (1.00, 1.28)	1.08 (0.96, 1.22)	1.03 (0.87, 1.21)
No. of years divorced at age 34						
0	5344	106	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
1–4	865	27	1.58 (1.03, 2.42)	1.53 (1.00, 2.34)	1.49 (0.98, 2.28)	1.45 (0.95, 2.21)
5–20	610	42	3.55 (2.49, 5.08)	3.43 (2.40, 4.91)	2.08 (2.14, 4.45)	2.98 (2.06, 4.31)
No. of years divorced			1.14 (1.09, 1.20)	1.14 (1.10, 1.20)	1.12 (1.08, 1.18)	1.12 (1.07, 1.17)
No. of years divorced at age 39						
0	5464	99	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
1–4	929	29	1.73 (1.14, 2.62)	1.65 (1.09, 2.50)	1.58 (1.05, 2.40)	1.56 (1.03, 2.37)
5–9	661	28	2.37 (1.56, 3.61)	2.26 (1.48, 3.45)	2.14 (1.40, 3.27)	2.06 (1.35, 3.15)
10–25	371	30	4.59 (3.05, 6.90)	4.43 (2.93, 6.67)	3.79 (2.48, 5.77)	3.66 (2.40, 5.58)
No. of years divorced			1.12 (1.09, 1.16)	1.12 (1.09, 1.16)	1.10 (1.07, 1.14)	1.10 (1.06, 1.11)

[a] Hazard ratio.

Model 1: mothers marital status, fathers social class, birthweight.

Model 2: Model 1 + psychiatric admission.

Model 3: Model 2 + having a biological child.

are not mutually exclusive and they are acting simultaneously or sequentially throughout the life course.

Short term effects of especially widowhood on mortality has been shown.[30] It would have been interesting to study both short and long term effects of marital status and marital history; however, we had too few events in a short time from exposure to answer the question about a short term effect. Long term effects seem plausible based on our results since marital status at all ages was a predictor of mortality from age 40 to 49 years.

As pointed out by Kuh and Ben-Shlomo, longitudinal designs are most appropriate for the study of accumulation of risk.[14] We collected data repeatedly and could thereby provide the accurate time sequences of events and intra-individual change over time necessary to test different life course models. In addition we also had complete follow-up.

Multivariate analyses allowed us to identify independent effects after control for potential confounders, but this method is limited if the exposure and the confounder are very closely correlated, or if there is a difference in the measurement error (misclassification) of exposure and confounder.[14] In our study, being the father of a biological child is closely related to the exposure, but it is also a strong predictor of mortality, therefore we included the variable as a possible confounder in our analyses. Most of our variables were based on complete registers and we judge the measurement error to be minimal and similar for the different covariates.

However, there might be a problem with random misclassification of the exposure since living with a partner without being married was and still is relatively frequent in this generation of Danish men. We expect that a rather large number of those classified as never married actually either live with a partner or have experienced several break-ups from earlier partners whom they have lived with although not formally married. This may have diluted the true estimates and therefore we expect the associations to be even stronger than reported. Furthermore, although our data are impressive in numbers, we are still not fully able to test our hypotheses, since relatively few of these males experienced divorce and especially widowhood in the age span 15–39 years.

It is also a limit for the study that we have no information on women, since it would be interesting to study the influence of marital history on mortality among young females too. Further, we had no information on a number of important covariates such as social class and health behaviours.

Comparison with other studies

Most previous studies have demonstrated a protective effect of being married among males, although most of these have focused on middle-aged or elderly populations. In studies of older populations, Johnson *et al*. found that the association between marital status and mortality was stronger among the

Table 5 The effect of marital status at age 39 on the association between cumulated marital history measures. Hazard ratios (95% CI). Never married excluded

	Total no.	Deaths age 40–49	Model 1	Model 2	Model 3
No. of years married at age 39					
0–4	1431	46	1.00	1.00	—
5–9	2136	59	0.90 (0.61, 1.32)	1.55 (0.89, 2.69)	—
10–14	2177	47	0.82 (0.54, 1.23)	1.55 (0.83, 2.88)	—
15–25	1681	34	0.89 (0.56, 1.42)	1.58 (0.84, 2.97)	—
Marital status at age 39					
Married	6090	113	1.00	1.00	—
Divorced/widowed	1335	73	2.92 (2.14, 3.99)	6.42 (3.52, 11.72)	—
No. of years divorced at age 39					
0	5464	99	1.00	—	1.00
1–4	929	29	1.17 (0.69, 1.97)	—	1.15 (0.68, 1.93)
5–9	661	28	1.45 (0.83, 2.56)	—	1.40 (0.79, 2.45)
10–25	371	30	2.54 (1.39, 4.62)	—	2.30 (1.26, 4.19)
Marital status at age 39					
Married	6090	113	1.00	—	1.00
Divorced/widowed	1335	73	1.98 (1.21, 3.23)	—	1.72 (1.05, 2.82)
Number of marital breakups at age 39					
0	5228	88	1.00	—	1.00
1	1961	87	1.74 (1.11, 2.72)	—	1.67 (1.07, 2.62)
2+	236	11	1.75 (0.85, 3.59)	—	1.59 (0.77, 3.28)
Marital status at age 39					
Married	6090	113	1.00	—	1.00
Divorced	1335	73	1.90 (1.21, 3.00)	—	1.64 (1.03, 2.60)

Model 1: Cumulated marital history measure + marital status at age 39 years.

Model 2: Model 1 + interaction term between number of years married and marital status at age 39.

Model 3: Model 1 + mothers marital status, fathers social class, birthweight, psychiatric admission, having a biological child.

youngest in their population who were 45–64 years old and weaker among the older counterparts 65+ years.[6] Likewise Tucker *et al*. and Sorlie *et al*. found that people aged 60+ years were less vulnerable to the non-married state than younger people.[17,31] The association between marital status and mortality in younger age groups has not been well described in past studies. However, among the earlier findings are Berkman and Syme's results from the Alameda County Study where the effect of marital status on mortality was quite strong even among the youngest participants aged 30–49 years, (relative risk = 2.9 for unmarried compared with married).[1] Thus the above-mentioned studies suggest a strong association between marital status and mortality at around ages 40–60 years in which the sensitive period may lie.

Our findings of a protective effect of number of years married are consistent with those of Lillard and Waite, who in a broader age group found that every year cumulated as married increased the protective effect of marriage. In their study, number of years in the latest marriage were cumulated contrary to ours where all previous married periods were combined. However, the findings were similar.[11]

Few studies have related marital status to specific causes of death in young adults. However, being unmarried is associated with an increased risk of suicide as shown in a previous Danish register study.[32] Furthermore, Rossow found that both alcohol consumption and divorce were independently and statistically significantly associated with male suicide rate.[33]

Mechanisms

At least two theoretical perspectives have been suggested to explain the protective effects of marriage on health. The health selection hypothesis suggests that healthy individuals are selected into marriage while unhealthy people are at a higher risk of never getting married or of getting divorced. The social causation hypothesis argues that marriage in itself is protective against ill health, for example through better health behaviours of the married,[34–36] or through higher economic security,[36] or higher degree of social integration.[37]

In this study we attempted to take into account the influence of health selection into and out of marriage by controlling for two crude indicators of health: birthweight and psychiatric admission. Psychiatric admission at the age of 15–22 years

may be a potential barrier for later marriage.[23] Likewise, low birthweight is associated with a lower chance of getting married[25,26] and is a risk factor health problems later in life.[38] In our study, the protective effect of marriage and the harmful effect of divorce was attenuated, but remained after control for both birthweight and psychiatric admissions.

We had no information on health behaviour in the study population, which means that we are unable to test if part of the association between marital status/marital history could be explained by differences in health behaviours. Unmarried people tend to have more risky behaviours and thereby tend to be at increased risk of mortality compared with their married counterparts.[39] However, in a study of marital status and mortality, Lund *et al*. found no attenuation of the significant association between marital status and mortality with inclusion of smoking, alcohol intake, and physical activity,[7] but smoking habits and physical inactivity are not the most obvious risk factors for mortality in young men. On the other hand, it would be relevant to consider risk behaviours such as driving a motor vehicle too fast or binge drinking, factors that unfortunately were not available in the dataset. Our analyses of cause-specific mortality suggest that these factors might be of relevance.

Improved financial stability has also been suggested as a key pathway through which marriage improves well-being and life chances.[11] Unfortunately, we had no information on income and could not test if this was a pathway in our analyses. Inclusion of measures of income and/or social class would presumably attenuate our results and the presented association might therefore be weaker.

It has been argued that the social integration provided by marriage results in lower mortality.[35] We tried to account for the possible effect of being a father which is a common result of marriage and may be a key factor in explaining increased survival among married men. Being a father did attenuate the protective effect of cumulated married periods and to some degree the harmful effects of cumulated divorced/widowed periods, but most of the significant associations remained.

Another plausible explanation for differences in marital history might be differences in personality. Unfortunately we did not have relevant data measuring personality characteristics. However, the measure of psychiatric admission may act as a proxy variable for deviant personality, and this variable was included in all analyses.

In conclusion, in this study we found that marital status was a risk factor for mortality among younger males. Marital status measured at one point in time is an important risk factor for mortality and the strength of the association seems to increase from age 24 to 39 years. Likewise, cumulated measures of marital history are important determinants of mortality. Our analyses suggested that in particular cumulated number of years divorced/widowed was a strong risk factor. This supports the theory of cumulated effects. Most recent marital status is also an important predictor, but it did not explain all the variation due to cumulated divorced/widowed periods or number of marital break-ups. This lends some support to the proximity model. Overall our study suggests that all three approaches can contribute to understanding the effects of marital history on mortality.

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KEY MESSAGES

- With this study we found a strong protective effect of being married compared with never being married or divorced/widowed at the ages 24, 29, 34, and 39 years, and the association increased in strength with age.
- Cumulated number of years divorced was associated with increased mortality in a dose-dependent manner at ages 34 and 39 years.
- One or more marital break-up was significantly associated with higher mortality.
- Inclusion of marital status at age 39 years attenuated the strength of the associations, but most of them remained statistically significant.

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