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ORIGINAL ARTICLE

Consistency and Timing of Marital Transitions and Survival During Midlife: the Role of Personality and Health Risk Behaviors

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Abstract
Background Marital status is associated with survival.
Purpose The aims of this study are to evaluate marital history and timing on mortality during midlife, test the role of pre-marital personality, and quantify the role of health risk behaviors.
Methods Cox proportional hazard models were run with varying classifications of marital history and sets of covariates.
Results In fully adjusted models compared to the currently married, lifetime marital history predicts premature mortality with never married at 2.33 times risk of death and ever married at 1.64 risk of death. Midlife marital history shows that not having a partner during midlife (hazard ratio (HR)= 3.10 formerly married; HR=2.59 remaining single) has the highest risk of death. Controlling for personality and health risk behaviors reduces but does not eliminate the impact of marital status.
Conclusion Consistency of marital status during midlife suggests that lack of a partner is associated with midlife mortality.

Keywords Marital history · Midlife mortality · Longitudinal study · UNC Alumni Heart Study

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Introduction

Survival through middle age to become elderly is expected, particularly for individuals who have survived until age 40, where remaining life expectancy in the USA at this age is an additional 43.6 years [1, 2]. Thus understanding who does *not* survive to become elderly is important. Getting and remaining married has long been associated with better survival, especially for men [3–7] in the USA [4, 5, 7] and Western Europe [3, 6]. This general and well-replicated finding was demonstrated as early as 1858 [6] and is not in dispute. Psychosocial and personality factors have been hypothesized to account for these mortality differentials. In general, control for these factors reduces, but does not eliminate the effect of marital status on mortality.

Ben-Shlomo, Smith, Shipley, and Marmot [3] in the Whitehall study in London, England found that unmarried men (born in 1903–1929) were at higher risk for mortality than married men aged 40–64 with 18 years of follow-up. They suggested that personality factors could be related to their findings. Tucker, Friedman, Wingard, and Schwartz [4] analyzed data from the Terman study. Marital history was assessed at age 40, birth cohorts were from 1904 to 1915, and mortality was assessed for the next 41 years. In this study, the currently married were split into those who had experienced a divorce before age 40 (currently remarried) to evaluate the impact of a prior divorce on the protective effect of marriage by comparing the remarried to consistently married study members who did not have a divorce in their history. There were adjustments for childhood personality, self-rated health, and social ties. They found that for men, those who had been divorced before age 40 had higher mortality than those who were consistently married suggesting that divorce has harmful effects that are not compensated for by remarriage. The findings were similar, but not significant for women. Johnson, Backlund, Sorlie, and Loveless [5] analyzed data from the National Longitudinal

Mortality Study for age groups 45–64 and 65 and older. The midlife cohorts were born from 1933 to 1940. Lifetime marital status was assessed at baseline as married, never married, or ever married. Mortality was assessed for 10 years with adjustment by socioeconomic status (SES) factors only. They concluded that currently married had better survival than the ever or never married participants who were not different from each other. Findings from Lund, Holstein, and Osler [6] supported the importance of marital history before age 40 in the 1953 birth cohort in Copenhagen, Denmark, where they found that being married compared to never married or divorced had higher survival over 10 years of follow-up to ages 40–49. Dupre, Beck, and Meadows [7] used data from the Health and Retirement Study (HRS) for individuals in 1931–1941 birth cohorts who were followed for mortality for 14 years. All never-married individuals were excluded from the study. They reported that specific timing factors surrounding entry and exits into marriage and the amount of time spent married were important in understanding mortality controlling for health behaviors during midlife.

Studies of cohorts who are members of the Baby Boom (1946–1954) who started turning 65 in 2011 are particularly useful [8] for important policy issues facing the USA [9] and the literature in this area has focused more often on earlier [3–5, 7] cohorts. As work by Schaie [10] has shown, it is important to understand the behavior of successive cohorts in areas where social change may operate. Meanings of marriage, divorce, and co-habitation have changed over time and thus the associations of variations in marital status to midlife mortality may differ for current cohorts [cf. 11]. Because psychosocial factors have a stronger impact on health at midlife rather than later in the lifecycle [12], it is important to study them *during* midlife. The University of North Carolina (UNC) Alumni Heart Study (UNCAHS) provides a good opportunity to test hypotheses about psychosocial predictors of mortality. It is a cohort study of individuals born in the 1940s, with personality data upon college entry [13], who have been studied during middle age with particular attention to behavioral risk [14–16].

The UNCAHS contains repeated measures of both marital and non-marital status that can be sorted into the following groups to test various conceptualizations of the timing and consistency of marital status. Lifetime marital history is a cross-sectional snap shot taken at any one point in time. Early marital history accounts for changes in marital status before age 40 and sorted currently married individuals into those married to their first spouse or remarried. Midlife marital history focuses on stability and change in marital status between the ages of 40–70. For midlife marital history consistently married persons had the same spouse during midlife and experienced no subsequent marital transitions. Formerly married persons had a history of being married and divorced, widowed, or separated before the age of 40 and had no subsequent marital transitions. Single individuals did not report living with someone as married and did not report any transitions. A final group called variable included all persons in the UNCAHS who changed their marital or non-marital status during midlife. This included later marriages, remarriages, divorces, widowhoods, and changes in "living with a partner as married". This approach reduces the potential for misclassification noted by Ben-Shlomo [3] that comes from a lifetime approach to marital status and does not track transitions over time. Furthermore, this approach will extend the findings of Dupre et al. [7] to non-married groups of the Baby Boom cohort.

We will use data from the UNCAHS to test eight hypotheses from the literature. By conceptualizing marriage as lifetime marital history [cf., 3, 5] we can test four hypotheses. First, we hypothesized that the currently married will have enhanced survival compared to the two other groups (never vs. ever married). Second, we hypothesized that the never married will not be significantly different from the ever married. Third, we hypothesized that personality measured before marriage will reduce the survival advantage of the married. Fourth we hypothesized that controlling for SES, self-rated health, and health behaviors at midlife will further reduce the survival advantage of the married. Our fifth hypothesis tests early marital history and [cf., 4] we hypothesized that the remarried will have higher mortality than the currently married to their first spouse due to the enduring negative impact of divorce. Our sixth hypothesis is also based on Tucker et al.'s [4] findings on the importance of divorce as harmful. We hypothesized that the formerly married will have higher mortality than the always single. Seventh, extending Dupre et al.'s findings, we hypothesized that the consistently married will have lower mortality than the variable group. Our eighth hypothesis proposes that midlife marital history will be a more powerful predictor of mortality than lifetime or early marital history. In sum, in the present paper we will test eight specific hypotheses about differing definitions of timing of marital history as a predictor of midlife mortality in a cohort of Baby Boomers, including testing the role of personality measured before marriage and health behaviors measured during middle age.

Methods

Sample

The UNC Alumni Heart Study (UNCAHS, 13–16) is a cohort study of 4,980 men and women designed to examine the impact of college personality on coronary heart disease (CHD) and CHD risk. This report is limited to the 4,802 individuals born in the 1940s and who had personality

assessed in college in 1964–1966. Spouses who joined the study in 1992 are not included in this report [17]. This subsample consists of 3,934 men (81.9 %) and 868 women (18.1 %) reflecting the gender composition of the cohort who attended The University of North Carolina at Chapel Hill (UNC) in the 1960s. The UNCAHS sample has a built-in gender differential as women did not enter the University as freshmen until 1966 [13]. Of the 178 excluded from this paper, 94 were born before 1940, 45 did not have covariates at age 40, and 39 did not have the college personality indicators. The mean age was 40.1 (standard deviation= 1.7 years). Age was calculated from the reported birth date and the date the first questionnaire was received.

Measures

Marital History and Timing

Individuals reported their marital status as single, living with someone as married, separated, divorced, or widowed at four times during the UNCAHS in questionnaires that were mailed in 1986–1987 (mean age 40), 1989 (mean age 42), 1994 (mean age 47), and 2004 (mean age 57). The 4,802 persons in this reported were classified by their marital history and timing. Lifetime marital history sorted individual into never married (n=349), ever married (n=701), and currently married (n=3,752). Early marital history sorted the currently married into those married to their first spouse (n= 2,712) and currently remarried (n=1,040). Midlife marital history used the four reports of marital status to classify individuals in terms of the consistency of their marital and non-marital patterns during middle age. The consistently married had the same spouse and no subsequent transitions during middle age (n=3,301), the formerly married had experienced the loss of a spouse to divorce, separation, or widowhood before the age of 40 and did not remarry or report living with someone as married and had no subsequent marital transitions (n=295), the always single never reported any other status (n=280). This left a final group called variable that included all possible changes during middle age (n=926) and included those who married late, got divorced, separated, or widowed during middle age, got remarried during middle age or reported changing non-marital status from single to "live with as married".

Mortality

Vital status was assessed through August 2009. There were 238 deaths from May 8, 1987 to November 1, 2008. All deaths were verified by death certificates or obituaries and only 32 deaths were reported for women included in this report. Cause of death information was available for 228 of the 238 deaths which were coded by a nosologist. The medical causes were: cancers (n=76), coronary heart disease (n=25), other cardiovascular conditions (n=26), AIDS (n=22), and other medical conditions (n=46); non-medical causes: suicides (n=21), accidents (n=11), and violent deaths (n=2).

Survival Time

Survival time was calculated from the enrollment date to the date of the last questionnaire received or the date of death. For deaths, date of last contact was from May 15, 1987 to November 11, 2009; for survivors, date of last contact was from May 28, 1987 to August 12, 2009.

College Personality

Personality was assessed upon college entry in 1964–1966 when the average age was 18.1 (standard deviation= 1.2 years). College personality was measured with the Minnesota Multiphasic Personality Inventory (MMPI) [18, 19]. Hostility from the 50-item Cook-Medley Scale [20] and pessimism from Colligan and colleagues [21–23] have been shown to predict all-cause mortality in the UNCAHS [see 15, 24]. The pessimism measure is represented as a T score (with a mean=50 and SD=10) with lower scores indicating optimism. Pessimism is significantly correlated with MMPI indicators of depression (r=0.62) and Social Introversion (r=0.70) from the clinical scales and with the research scale of obvious depression (r=0.83), and can be used as a proxy to control for depression and social activity in college. More recently, Tindle et al. [25] reported that hostility and optimism both predicted all-cause mortality in women aged 50–70 from the Women's Health Initiative. While conscientiousness has been shown to be an important personality predictor of survival, we did not have a measure at college from the MMPI to test this [26].

SES, Health, and Risk Behaviors at Midlife

Work status was coded as full time (1) vs. other (0). Educational attainment was coded as: 4=less than a college degree, 5=BA, 6=BA+additional training, 7=MA, 8=MA+ additional training, and 9=professional degree. Codes 1–3 were only observed in the spouse cohort of the UNCAHS who are not included in this report as they had no measures of college personality. Self-rated health (1=excellent, 2= good, 3=fair and 4=poor), body mass index (BMI=self-reported weight and height [kilogram per meter square]), smoking history (1=ever smoked vs. 0=never smoked), exercise status (1=some exercise, 0=sedentary), and alcohol status (1=current use , 0=no alcohol reported) were included as covariates to control for health risk behaviors at age 40. In addition, BMI and being a current smoker were

also modeled as time-varying covariates. These two variables were chosen because they were measured repeatedly in the UNCAHS in conjunction with the marital status indicators for the first three times of measurement (1987, 1989, and 1994) and in 2002, 2 years before the final measure of marital status in 2004. This sequence allows for the later changes in the variables to have an impact through the end of follow-up in 2009. Current smoking is a major risk factor for early mortality and continuing to smoke has been shown to modify the mortality differential due to marital status in the HRS after age 50 [27]. Potential changes in BMI have been shown to be related to other important behavioral risk indicators in the UNCAHS including sedentary behavior [28] and adult personality [29]. The study protocol was approved by the Duke Institutional Review Board. Informed consent was given at the time of study enrollment.

Analytic Plan

Survival analysis was conducted with Cox proportional hazards regression models with either time to death or censoring as the outcome using SAS version 9.1 [30]. The proportional hazard assumption was met. Models were first run to test for gender interactions with survival time and the marital history variable. These interactions were non-significant; however, gender was retained as a covariate in all analyses.

Known predictors of survival at midlife were used as adjustment variables in sequential models. Hypotheses were tested with three sequential models. The first model was adjusted only for age and gender. The second model added college personality indicators and the third model added the remaining socioeconomic and health risk behaviors at age 40 as well as BMI and current smoking as time-varying covariates. In order to quantify the relative contributions of the covariates used in the models described above, our covariates were divided into groups sharing similar characteristics to determine the significance and relative importance of each set to mortality when added to a null model containing no covariates. We tested the changes in log-likelihood for each model compared to that of the null model (likelihood ratio test). Wald chi-square tests were in good agreement with those derived from likelihood changes. Marital history was parameterized using dummy variables for each marriage class, setting married or consistently married as the comparand. Overall significance was tested using the multi-degree Wald chi-square for this set of parameters, while pair-wise tests were constructed by appropriate comparisons of the dummy variables. Hazard ratios and their confidence intervals were calculated by exponentiation of the appropriate Cox regression coefficients and their errors. We observed the relative change in the effect of each marital history classification in this way, when adding the control by different groups of covariates. The marital history results were compared as reflected by the log-likelihoods of analogous models, both with and without covariate groups.

Results

The characteristics of the sample are shown for the 4,802 study members sorted into the marital history groups used to test our hypotheses in Table 1. Lifetime marital history was used to test the first four hypotheses and characteristics of the sample are shown in the first three columns. Early marital history sorts the currently married from the third column into those currently married to their first spouse and currently remarried. These definitions are used to test the fifth hypothesis and shown in columns 4 and 5 of the Table. The midlife marital history groups are used to test the sixth and seventh hypotheses and are shown in the final four columns. These values give a good picture of the sample at age 40 when the prospective part of the UNCAHS started. While all of the contrasts are statistically significantly related to the marital history group age 40 (except for hostility in college early marital history and work status in lifetime and early marital history groups), the differences between the various groupings are small and show a relatively healthy sample with good health behavior profiles. Note that in this cohort, smoking history indexed by the rates of ever smoking are uniformly high (50 to 60 %) which is not surprising for North Carolina in the 1960s. Smoking behavior changed significantly over time for all groups by age 40 and continued to decline over time. Body mass index increased for all groups over time.

Figure 1 shows the proportion of survivors classified by the marital history classifications over the 22 years of follow-up for the lifetime (top) early marital history (middle) and midlife marital history (bottom) parts of the figure with empirical survival curves. The results of the survival models are shown in Table 2 in the same order. The initial model included marital history, age, and gender. The second model added personality measured at college entry, the third adjusted for the set of covariates at baseline enrollment into the UNCAHS at age 40 and changing values of current smoking and BMI as time-varying covariates.

The first four hypotheses tested lifetime marital history and are shown in the set of models in the top third of Table 2. The never married are at almost three times the risk (hazard ratio (HR)=2.84) and the ever married at twice (HR=2.03) the risk of the married in model 1. These hazards are reduced to 1.64 for the ever married and 2.33 for the never married in model 3 which remains significantly different. The first hypothesis is supported with this cohort. The second hypothesis tested differences between ever and never

Table 1 UNC Alumni Heart Study participants classified by marital history. Means and standard deviations are given for continuous variables and numbers of respondents and percentages for categorical variables

Index for sample	Lifetime marital history			Early marital history		Midlife marital history			
	Never	Ever	Married	Married	Remarried	Married	Formerly	Single	Variable
N=4,802	349	701	3,752	2,712	1,040	3,301	295	280	926
Mean (SD)									
Age	40.4 (2.0)	40.3 (1.9)	40.0 (1.6)	39.9 (1.5)	40.1 (1.7)	40.0 (1.6)	40.5 (2.0)	40.3 (1.8)	40.1 (1.8)
Hostility college	18.8 (8.3)	19.5 (8.7)	18.5 (8.3)	18.5 (8.4)	18.7 (8.1)[a]	18.5 (8.3)	19.9 (8.8)	19.0 (9.1)	18.4 (8.5)
Pessimism college	54.6 (11.1)	52.5 (10.5)	50.6 (10.0)	50.6 (9.9)	50.8 (10.2)	50.6 (10.0)	53.3 (10.9)	55.0 (11.1)	51.4 (10.1)
Education	6.1 (1.4)	6.2 (1.4)	6.4 (1.4)	6.4 (1.3)	6.3 (1.4)	6.4 (1.4)	6.1 (1.4)	6.0 (1.4)	6.4 (1.4)
Self-rated health	1.6 (0.7)	1.5 (0.6)	1.5 (0.6)	1.5 (0.6)	1.5 (0.6)	1.5 (0.6)	1.6 (0.6)	1.7 (0.7)	1.5 (0.6)
BMI	24.5 (4.0)	24.5 (4.3)	24.9 (3.6)	25.1 (3.7)	24.5 (3.2)	25.0 (3.6)	24.6 (4.7)	24.6 (4.1)	24.4 (3.6)
BMI[b]	26.6 (4.8)	26.6 (5.4)	26.8 (4.3)	26.8 (4.3)	26.6 (4.4)	26.8 (4.4)	27.4 (6.8)	26.7 (4.5)	26.3 (4.3)
N; %									
Total mortality	38; 10.9 %	53; 7.6 %	147; 3.9 %	98; 3.6 %	49; 4.7 %	127; 3.9 %	40; 13.6 %	34; 12.1 %	37; 4.0 %
Gender									
Male	292; 83.7 %	503; 71.8 %	3,139; 83.7 %	2,273; 83.8 %	866; 83.3 %	2,770; 83.9 %	203; 68.8 %	236; 84.3 %	725; 78.3 %
Female	57; 16.3 %	198; 28.2 %	613; 16.3 %	439; 16.2 %	174; 16.7 %	531; 16.1 %	92; 31.2 %	44; 15.7 %	201; 21.7 %
Work status									
Full time	290; 83.1 %	606; 86.5 %	3,348; 89.2 %	2,421; 89.3 %	927; 89.1 %	2,940; 89.1 %	256; 86.8 %	235; 83.9 %	813; 87.8 %
Other	59; 16.9 %	95; 13.5 %	404; 10.8 %	291; 10.7 %	113; 10.9 %	361; 10.9 %	39; 13.2 %	45; 16.1 %	113; 12.2 %
Alcohol status									
Current	289; 82.8 %	622; 88.7 %	3,313; 88.3 %	2,355; 86.8 %	958; 92.1 %	2,892; 87.6 %	265; 89.8 %	223; 79.6 %	844; 91.1 %
No alcohol	60; 17.2 %	79; 11.3 %	439; 11.7 %	357; 13.2 %	82; 7.9 %	409; 12.4 %	30; 10.2 %	57; 20.4 %	82; 8.9 %
Exercise status									
Current	301; 86.3 %	613; 87.5 %	3,343; 89.1 %[a]	2,413; 89.0 %	930; 89.4 %[a]	2,930; 88.8 %	250; 84.8 %	236; 84.3 %	841; 90.8 %
No exercise	48; 13.7 %	88; 12.5 %	409; 10.9 %	299; 11.0 %	110; 10.6 %	371; 11.2 %	45; 15.2 %	44; 15.7 %	85; 9.2 %
Smoking history									
Ever	201; 57.6 %	437; 62.3 %	2,049; 54.6 %	1,411; 52.0 %	638; 61.4 %	1,788; 54.2 %	191; 64.8 %	158; 56.4 %	550; 59.4 %
Never	148; 42.4 %	264; 37.7 %	1,703; 45.4 %	1,301; 48.0 %	402; 38.6 %	1,513; 45.8 %	104; 35.2 %	122; 43.6 %	376; 40.6 %
Current smoker	43.6 %	41.4 %	27.9 %	25.9 %	32.4 %	27.4 %	48.3 %	47.65 %	33.4 %
Current smoker[b]	12.7 %	15.3 %	9.62 %	8.9 %	11.2 %	9.4 %	17.1 %	12.5 %	12.5 %

[a] All of the contrasts at baseline for the marital history comparisons are statistically significant at the univariate level except for hostility in college in the marital history before age 40 and exercise status in lifetime and early marital history classifications

[b] Values for the index as a time-varying covariate at last follow-up for the individual

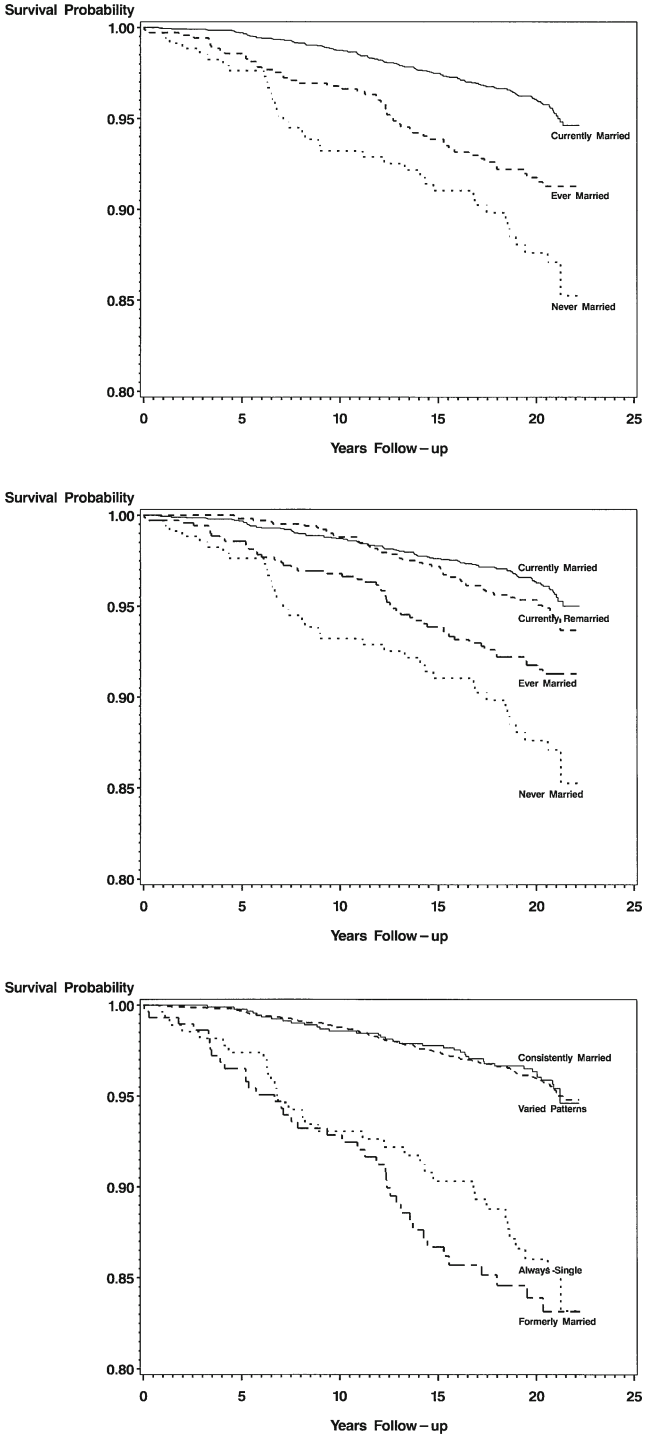

Fig. 1 Empirical survival curves for definitions of marital status in the UNC Alumni Heart Study. *Top panel* is lifetime marital history, *middle panel* is early marital history, and the *bottom panel* is midlife marital history

married. They are never significantly different from each other. The second hypothesis was also supported with this cohort. The third hypothesis was not supported. Control of college personality (comparing model 2 to model 1), had no effect on survival. Our fourth hypothesis was also supported as the addition of the full covariate set in model 3, reduced but did not eliminate the mortality differentials.

The fifth hypothesis tested the difference between the married and remarried and is shown in the analyses in the middle of Table 2. The married and remarried are not different from each other thus a history of divorce did not result in increased mortality compared to the currently married.

The sixth and seventh hypotheses were tested with midlife marital history shown on the bottom of Table 2 . These hypotheses were not supported. When the formerly married were compared to the always single, these groups were not significantly different from each other and did not change across the models. The difference between being consistently married during midlife was also not significantly different from the variable patterns and this did not change across the models.

Comparisons of the relative contributions of the three conceptualizations of marital status and groups of covariates are shown in Table 3. Our eighth hypothesis was supported. By comparing the values of the Wald Chi-squares in the middle column of the table, it can be seen that the midlife marital history accounts for about twice as much of the variation in survival as either of the other two marital history classifications. In addition, as shown in the final column of the table, this greater ratio of variance did not change in the fully adjusted model.

Table 4 provides information about the covariates that were included in the sequential models. The Wald chi-squares give a picture of the relative power of each set of variables, while the hazard ratios in the final column show how each variable predicted survival. The risk behaviors are highly significant with a Wald chi-square value of 120.4, then age and gender with a value of 49.3, followed by self-rated health with a value of 38.6, SES with a value of 11.6, and college personality with a value of 6.4. The hazard ratio of each individual variable provides additional information for this cohort. Only work and alcohol status at age 40 and BMI as a time-varying covariate do not have a significant association with mortality when tested as individual predictors. Current smoking as a time-varying covariate tested separately had a HR=3.79. This is compared to smoking history at baseline HR=1.52. Each smoking indicator significantly predicts mortality when it is the only variable in the model; however, the time-varying covariate is much stronger. This is in contrast to baseline BMI when fit in a non-time-dependent model (not shown) had HR=1.05 (CI= 1.02, 1.08) but when BMI was treated as a time-varying covariate, it was no longer significant HR=1.02. Body mass index is a more complex variable that is known to be related to gender, personality [29], and sedentary behavior [28] in the UNCAHS. As well, mortality related changes in BMI may be related to causes of death during midlife with declines in BMI shortly before death related to specific

Table 2 Cumulative survival models predicting 22-year survival in the UNC Alumni Heart Study with marital status defined as lifetime, early, and midlife marital history in 4,802 ss. Hazard ratios and 95 % confidence intervals.

Marital status	Model 1, age and gender	Model 2, adding college personality	Model 3, adding midlife risk behaviors
Lifetime marital history			
Married	1.0	1.0	1.0
Ever married	2.03 [1.48, 2.79]	1.99 [1.45, 2.73]	1.64 [1.19, 2.26]
Never married	2.84 [1.98, 4.06]	2.81 [1.95, 4.04]	2.33 [1.61, 3.36]
Early marital history [before age 40]			
Married	1.0	1.0	1.0
Remarried	1.24 [0.88, 1.75]	1.24 [0.88, 1.74]	1.19 [0.84, 1.68][a]
Ever married	2.17 [1.55, 3.04]	2.13 [1.52, 2.98]	1.73 [1.23, 2.45][a]
Never married	3.04 [2.08, 4.43]	3.01 [2.05, 4.41]	2.46[1.67, 3.63]
Midlife marital history [ages 40–69]			
Consistently married	1.0	1.0	1.0
Formerly married	4.29 [2.99, 6.15]	4.18 [2.91, 6.02]	3.10 [2.15, 4.5]
Always single	3.31 [2.26, 4.83]	3.28 [2.23, 4.81]	2.59 [1.75, 3.82]
Variable patterns	0.97 [0.67, 1.40]	0.96 [0.67, 1.39]	0.92 [0.64, 1.33]

[a]All paired comparisons are statistically significant ($p<0.05$) except for the contrast of remarried vs. ever married in model 3 of early marital history ($p=0.059$)

causes such as AIDS or cancer. Comparing the contribution of the psychosocial variables taken singly, to these variables when considered jointly, suggests that the intercorrelations among the psychosocial set of factors makes their impact seem smaller than it actually is. In addition, adding control for the behavioral risk set only changed the significance of one contrast as is shown in the middle of Table 2. In the early marital history analyses comparing the ever married to the remarried, the difference between these two subgroups ($p=0.005$ model 1, $p=0.007$ model 2) was significantly different until model 3 ($p=0.059$ model 3). This suggests that health risk behaviors during midlife may play a particularly important role for those who do not remarry.

Discussion

Our findings have shown (see Table 3) that midlife marital history accounts for about twice as much of the variance in survival as shown in the log-likelihoods than measures based on early marital or lifetime marital history. Secondly, as shown for all of the models tested in Table 2, independent of the definition of marital history, psychosocial factors reduce but do not account for the survival advantage of married persons seen in midlife mortality and thus is not a proxy for self-rated health or poor health habits [31].

Table 3 Mortality in Cox models of survival during midlife by separate definitions of marital history estimated separately

Model	−2 Log (likelihood)	Wald χ^2, df[a]	Wald χ^2, df[b]
Null	3,921.9	Unadjusted	
Lifetime	3,879.9	48.1, 2**	24.0, 2**
Early marital history	3,877.8	49.6, 3**	24.8, 3****
Midlife marital history	3,843.8	97.3, 3***	54.1, 3 ****

*$p<0.05$, **$p<0.01$, ***$p<0.001$, ****$p<0.0001$

[a] The chi-square values in this column were estimated separately

[b] The chi-square values in this column were simultaneous tests of marital status in the full model with time-varying covariates

Use of repeated measures of marital status and non-marital status groups can limit misclassification that may have occurred in prior studies depending on the design and the analytic strategy. In the UNCAHS, definitions of both marital and non-marital status were treated with equal weight. The emphasis was put on the stable versus variable patterns while the respondent remained in the UNCAHS. It may be that the formerly married who do not remarry are under more chronic stress and have less social support. The impact of dependable support versus intermittent support did not have an impact on survival as seen by comparing the consistently married and variable groups.

Joung et al. [32] argue that mortality differentials are due to either selection mechanisms or social causation mechanisms. Our findings provide evidence for both interpretations to be operative but at different times in the lifecycle. The personality variables were measured 22 years earlier in college. They were associated with the midlife marital history indicators strongly for pessimism ($F=20.63$, 3 df, $p<0.001$) and marginally for hostility ($F=2.56$, 3 df, $p=0.053$) suggesting that personality has an impact on selection into marital patterns with those who remained single or divorced and never remarried being higher on pessimism in college.

The UNCAHS was designed to study personality and the risk of coronary heart disease and not marital history and mortality. In this report where the focus is on mortality

Table 4 Mortality in Cox models of survival during midlife by covariates estimated without Marital History

Model	−2 Log (likelihood)	Wald χ^2, *df*, group	Hazard ratios, [95 % confidence intervals of components]
Age and gender	3,879.6	49.3, 2****	
Age			1.22 [1.15, 1.29]
Gender			1.53 [1.06, 2.22]
Personality	3,915.5	6.4, 2*	
Hostility			1.02 [1.00, 1.03]
Pessimism			1.02 [1.00, 1.03]
Socio economic status	3,910.7	11.6, 2**	
Education			0.86 [0.79, 0.94]
Work status			0.81 [0.56, 1.18]
Self rated health	3,886.1	38.6, 1***	1.89 [1.55, 2.31]
Behavioral risk	3,820.9	120.4, 5****	
Time-varying body mass index			1.02 [0.99, 1.05]
Smoking history			1.52 [1.16, 1.98]
Time-varying current smoker			3.79 [2.91, 4.95]
Alcohol status			0.79 [0.55, 1.13]
Exercise status			0.43 [0.32, 0.59]

*$p<0.05$, **$p<0.01$, ***$p<0.001$, ****$p<0.0001$

during midlife due to marital status, there are limitations of UNCAHS that should be considered. First, the sample was all white and very well educated and is representative of 25–30 % of population in similar circumstances; however, these same factors make the sample able to successfully participate in a long-term mail survey and take advantage of archival personality data. Compared to the US population of similar age [33], the UNCAHS is more likely to be married (79 vs. 65 %) and thus less likely to be ever married (11 vs. 22 %) or never married (7.3 cf. 11.7 %). Nonetheless, when the members of the cohort were analyzed with the life time definition of marital history, the overall finding of married vs. ever vs. never married was confirmed. Second, only 32 women died during the observation period. This is not surprising given that men are more likely to die during middle age [34] and the parent cohort was 82 % male [10]. When the final analysis was repeated for the men only (n=3,934 with 206 deaths) the results did not substantively change. We were not able to test patterns for women separately due to the small number of deaths observed for them. There was no evidence of a gender interaction in survival during middle age, but again, the power to examine an interaction was restricted in this sample. Third, we did not measure social support at baseline or at each time we measured marital status, thus we could not test the associations of social support to marital status over time directly as recent meta-analyses reported that social support was a major contributor to mortality [35] even though studies where marital status was the only measure of support were excluded. Fourth, our timing of measures of adult personality did not allow us to test levels of or changes in adult personality as part of our covariate series. However, we have previously reported associations of adult personality with BMI in the larger sample where between the ages of 43 and 55, low conscientious men and women gained more weight than did their higher conscientious peers [29].

In the UNCAHS cohort, most of the marital dissolution was due to divorce or separation and not widowhood and thus the patterns may change as the cohort ages and widowhood becomes more common [cf., 5, 7]. Our findings further suggest that attention to non-marital patterns of partnership is likely to become more important for the Baby Boomer cohort. Current literature on premature mortality differentials tend to focus on the SES gradient and social inequality [36]. Our findings suggest that even in relatively advantaged cohorts, social ties during midlife are important in understanding premature mortality [37, 38], are related to declining health indicators [39, 40] and suggest the need for future research to discover the extent to which the patterns we have used here actually reflect chronic versus intermittent support or stress in long-term marital as well as non-marital patterns. These patterns appear to provide different levels of emotional and functional social support which has long been shown to be related to mortality [38].

Nonetheless, the timing parameters of the UNCAHS are important. Due to cultural changes in the time the measures were taken (1987–2004), the choice of "live with as married" would have a different meaning for gay couples vs. straight couples and we did not track changes in non-marital partners with the same degree of specificity. In addition, divorce may have less of a stigma than at earlier times of measurement or for members of earlier birth cohorts. All studies are part of the time and place in which they were designed. Future studies will need to have better coverage on marital/partner arrangements.

In sum, having a partner during middle age is protective and variations in exact timing and duration were not important in these analyses. Being single or losing a partner without replacement are the situations that increase mortality risk during middle age and decrease the probability that one will survive to be elderly. New research on chronic loneliness [41, 42] may provide a partial explanation for our findings. Maintaining a stable marriage during midlife independent of marital dislocations before age 40 or changes in marital status during middle age were not different from each other. Understanding the role of being partnered versus being married will be increasingly important as the members of this cohort negotiate the next 40 years of their lives, as findings from a recent meta-analysis of studies on non-elderly singles and mortality indicate [43]. Boomers

are expected to change everything—the results from this college cohort can add to our ability to prepare for the future [9, 10].

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