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Is the Mortality Advantage Associated with Marriage Changing Over Time?

Dejun Su

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Department of Sociology

University of Texas-Pan American

1201 W. University Dr.

Edinburg, TX 78541

Tel: 956-380-8798

Email: dsu@utpa.edu

Abstract

Using data from the Union Army Sample (n=9,420) and the 1971-75 National Health and Nutritional Examination Survey Epidemiological Follow-up Sample (NHEFS) (n=2,682), this study examines the relation between marital status and risk of mortality among white male Americans during two periods: from 1900 to 1918, and from the early 1970s to 1992, with 18 years of follow-up in both samples. The results indicate that being married is associated with a sizable mortality advantage in both samples, but the advantage becomes more salient in the NHEFS, suggesting a growing mortality gap between the married and unmarried over time. It has also been found that over the course of the twentieth century marriages are becoming more selective in terms of height of males and less selective in terms of nativity. These two types of selections by marriage, however, cannot account for the observed mortality advantage associated with marriage in the two samples.

Key Words: Marital Status, Mortality Trends, Marital Selection, Union Army Sample, NHEFS.

Introduction

Extant literature on mortality disparities has unequivocally revealed a mortality advantage of married individuals over their unmarried counterparts. Results from a recent review and meta-analysis of 53 studies on the relation between marital status and mortality indicate an overall relative risk of mortality of 0.88 (with a 95% C.I. of 0.85-0.91) for married versus unmarried individuals. Moreover, the reduced risk of mortality associated with marriage is generally robust to statistical controls and sensitivity analyses (Manzoli et al. 2007). Accumulative evidence has also suggested that the mortality advantage associated with marriage is usually more salient among men than among women (e.g. Smith & Waitzman 1997; Johnson et al. 2000; Wilkins 2003).

Despite these findings, so far few studies have examined whether and the extent to which the relation between marriage and mortality has changed over time. Given the unprecedented changes in both mortality and marriage in the past century, it becomes important to assess trends in mortality differentials across marital status categories. Declining mortality implies married couples could potentially have more years to spend in marriage, whereas at the same time the unabated prevalence of cohabitation and divorces constantly challenge the stability of marriage. These profound demographic transformations point to the possibility that mortality differentials across marital status categories could change over the course of the twentieth century.

On the basis of a delineation of trends in marriage in the U.S. from 1900 to the 1970s, this study examines the relation between marital status and risk of mortality among white male Americans during two historical periods: from 1900 to 1918, and from the early 1970s to 1992. Specifically, the empirical analyses of this study focus on three interrelated questions. Was the relative gap in mortality between the married and unmarried (including never married, widowed, and divorced) increasing over time? Was marriage becoming more selective in terms of height and nativity between the two periods? To what extent can these two types of selections account for the mortality advantage associated with marriage? Answers to the latter two questions have implications to weighing the relative importance between marital protection and marital selection when it comes to explaining the marital advantage in mortality.

Data and Methodology

Data

I address the research questions through a comparative study using two longitudinal samples: the Union Army (UA) sample and the 1971-75 National Health and Nutritional Examination Survey Epidemiological Follow-up Sample (NHEFS). The UA sample (Fogel 2000, 2001) contains detailed records on major life events from childhood to death for roughly 36,000 Union Army soldiers who fought the American Civil War. The compilation of the Union Army data was an arduous undertaking since it involved finding, coding, and integrating relevant information from three sources: the military records, the Surgeon's Certificates, and the U.S. Census data. Analysis of possible sample selection bias indicates that the Union Army sample is generally representative of the population of white recruits into the Union Army. Comparisons between the

Union Army sample and the northern population in the same age group suggest these two groups resemble each other in terms of wealth in 1850 and 1860 and in terms of mortality circa 1900 (Fogel et al. 2001). The part of the UA sample used in this study contains life history records for 9,420 white male veterans aged between 50 and 74 in 1900 who can be linked to the 1900 Census where information on their socioeconomic conditions can be found.

The NHEFS collected information on demographics, anthropometry, nutrition, diseases, health behaviors, and so forth from a probability sample of civilian non-institutionalized Americans aged one to 74 between 1971 and 1974. It oversampled minority and low-income groups, but this can be corrected by using sample weights for national estimations. Out of the 23,808 subjects initially screened between 1971 and 1974, 14,407 of them with ages between 25 and 74 were followed to 1992 for updates on vital status as well as health and functional status. The part of the NHEFS used in this study contains longitudinal records for 2,682 white male Americans aged between 50 and 74 at the baseline.

Methodology

To examine the relation between marital status and mortality, I first employed life table methods to estimate survival curves for each of the four marital status categories including married, widowed, never married, and divorced in the follow up periods for both samples. Comparisons between corresponding curves across the two samples are expected to reveal, on a bivariate basis, whether and the extent to which mortality differentials by marital status categories changed from 1900 to the 1970s.

In an effort to adjust for the effects of age, height, and nativity on risk of mortality, I then used Cox Proportional Hazard (CPH) Models to assess the effect of marital status on risk of mortality in the two samples. An important assumption of the CPH analysis is the proportionality of hazard, that is, the effect of changing values in a certain explanatory variable on the hazard rate is constant, independent of time. This assumption was tested for all the explanatory variables in the CPH models. The test results indicate that the proportionality assumption holds for the explanatory variables.

Finally, I adopted logit models to assess whether marriage was becoming more selective in terms of height and nativity between the two periods. Results from these logit models will be examined in conjunction with relevant results from the CPH models to determine whether and the extent to which marital selection based on height and nativity can account for the mortality advantage associated with marriage.

Sample weights were used in all calculations in the NHEFS. The UA sample, however, has no variables on sample weights. This is unlikely to constitute a major problem for the comparative study, since the UA sample used in this study is much bigger than the unweighted NHEFS. Moreover, the fact that the Civil War was a nationwide, full blown conflict and the Union Army enlisted eligible soldiers from all walks of life implies that the UA sample should have a good level of representativeness of the adult white male population back then. During the Civil War, approximately 95 percent of white males between age 18 and 25 in the United States were

examined and approximately 75 percent of the examinees were inducted (Fogel, Engerman, and Floud 1983).

Results

A. A Comparison Between the Two Samples

A critical step in this study is to select two longitudinal samples at two different historical periods that contain information on both mortality and marital status, and more than that, the two samples ideally should be as comparable as possible in terms of demographic composition, years of follow up, and other factors considered so that it can become more straightforward to assess whether and the extent to which the relation between marital status and mortality evolves over time. For this purpose, in both the UA sample and the NHEFS ages at the baseline have been confined between 50 and 74, with a follow-up period of 18 years. The two samples also come very close to each other in terms of mean age and adulthood height, as indicated in **Table 1**. These proximities, to a certain extent, provide a controlled setting for subsequent survival analysis and make it as comparable as possible.

(Table 1 about here)

A notable difference between the two samples lies in marital status. The percentage of 'widowed' in the UA sample is 10.1, as compared to 4.2 in the NHEFS. Divorce was rare among the UA veterans, with 0.8 percent of the sample reporting divorces circa 1900, which stands in contrast with 4.1 percent in the NHEFS. This means divorce rate among white male Americans aged between 50 and 74 increased over 400 percent from 1900 to the 1970s. The differences in marital status between the two samples to a certain extent reflect changes in both mortality and marriage since 1900. Life expectancy among Americans was much lower in 1900 than in the 1970s and the female advantage in longevity over males was less salient back then, which explains the higher rate of 'widowed' in the UA sample. In terms of percentages of 'married' and 'never married', the two samples do not differ much.

The other obvious difference between the two samples is nativity. Fifteen percent of the UA veterans were born outside the U.S., as compared to 8.6 percent in the NHEFS. Most of the foreign born UA veterans came from Great Britain, Ireland, and Germany. Out of the 8.6 percent of for foreign-born respondents in the NHEFS, the majority came from Europe (5.4 percent) and North America (2.2 percent).

B. Marital Status and Mortality in the Two Samples

The survival curves as illustrated in **Figure 1** suggest an apparent mortality advantage associated with marriage in both samples, but this mortality advantage becomes remarkably larger in the NHEFS than in the UA sample, indicating a growing gap between the married and unmarried over time. At the end of the 18 years of follow up, 37 percent of married veterans in the UA sample survived, but for widowed, never married, and divorced veterans, the corresponding percentages are all between 25 and 30 percent. In the NHEFS, 50 percent of the respondents survived the follow-up period, with the percentages for the rest three categories of marital status ranging from 24 percent for the divorced and 33 percent for the widowed.

(Figure 1 about here)

Results based on **Figure 1** also reveals that mortality differentials across marital status categories in the two samples are essentially differences in mortality between the married and unmarried. In the UA sample, there is literally no difference in mortality across widowed, never married, and divorced veterans. In the NHEFS, widowed and never married respondents also come very close in mortality rates at the end of the follow-up. A notable change, however, is that divorced respondents departed from the other two unmarried categories by showing the highest rate of mortality among all marital status categories. One of the significant findings here is that despite unprecedented decline in mortality in the twentieth century, mortality rates for divorced white males aged between 50 and 74 remained the same for most of the twentieth century.

In light of findings based on **Figure 1**, a further question is whether and to what extent the observed mortality differentials across marital status categories as well as their trends still hold after taking into account the effects of age and other relevant factors. Results from the CPH models as summarized in **Table 2** provide clues to the question. Comparisons of hazard ratios between the two samples should tell whether relative mortality gaps across marital status categories changed over the two periods.

(Table 2 about here)

Results from the CPH models confirm findings based on **Figure 1** from a multivariate perspective. After adjusting for the effects of age, being married at the baseline in both samples is associated with a substantial mortality advantage. For example, in the UA sample using 'married' as the reference category, the point estimates of the excessive risks of mortality for widowed, never married, and divorced are 16, 18, and 32 percent, respectively. The corresponding elevated risks of mortality associated with the same unmarried categories in the NHEFS are 18, 47, and 127 percent, respectively. Thus, the findings suggest that the mortality advantage associated with being married relative to being widowed did not change much during the twentieth century, whereas the mortality gaps between married and never married, and between married and divorced turned out to have a remarkable increase over time.

A comparison between Models 1 and 2 in the two samples indicate that the observed differentials in mortality across marital status categories as well as their trends over time still hold after adjusting for the effects of adulthood height and nativity on risk of mortality. Adulthood height has a significant impact on risk of mortality in the NHEFS, but not in the UA sample. On average, being one inch taller in the NHEFS is associated a reduced risk of mortality of four percent, after adjusting for the effects of age, marital status, and nativity on risk of mortality.

Whether or not born in the U.S. makes a significant difference in chance of survival during the follow-up period in both samples, but interestingly the effect has been reversed over time. Relative to native-born veterans in the UA sample, foreign-born veterans had an excessive risk of mortality of 11 percent. By contrast, the relative risk of mortality for foreign-born respondents in the NHEFS becomes 24 percent *lower* than their native-born counterparts.

Information on height and nativity in the two samples also makes it possible to assess the extent of marital selection and its trends over time. The fact that nativity, and to a less extent adulthood height, are usually well established prior to entry into marriage make these two variables ideal indictors of marital selection. **Table 3** presents results from two logit models where age, height, and nativity have been used to explain chance of being married at the baseline in the two samples.

(Table 3 about here)

Marriages were selective in terms of height and nativity in both samples. In the UA sample, on average being one inch taller is associated with an elevated chance of three percent of being married in 1900. The corresponding higher chance becomes nine percent in the NHEFS. This suggests that marriages tended to become more selective in terms of male's height over time. As for the effect of nativity, being born outside the U.S. is associated with a lower chance of being married at the baseline in both samples. The point estimates of the reduced odds are 24 and 12 percent in the UA sample and the NHEFS respectively. Thus, to take into consideration of the typical timing of marriages in the two samples, the findings based on **Table 3** suggest that marriages tend to become less selective in terms of males' nativity from the second half of the nineteenth century to the first half of the twentieth century.

Discussion and Conclusion

Previous studies have documented trends in socioeconomic disparities in mortality over time (e.g. Pamuk 1985; Duleep 1989; Feldman et al. 1989; Pappas, Queens, Hadden & Fisher 1993; Preston & Elo 1995; Crimmins & Saito 2001; Mackenbach et al. 2003). In general a converging finding from most of these studies is that individuals with higher SES, as indicated by their education, income, or occupation, benefited more from mortality decline than those with lower SES did. As a result, the relative mortality gap between the have and have not was increasing over time. Few studies, however, have examined trends in the mortality advantage associated with marriage over time. Even fewer studies, if any, have examined the trend with a time span of more than 70 years.

Through a comparative study between the UA sample and the NHEFS, this study complements the literature by examining trends in mortality differentials across marital status categories among white male Americans over the course of the twentieth century. As a result of a series of structural and cultural changes in the past century, marriage as a social institution is not as wanted or revered as it used to be. Some of the symptoms include declining marriage rates, high divorce rates, low rates of remarriage, increases in cohabitation, and increases in men and women not in any partnership (Waite 2000). Consistent with these changes and mortality decline, findings from this study suggest that relative to their counterparts in 1900, white male Americans aged between 50 and 74 in the early 1970s are more likely to become divorced, but less likely to become a widower. The percentage of the married and never married, however, did not change much from 1900 to the 1970s.

Results from this study also reveal that marriages were becoming more selective in terms of adulthood height of males, but less selective in terms of nativity. With women's

educational level and earning power improving over time, they could have more preferences for taller men than they used to. But for American women who were married in the nineteenth century, since most of them did not work outside home, their top priority usually had to be on the supporting capability of the bread winner, not on height.

As for the declining marital selection in terms of nativity, a plausible explanation would be that back to the nineteenth century native-born Americans on average had a substantial advantage over their foreign-born counterparts in terms of both health and economic status, but over time later immigrants gradually caught up. As a result, marital selection over nativity declined. According to an estimate by Komlos and Baur (2004), among adult males the American height advantage over Western and Northern Europeans was in between 3 to 9 centimeters in the middle of the nineteenth century. Moreover, information from the UA sample also provides evidence that foreign-born veterans had a tremendous economic disadvantage as compared to native-born veterans. Based on information from the 1860 census, **Figure 2** shows the differences in wealth between veterans from Germany and Ireland and those born in the United States. The main economic advantage of US-born veterans lies in their ownership of real estate, the value of which is substantially higher than that for veterans from Germany and Ireland. With the U.S. immigration policy becoming more restrictive over time, immigration selection makes it possible for immigrants to catch up with or even outperform native-born Americans in terms of both health and economic status. Correspondingly, marital selection over nativity eventually becomes dissipated over time.

(**Figure 2 about here)**

Concurrent with changes in marriage is a growing mortality advantage associated with marriage over the course of the twentieth century. Empirical evidence from the two samples used in this study suggests that as mortality and marriage evolved, the relation between marriage and mortality could change as well. This is consistent with the well documented expanding relative gap in mortality between the have and have not, since underlying disparities in marital status could well be disparities in economic status.

One of the key findings from this study is that, for white male Americans aged between 50 and 74 in the early 1970s, those who were married benefited the most from mortality decline in the twentieth century, whereas for those unmarried, particularly for those who were divorced, the gain was very little. The highest risk of mortality among divorced men was also reported in an international study of mortality differentials by marital status (Hu and Goldman 1990). For intervention purpose, a further inquiry along this line would be to identify the social, psychological, mental, and economic factors that have contributed to the excessive risk of mortality among divorced individuals.

Findings from this study also shed some light to the issue of marital selection or protection in explaining marital advantage in mortality. A detailed reading of the results based on the CPH models in **Tables 2** suggests that marital selection over height and nativity is unlikely to account for the mortality advantage associated with marriage. This is because, if the selection over height or nativity is an important contributing factor to the marital advantage in mortality, then adjusting for their effects in the CPH models (Model 2 in **Table 2**) should substantially narrow down the mortality gap by marital status. But this did not occur. The results indicate that whether or not adjusting for the effects of height and nativity makes virtually no

difference in mortality differentials by marital status. It should be noted, however, that these findings do not disprove the possible role of marital selection in the mortality advantage associated with marriage. It simply means that findings from this study have excluded selection over height or nativity as an important contributing factor to the observed marital advantage in mortality.

This study has several limitations. First, the use of sample weight in both the Cox and logistic regressions in the NHEFS could have resulted in biased estimates of standard errors of the coefficients as well as the 95 percent confidence interval, although this would not complicate the point estimates of the coefficients themselves. Correspondingly, the presented confidence intervals in the tables should not be read with caution. Second, due to the difficulties in finding identical variables in the two samples, only four variables were used in the multivariate analyses of the effect of marital status on risk of mortality. Future studies can assess the relation between marital status and mortality with more socioeconomic variables incorporated, which would allow for options in model construction. Finally, the key dependent variable used in this study is all-cause mortality during the 18 years of follow up. A valuable future step would be to explore the possibility of utilizing information on cause-specific mortality in the two samples and thus move towards a better understanding of the relation between marital status and mortality as well as its changes over time.

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Table 1: A Comparison Between the Two Samples at the Beginning of Follow-up

	UA Sample	NHEFS
Age Range	50-74	50-74
Years of Follow-up	18.0	18.0
Mean Age	60.5	59.7
Marital Status (%)		
Married	84.3	86.0
Widowed	10.1	4.2
Never Married	4.8	4.3
Divorced	0.8	4.1
Adulthood height (inches)	68.0	68.1
Percentage of Foreign-Born	15.0	8.6
Number of Cases	9,420	2,682 18,158,074 (weighted)

Source: The Union Army Sample and the NHEFS.
Note: Calculations in the NHEFS have been adjusted for sample weight.

Table 2: Marital Status and Relative Risk of Mortality in the Two Samples

Explanatory Variables	Hazard Ratios			
	UA Sample		NHEFS	
	Model 1	Model 2	Model 1	Model 2
Age	1.09*** (1.09, 1.10)	1.09*** (1.08, 1.10)	1.09*** (1.09, 1.09)	1.08*** (1.08, 1.08)
Marital Status				
Married	reference	reference	reference	reference
Widowed	1.16*** (1.08, 1.26)	1.18*** (1.08, 1.28)	1.18*** (1.18, 1.18)	1.20*** (1.20, 1.21)
Never Married	1.18** (1.05, 1.32)	1.16* (1.03, 1.30)	1.47*** (1.46, 1.47)	1.41*** (1.41, 1.42)
Divorced	1.52** (1.16, 1.98)	1.55** (1.16, 2.06)	2.27*** (2.27, 2.28)	2.25*** (2.25, 2.26)
Adulthood Height (inches)		1.00 (0.99, 1.01)		0.96*** (0.96, 0.96)
Foreign-Born		1.11** (1.03, 1.19)		0.76*** (0.76, 0.76)
Number of Cases	9,420	8,196	2,143	2,132
			18,030,380 (Weighted Sample Size)	17,910,713 (Weighted Sample Size)

Source: The Union Army Sample and the NHEFS.

Note: Calculations in the NHEFS have been adjusted for sample weight. * p<0.05; ** p<0.01; *** p<0.001

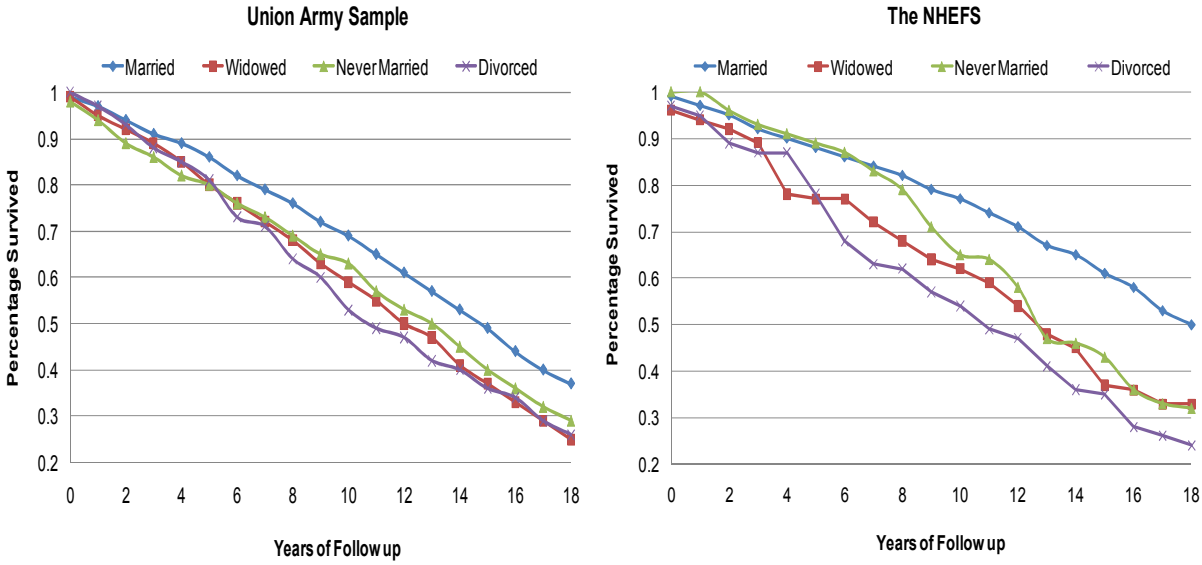
Table 3: Height, Nativity, and Chance of Being Married at the Beginning of the Follow up

Explanatory Variables	Odds Ratios	
	UA Sample	NHEFS
Age	0.95*** (0.94, 0.96)	0.97*** (0.97, 0.97)
Adulthood Height (inches)	1.03** (1.01, 1.06)	1.09*** (1.09, 1.10)
Foreign-born	0.74*** (0.63, 0.86)	0.88*** (0.88, 0.89)
Number of Cases	8,196	2,123
		17,780,664 (weighted)

Source: The Union Army Sample and the NHEFS. ** p<0.01; *** p<0.001

Note: Calculations in the NHEFS have been adjusted for sample weight.

Figure 1: Marital Status and Survival in the Two Samples



Source: The Union Army Sample and the NHEFS.

Figure 2: Wealth in 1860 by Country of Birth