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ORIGINAL RESEARCH

Marital Status and Self-Rated Health in China: A Longitudinal Analysis

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Abstract

Research has shown that there exists a positive correlation between marriage and good health, but the reasons for this association are disputed. Scholars acknowledge that the key to answering these questions lies in understanding the role of marriage in specific social contexts. This paper utilizes marital protection, marital selection, and life course perspectives to investigate the relationship between marriage and health in China, a society characterized by nearly universal marriage, strong societal pressure to marry, especially for women, and a distinct rural and urban divide in family life. I analyze the China Health and Nutrition Survey (CHNS) with lagged dependent variable models and fixed-effects linear regression models, to predict self-rated health and control for baseline health status and time-invariant omitted variable bias. The health status difference between those who are single and those who are married is primarily explained by marital selection, while marital protection explains the health differences between married and widowed rural women. The health differences between widowed and married rural women vary over age, consistent with the prediction of the life course perspective. Health differences associated with marriage are found mainly among the rural population and less among the urban population. The selection, protection, and life course perspectives each contribute to understanding different pieces of the marriage–health relationship in China. Marriage, gender, and age intertwine with the rural–urban divide to shape self-rated health in different ways and directions for different groups. Most notably, marriage effects on health are mainly a rural phenomenon in China.

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Introduction

The health implications of marriage have been studied in many national settings, and it has been widely documented that family is a major source of social support that tends to enhance adults' health and well-being (House et al. 1988; Kiecolt-Glaser and Newton 2001; Lillard and Panis 1996). While much research investigates the association between marriage and health, most of the work has focused on developed countries. There is less evidence about the marriage–health linkages in low- and middle-income countries, where the marriage market and norms, and family dynamics may differ substantially from those characterizing developed countries.

Unlike marriage in some European countries and the US, nearly universal marriage is still the norm in China and marriage remains the predominant union type (Ji and Yeung 2014; Jones and Gubhaju 2009; Raymo et al. 2015). Even though the mean age at first marriage has increased and cohabitation is more socially accepted than before, marriage is still the gold standard for long-term relationships in China and nearly everyone eventually marries (Ji and Yeung 2014; Raymo et al. 2015). Given this pro-marriage norm, single adults face tremendous social pressure to marry, which tends to increase with age, since marriage is an age-graded life transition. Unmarried men and women are stigmatized as "bare branches" and "leftovers," respectively (Qian and Qian 2014).

Moreover, the ideology of gender equality promoted during the socialist period has gradually eroded following marketization, and traditional patriarchal values are beginning to make a comeback (Ji 2015; Sun and Chen 2015). Marriage as a patriarchal institution has long been considered a health risk for women but a health benefit for men, a discrepancy alluded to in the expression '"his" and "her" marriage' (Bernard 1982). While a large body of literature has suggested that women enjoy the same health benefits of marriage as men, the evidence primarily comes from gender-egalitarian societies, such as the USA and European countries. Evidence from strongly patriarchal societies is scarce (Lim and Raymo 2016).

Meanwhile, the rural–urban divide in China corresponds to disparities in terms of mobility, resource accessibility, and variation in modes of marriage and family life. In urban areas, the marriage norms and behaviors are more similar to those of the West, and singlehood as a lifestyle is gradually becoming more acceptable to the urban population (Osteria 2015; Raymo et al. 2015), while in rural areas marriage remains strongly normative, patrilineal, and patriarchal.

Given these differences in norms and behaviors related to marriage and family, it would be expected that the marriage–health relationship in China differs from that found in Western countries. In this paper, I draw on a unique longitudinal dataset from nine provinces in China to assess the link between marriage and overall health status, as indicated by self-rated health. I address the following questions: What are the health implications of marriage in China, where nearly universal marriage is still practiced, marriage is the predominant union type, and single individuals face tremendous social pressure and stigma? How does the

marriage–health link vary by gender and age in a context with different gender and marriage norms from those of the West? And, what role does the profound rural–urban divide play in the health benefits of marriage?

This research contributes to the existing literature in three ways. First, the dearth of large-scale longitudinal data limits our knowledge of the marriage–health gradient. By utilizing large-scale, population-level, longitudinal data, this study enables simultaneous examination of various theoretical frameworks with longitudinal evidence, thereby adding solid empirical evidence to this research field. Second, China presents a special case with a distinctive marriage norm, behaviors, and structures. Using China as a case study makes it possible to extend and test theoretical frameworks developed in Western countries in a very different context, thus contributing to the comparative literature on whether the marriage–health gradient is uniform in different social contexts. Third, by investigating the health implications of entrance and exit, this study complements the existing social science work on the role of marriage and the rural–urban divide in China, which has focused on the health benefits of marriage in societies with early and nearly universal marriage, the stigmatization of singlehood, a strong patriarchal tradition, and divergences of family life in rural and urban settings.

Theoretical Framework

Social relationships are essential elements of well-being, and numerous scholars have studied the connection between social relationships and well-being (House et al. 1988; Umberson and Karas Montez 2010). Marriage, as one of the most important social relationships for most adults, is crucial to well-being. A large body of research suggests a beneficial association between marriage and health (Ross et al. 1990; Schoenborn 2004). Married people live longer, on average, and have fewer physical and mental health problems (Lillard and Panis 1996; Williams and Umberson 2004; Wilson and Oswald 2005). Research has also shown that marriage confers real benefits on individuals' health through several channels. Empirical evidence has found that married people receive more social support and financial resources, compared to their non-married counterparts (House et al. 1988; Lillard and Panis 1996). Married people are also less likely than non-married people to resort to substance abuse (Duncan et al. 2006) and are more likely to maintain a healthy lifestyle (Umberson 1987).

While this marital protection hypothesis is supported by ample evidence, doubts have been raised by those who contend that the observed health benefits of marriage are primarily due to selection effects; i.e., healthier people are more likely to be selected for marriage and to stay married than those who suffer from poor health. From this perspective, the health benefits of marriage are overstated or spurious. Various statistical methods have been adopted for determining the relative validity of these competing perspectives. Tumin and Zheng (2018) examined the relationship between marriage and health in the USA by using propensity score matching and a heterogeneous treatment effect model, and found that the health benefits of marriage do not depend on the likelihood of getting married. Using lagged dependent variable

models, researchers in the USA have found that early marriage does not have protective effects on health, and that the selection effects of health on marriage vary with race for women, but not for men (Mullan Harris et al. 2010). Researchers have also utilized individual fixed-effects models to account for time-invariant omitted variables that are correlated with marriage and health, and empirical studies using fixed-effects usually find weaker or even no health benefits of marriage (Guner et al. 2014; Tumin 2018).

Furthermore, the health differences between married and unmarried people are also deeply shaped by the marriage and family norms rooted in the social context. If singlehood is strongly stigmatized, then the observed health differences between married and unmarried are likely to be profound (Liu and Umberson 2008). Using pooled cross-sectional data, Liu and Umberson (2008) showed that the differences in self-rated health between married and never married converged between 1972 and 2003, especially for men. They argue that a decline of stigmatization and an increase in accessibility of resources for individuals are two possible mechanisms contributing to the narrowing health gap between married and never married in the USA. Some scholars also suggest that if other family structures and norms provide functions similar to those of marriage, then the health differences between married and unmarried would be insignificant (Elwert and Christakis 2006; Sarkisian and Gerstel 2008). In the USA, cohabitation is more common among young cohorts as a transition into marriage, and the mechanisms by which marriage confers health benefits, such as financial resources and social support, can also be delivered in a cohabitation relationship. Thus, in this context, the health benefits of marriage are less prominent, since cohabitation serves a nearly equivalent function (Musick and Bumpass 2012).

In addition, researchers also note that the selection mechanism is not identical over time or context. In a society where marriage is the norm and nearly everyone eventually marries, those who are not married are likely to belong to the most disadvantaged groups. In such a context, health differences between married and unmarried are mainly due to marital selection (Goldman 1993). In the USA, the phenomenon of retreat from marriage prevails among the disadvantaged groups (Cherlin 2010; Schoen and Cheng 2006), and as a selection process is one potential mechanism explaining the diminishing health benefits of marriage in recent cohorts in the USA (Tumin 2018).

Beyond the focus of marital protection and selection, scholars have also paid much attention to how the benefits of marriage differ by gender and over the life course (Carr and Springer 2010). Researchers have long been aware that the health benefits of marriage may differ for men and women. From this perspective, marriage as a patriarchal institution is harmful to women's health, but beneficial to men's health. In addition, men and women tend to play different social roles and have access to different resources within and outside the family. Within the family, women are more likely to be caregivers and monitor the unhealthy behaviors of men, and wives tend to be better connected with other people than husbands (Williams and Umberson 2004). For these reasons, men may gain more health benefits than women from staying in marriage and are thus more vulnerable when they exit marriage.

However, outside of the family, a large body of literature on gender stratification suggests a profound gender inequality in labor markets and wealth. Women tend to earn lower wages and possess less wealth than men (Chang and England 2011; England 2005; Yamokoski and Keister 2006). Moreover, research has also found that more women live in poverty than men (McLanahan and Kelly 2006). These social and economic disadvantages suggest that women gain more health benefits from marriage than men do (Lillard and Waite 1995). Nonetheless, the empirical findings about the role of gender in the health benefits of marriage are mixed.

In the USA, Williams and Umberson (2004) found that men, but not women, have worse self-rated health after exiting marriage. Elwert and Christakis (2006), however, found that both white men and women suffer substantial widowhood effects and that there is no appreciable gender difference for widowhood effects. In other societies, researchers have found that married women display better self-rated health in Japan, a highly gender-segregated society characterized by strong patriarchal values (Lim and Raymo 2016). A study from India, however, found that being widowed is associated with poor self-rated health and more depressive symptoms for women, but not for men (Perkins et al. 2016). Thus, gender remains a salient dimension to be considered in understanding the relationship between marriage and health in different social contexts with different gender norms.

The health benefits of marriage are also contingent on age. The life course perspective provides a comprehensive framework for explaining the heterogeneous effects of marriage on health over the course of adulthood, and highlights the importance of the timing of social role transitions in shaping health and well-being (Elder 1985; Williams and Umberson 2004). Entering or exiting marriage is a salient social role transition over the course of adulthood, and this transition is related to the availability of resources to maintain or improve health and well-being. Deviating from expected social roles potentially triggers social stress and constrains resource mobilization. Therefore, the life course perspective predicts that the benefits of marriage vary across life stages, as marriage is an age-graded life transition. Williams and Umberson (2004) hypothesize that the health gain in transition into marriage is likely to be larger at an older age than at a younger age, since getting married in a later life stage is more likely to relieve social stress. Scholars also suggest that those who marry at an earlier age may be less mature, are unstable their careers, have lower marital quality, and are more likely to experience marital disruption (Bumpass et al. 1991; Oppenheimer 1988; Umberson et al. 2005), and thus may gain less health benefits from marriage than those who marry late.

Williams and Umberson (2004) also hypothesize that as people age, family usually becomes more central to social life, and also becomes the major source of social support, whether emotional or instrumental. Thus, transition out of marriage at a later life stage may have a stronger detrimental effect on health than it does at an earlier life stage.

Overall, the health differences between married and unmarried can be explained by either the marital protection hypothesis or the marital selection hypothesis, depending on the prevailing social context and norms about marriage and family. Moreover, the marriage–health relationship is likely to vary across gender and life stage.

China Background

Early and Nearly Universal Marriage

A great deal of research has investigated the nature of marriage markets, family norms, and family structures in China (Riley 1994; Slote and De Vos 1998), but the marriage–health relationship remains unexplored. The theoretical frameworks and empirical evidence discussed above are also relevant for developing hypotheses about the marriage–health relationship in China. However, the nature of this relationship is not very straightforward in the case of China, due to the distinctive features of the marriage norms, the marriage market, and the broader Chinese social context. These features make China's marriage market an interesting case to test theoretical frameworks developed in Western countries.

Early and nearly universal marriage has long been the norm in China, but this is beginning to change. Between 1995 and 2005, the mean age at first marriage increased from 24 to 25.7 for men and from 22.1 to 24.6 for women (Raymo et al. 2015). The expansion of education, rapid urbanization, and the rise of consumerism and careerism are all contributing to this unfolding phenomenon (Mu and Xie 2014; Oppenheimer 1988). Greater educational opportunities, increasing standards of living, and more time for career building and self-fulfillment have all made traditional marriage and family roles less attractive to young adults (Bumpass et al. 2009; Lesthaeghe 2010).

Despite the fact that young adults have other priorities and interests than marriage and postpone marriage to pursue these goals, marriage is not forgone. Nearly universal marriage is still common. In 2005, around 98% of women and 90% of men were married by the age of 30–34. By the age of 35–39, almost all women were married and less than 5% of men remained single (Ji and Yeung 2014). In addition, cohabitation as another type of union is more socially acceptable and prevalent than it used to be. Recent research found that one third of newlyweds (2010–2012) had cohabitated prior to marriage and that cohabitation is more common in urban and coastal areas and among the highly educated (Xu et al. 2014). Yet, cohabitation is still more of a precursor than an alternative option to marriage (Raymo et al. 2015). To be sure, the boundary between marriage and cohabitation remains distinct and there is no indication that cohabitation is coming to be widely regarded as equivalent to marriage, either functionally or symbolically. Thus, marriage is still the gold standard, and almost everyone in China eventually marries.

What are the health implications of delaying nearly universal marriage? Nearly universal marriage possibly enhances both the health benefits of marriage as well as the likelihood of selection into marriage. On the one hand, since marriage is strongly normative and remains the only option for a long-term and stable intimate relationship, single adults still face tremendous pressure from their families to get married, and other types of union do not provide the same health benefits as marriage. There is also a strong social stigma attached to being single, for both men and women. The derogatory expressions "leftover" (*sheng nu*) and

"bare branch" (*guang gun*) for single women and single men, respectively, reflect the culturally conditioned stigmatization of singlehood (Fincher 2016; Jin et al. 2013). Thus, social pressure, stigmatization, and constraints on the accessibility of resources all contribute to the health differences between single and married people. On the other hand, this strong marital norm along with the increasing importance being given to the economic status of a prospective spouse, especially for men, could also magnify the selection effects (Goldman 1993; Yu and Xie 2015). Those who are not married in this context are likely to belong to highly selective groups, or else to disadvantaged groups whose members have difficulty finding a spouse.

Gender and Age Variation

Furthermore, the health benefits of marriage are stratified by gender and age. Chinese society is characterized as patrilocal, patrilineal, and patriarchal (Thornton and Lin 1994). Women are disadvantaged in both the public and private spheres (Ji et al. 2017). In spite of the promotion of gender equality during the early decades of the Communist regime, since the economic reforms of the 1980s the ideology of gender equity and institutional arrangements that foster equity have rapidly waned, and patriarchal norms persist, especially in rural areas (Cohen and Wang 2009; Chen et al. 2015; Ji et al. 2017).

In the public sphere, gender inequality in income and professional status has sharply increased since marketization (Cohen and Wang 2009). Research has suggested that this widening gender gap is primarily the result of marriage and motherhood penalties applied to urban women (Zhang et al. 2008). Meanwhile, rural women face different challenges in the labor market. Due to the huge discrepancy in economic development between rural and urban areas, a large portion of the rural population has migrated to urban areas in search of better work opportunities (Liang et al. 2014). Although single young women also join this migration, they tend to be limited to low-level and low-paid jobs, and usually return to the countryside after marriage (Fan and Huang 1998).

In the private sphere, married Chinese women, similar to married women in other contexts, perform the major share of household chores and are the primary caregivers in the family. Overall, similar to other societies, women are economically disadvantaged; thus it is expected that women gain health benefits from financial security through marriage. Women are also the primary caregivers; thus it is expected that married men are healthier than their unmarried counterparts. Based on the above discussion, I formulate two competing hypotheses:

H1 Marital protection hypothesis. Being married is healthier than being single or being widowed for both men and women.

H2 Marital selection hypothesis. The observed health benefits of marriage will substantially attenuate or disappear after controlling for baseline health status and time-invariant unobserved factors, particularly for men.

Besides, the life course theory emphasizes that marriage is an age-graded transition, suggesting that deviating from social norms may trigger stress and constrain access to resources, and that the social pressures for getting married are likely to increase with age. Meanwhile, social attitudes and expectations toward late marriage may differ for men and women. For men, the expectation that they will pay a large bride price and also be the chief breadwinner after marriage leads many men to delay marriage in order to accumulate economic resources (Jiang and Sánchez-Barricarte 2012; Wei and Zhang 2011). This delay is socially tolerated, since husbands are expected to be well established in their careers, and tend to marry women younger than themselves (Mu and Xie 2014).

By contrast, traditional gender roles and stereotypes remain unchanged for women, even though women are more educated and economically independent than ever before. Thus, women who delay marriage typically face pressure from parents and other relatives, and unmarried women are explicitly and implicitly stigmatized in various social settings (Fincher 2016; Qian and Qian 2014). Moreover, those who get married earlier may be less mature, lack job stability, and be less educated (Ji and Yeung 2014; Oppenheimer 1988), and thus may gain less health benefits from marriage. Based on the above discussion, I hypothesize that the relationship between marriage and health over age in China is as follows:

H3 The health differences between single and married are wider over age for women, but not for men.

As mentioned in the Theoretical section Williams and Umberson (2004), argue that the family usually becomes the major source of social support at later life stages. Thus, transition out of marriage at a later life stage may have a stronger detrimental effect on health than it does at an earlier life stage. However, researchers have noted the long-standing emphasis on intergenerational ties over the conjugal bond in the Chinese family system, as a result of which the emotional support brought by marriage in China may be less than in Western society, particularly in rural areas (Pimentel 2000; Chen et al. 2015). In addition, in Chinese society the social support from intergenerational ties is expected to be larger later in life, given that adult children are expected to take care of their aging parents, and are more capable of doing so. Meanwhile, the norm in China is to have children soon after marriage; thus being widowed at an early life stage often means taking care of children without support from a spouse, which may trigger tremendous stress. Although both widows and widowers often receive support from their parents to take care of their children, women are disadvantaged in the labor market. Thus, the burden is larger for widows, relative to widowers. Taken all together, I hypothesize the following:

H4 The health differences between widowed and married are wider at a younger age, but narrower at an older age for women, but not for men.

The Rural and Urban Divide

Apart from gender and age variation, the rural–urban divide is another crucial dimension in understanding the relationship between marriage and health in China. The Chinese population is organized into a household registration (*hukou*) system which determines where each person is allowed to officially reside. This system plays a profound role in shaping the lives of both the urban and rural populations. Those with an urban hukou earn more wages, have better job opportunities, and have access to more medical and educational resources than their rural counterparts (see Chan 2009 for a review). The hukou system not only perpetuates economic and social inequality, but also has a major impact on patterns of family life.

Even though both urban and rural men and women eventually get married, marriage-related norms have shifted in urban areas. In urban areas, cohabitation is more common and socially accepted (Xu et al. 2014) and parents are less involved in their children's choice of mate (Riley 1994). Moreover, singlehood as a lifestyle, personal autonomy, and social support from friends are gradually being embraced by the urban population in China (Osteria 2015). These potential benefits of being single may buffer the social pressures for getting married in urban areas. By contrast, in rural areas traditional ideas about marriage still prevail and family life continues to follow the patrilineal and patriarchal norms inherited from Confucianism. Moreover, the burdens of labor-intensive farming, childcare, and parents-in-law with limited public educational and medical resources in remote areas, the health benefits of marriage are limited in rural areas for young married women (Chen et al. 2015). Nonetheless, marriage remains expected to be crucial for health for men and later life stages because of the strong social stigma against singlehood, and the lack of alternatives for long-term intimate relationships outside of marriage.

Simply speaking, in comparison with those with a rural hukou, the urban population has more access to public resources, and its marriage norms and behaviors are more convergent to Western practices. Given these considerable rural–urban differences in marriage norms and behaviors, I hypothesize that,

H5 Being married is not associated with health benefits in the urban population, but is among the rural population.

In sum, this study examines the relationship between marriage, health, and gender over the life course in China, where there is nearly universal marriage and a strong stigma attached to singlehood. Moreover, given the substantial differences in family life between rural and urban areas, this study also examines whether the marriage–health relationship is contingent on rural–urban residence. China provides an intriguing case to examine whether marriage confers health in a context that is substantially different from Western countries where singlehood and cohabitation are widely accepted.

Data and Methods

Data

The data used in this study come from the China Health and Nutrition Survey (CHNS), a multistage probability sample including every member living in the same household. The survey was first conducted in 1989 in eight provinces of China,[1] with follow-up data collected in 1991, 1993, 1997, 2000, 2004, and 2006. I include in my analysis the respondents aged 15 and above, and do so for two reasons. First, research suggests that marriage before the legal marriage age (22 for men and 20 for women) is not uncommon in China (Liu and Zhao 2009). Second, incorporating information for those at an earlier age stage provides more premarital health information in the analysis, which is essential for individual fixed-effects models that rely on within-person variations. In addition, only the 1991 and 2006 questionnaires collected data on self-rated health. Therefore, my sample is limited to the survey rounds conducted in 1991 to 2006. Additionally, my sample is limited to person-time observations without missing values of self-rated health and marital status, and about 17% of person-time observations are excluded. Missing values for all other time-varying independent variables are handled with multiple imputation by chain equation (Rubin 2004).

Following Allison's (2001) suggestions for multiple imputation for longitudinal data, each variable with missing values is imputed based on information from all six time points, and about 6% of person-time observations are imputed. The attrition rate is about 6% to 10% across each wave. Because the attrition rate was not low, I also conducted attrition analysis to test whether this would bias the statistical estimation in this study. The attrition analysis indicates that the estimation is unbiased with a few exceptions (See Appendices A and B), and this result is consistent with many previous studies which have found that sample attrition is not always a concern in longitudinal data analysis (Alderman et al. 2001; Falaris and Peters 1998; Twisk and de Vente 2002). Because my analytical approach requires observations for at least two points in time, I excluded cases that had an observation for only one point in time. The final analytical sample consists of 48,643 person-time observations and 13,136 cases.

Outcome Variables

Self-rated health was measured by the following question: "How would you describe your present health compared to that of other people your age?" The respondents rated their health from 1 (poor) to 4 (excellent). Self-rated health is a well-established predictor of mortality (Idler and Benyamini 1997) and has been widely adopted as an indication of overall health status in large-scale surveys. The existing literature also suggests that self-rated health is closely linked to a wide range of

[1] The sample began with eight provinces in 1989 and added a ninth province, Heilongjiang, in 1997.

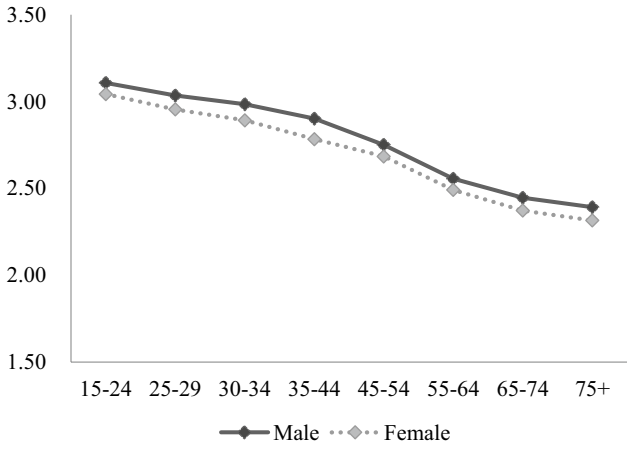


Fig. 1 Mean self-rated health over age by gender in 1991

objective indicators of health status in China, such as cardiovascular disease, mental illness, and various risk factors, such as stress and poor quality of interpersonal relationships (S. Wu et al. 2013).

Despite these desirable properties, scholars have also expressed concern that self-rated health, as a subjective measurement of overall health status, is subject to reporting heterogeneity bias, meaning that each individual may report their health status differently, given the same objective health state. Indeed, research in developed countries has found that reporting heterogeneity in self-reported health occurs in relation to gender, but not in relation to socioeconomic status (Van Doorslaer and Gerdtham 2003). Research in China, Indonesia, and India has similarly found only a slight reporting heterogeneity bias relating to socioeconomic status. Thus self-rated health can be seen as a valid measurement reflecting health disparities across demographic and socioeconomic groups (Bago d'Uva et al. 2008).

Figure 1 displays the mean self-rated health in terms of age and gender in the first wave of the survey. As expected, a much higher proportion of the respondents reported good or excellent health at earlier ages than at older ages. Although the respondents were asked to evaluate their health compared to people of similar age, we still see variation of self-rated health over age for both men and women.

The questionnaire uses a four-point Likert scale to measure self-rated health. Some scholars suggest that self-rated health should be recoded into a dichotomous variable, but there is evidence to suggest that there is no one best way to code self-rated health (Manor et al. 2000). Moreover, self-rated health in a continuous form is also a good predictor of risk factors and illness (Manderbacka et al. 1998). In the present study self-rated health is thus treated as a continuous variable in each analysis.[2]

[2] I also conducted the same analysis while treating self-rated heath as a dichotomous variable rated as excellent/good versus fair/poor. The findings were similar to the results I present in this paper.

Main Explanatory Variables

In the questionnaire marital status is divided into five categories: never married, married, divorced, separated, and widowed. However, since the proportion of divorced and separated respondents was quite small, I excluded these two categories from my analysis,[3] and included only the remaining three categories in each analysis. Since the marital status for an individual changes over survey years, it is treated as a time-varying variable in all analyses. "Married" is the reference group for all models.

Control Variables

Both time-invariant and time-variant variables are used in my analysis. The time-invariant variables consist of gender, highest level of education, stature, and province. For gender, female is coded as 1 and male as 0. Highest level of education is divided into three categories: lower middle school and below (0), upper middle school (1), and college and above (2). The life course sequence of education and marriage in China remains highly normalized and the great majority of Chinese have achieved their highest level of education before entry into marriage (Yeung and Hu 2013); thus I treated highest level of education as a time-invariant variable and fixed it at the highest level of education across waves. Anthropometric stature is included as a proxy for health status prior to marriage, since much research has shown that stature is a good proxy for overall long-term nutritional status as well as for early life conditions (Behrman 2009; Case and Paxson 2009). The unit of measurement for stature is centimeters and each participant's stature is fixed at the highest stature across waves in order to control for the shrinkage of height as the respondent ages. I also include province dummies to control for provincial variation.

The time-variant variables consist of age, age squared, employment status, per capita household income, and urbanization. Age is centered to the minimum legal age for marriage (22 for men and 20 for women) in the analytical sample. Employment status is coded as 1 if the individual is employed and 0 otherwise; per capita household income is defined as the total household income divided by the number of household members and is used as a proxy of overall household financial resources. All waves of per capita household income are inflated to 2009 and transformed to log form. Urbanization is measured at the community level. The index of urbanization is constructed based on the multi-dimensional characteristics of a community, including population, occupation structures, level of education, economic development, infrastructure, health facilities, and so on (for details, see Jones-Smith and Popkin (2010)). With this index, the level of urbanization of a community can be more comprehensively captured than when relying on a single characteristic of a community.

[3] I also tested the results with the "divorced" category, which combines both divorced and separated, and the results were stable.

Lagged Dependent Variable Models and Fixed-Effects Models

The primary goal of this study was to evaluate the effects of marital status on self-rated health and how the marriage and health relationship varies across age and gender and is contingent on the rural–urban divide. First, to examine whether marriage confers health benefits, I used lagged dependent variable models to estimate separately for the four subsamples: urban females, rural females, urban males, and rural females. Second, I further examined whether the health differences between married and non-married are due to selection or unobservable time-invariant factors using fixed-effects models. Third, I tested the life course theory by adding an interaction term between age and marital status to investigate whether the relationship between marital status and self-rated health changes over age by gender and residence.

My analytical approach was to make use of both lagged dependent variables (LDV) and fixed-effects models to estimate the marriage and health relationship across gender over life course. First, I estimated ordinary least square (OLS) regression with a lagged dependent variable model to reduce potential endogeneity between marriage and health (Lim and Raymo 2016; Simon 2002). I predicted health status in time t with all time-invariant and time-variant covariates as well as prior health status at the baseline survey. Second, consider the following model, where the subscript i denotes persons and t represents survey waves. Y_{it} refers to self-rated health for individual i observed at time t; x_{it} denotes the observed time-invariant covariates; Mar refers to marital status and is a time-varying covariate; z_{it} refers to other observed time-varying covariates; $\alpha_i$represents time-invariant unobserved heterogeneity, and ε_{it} refers to residuals.

$$Y_{it} = \beta_0 + \beta x_{it} + \gamma_1 Mar + \gamma z_{it} + t\alpha_i + \varepsilon_{it}$$

In the fixed-effects models, α_i is treated as an individual-specific constant effect that is canceled out. Fixed-effects models allow researchers to estimate only coefficients of time-varying variables $\gamma_1$andγ and coefficients of time-invariant variables β are cancelled out. Fixed-effects models are of strategic importance to this study and are commonly used to disentangle marital protection and selection and provide a more stringent and conservative estimation (Wilson and Oswald 2005; Wu and Hart 2002).

This approach allowed me to control for time-invariant unobserved heterogeneity, such as genetic predisposition and medical history. For example, a positive personality is an important time-invariant omitted variable that is likely to be associated with better health and with better chances of getting married or staying married (Botwin et al. 1997; Harker and Keltner 2001). Therefore, the positive association between marriage and health in the ordinary least square estimation may be the result of a positive personality; personality is also likely to be associated with different strategies of coping with stressful life events (Bolger 1990; Carver and Connor-Smith 2010; Holahan and Moos 1985). Existing empirical studies show that the health benefits of marriage observed in random-effects models and other analytical approaches, such as pooled OLS regression, tend to

Table 1 Descriptive table of all variables

	Men (Obs[a] = 15,190)				Women (Obs = 16,284)			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Self-rated health	2.76	0.75	1.00	4.00	2.63	0.76	1.00	4.00
Single	0.06	0.23	0.00	1.00	0.02	0.14	0.00	1.00
Married	0.91	0.29	0.00	1.00	0.87	0.33	0.00	1.00
Widowed	0.04	0.19	0.00	1.00	0.11	0.31	0.00	1.00
Age[b]	21.52	13.90	− 8.73	64.16	22.03	13.88	− 8.93	73.83
Age squared	6.56	6.93	0.00	41.17	6.78	7.35	0.00	54.51
Stature (cm)[c]	7.07	6.29	− 19.80	28.00	− 3.90	6.14	− 31.70	19.00
Highest level of education (primary school and below as reference)								
Primary school and below	35.15				57.03			
Upper middle or vocational school	36.93				26.17			
College and above	27.92				16.80			
Employed	0.78	0.42	0.00	1.00	0.64	0.48	0.00	1.00
Household income per capita	8.15	1.00	1.60	12.35	8.14	1.01	0.75	12.35
Urbanization[d]	0.10	19.52	− 37.50	46.17	0.56	19.40	− 37.50	46.17

[a]Obs represents person-times observations

[b]Age centered at age 22 for men and 20 for women

[c]Stature centered at 160 cm.

[d]Urbanization centered at mean

attenuate or even disappear. Thus, without properly controlling for unobserved heterogeneity, the results may overstate the health benefits of marriage.

There are two reasons that my estimation using a fixed-effects model is likely to be conservative. As mentioned earlier, there is measurement error due to reporting heterogeneity for self-rated health. By focusing on within-person variations, a fixed-effects model may exacerbate measurement error, thus reducing the likelihood of finding statistical significance (Griliches 1979). Second, the sample size for different marital statuses is relatively small. Thus focusing on within-person variation may reduce the statistical power of the results.

Results

Descriptive Analysis

Table 1 displays the descriptive statistics for all variables included in the analysis by gender. The men, on average, reported better health than the women. About 9% of the men and 7% of the women in the sample were single. The proportion widowed was substantially different between men and women. The proportion of widowed women was about three times higher than widowed men, reflecting the fact that women in China have a longer life expectancy.

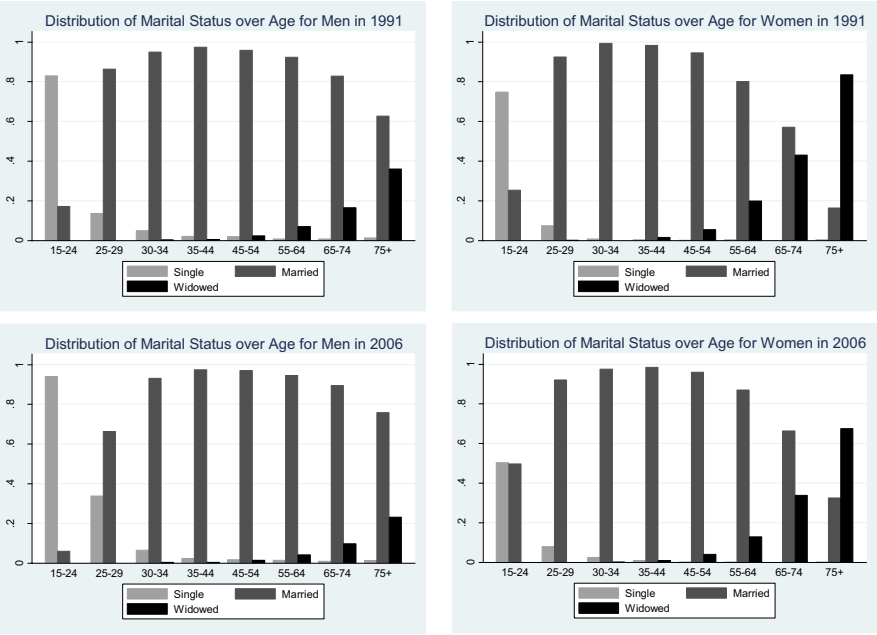


Fig. 2 Distribution of marital status by gender and age groups in 1991 and 2006

Table 2 Frequency of marital transition by gender and residence between 1991 and 2006

	Female		Male	
	Urban	Rural	Urban	Rural
Continuously single	298	458	385	824
Single to married	58	50	127	311
Continuously married	4,766	10,775	4,621	10,170
Married to widowed	159	326	51	138
Continuously widowed	507	1,056	100	327

The distribution of marital status by gender and age group in 1991 and 2006 is displayed in Fig. 2, which shows clear marriage patterns by gender over age. About 82.6% of the men and 66.3% of the women were single between the ages of 15 and 24, but for the 30–34 age group the proportion was a mere 5% for men and less than 2% for women in 1991. After age 35, almost all were married. Additionally, the proportion widowed increased with age. About 2.14% of the men in the 45–54 age group were widowed, and this figure rapidly rose to 5.12% for the 55–64 age group. For those 75 and above, 25.5% of the men and 70.6% of the women were widowed.

Moreover, the number of transitions from single to married was 438 for men and 108 for women, and the number of transitions from married to widowed was 189 for men and 485 for women between 1991 and 2006 (Table 2). Overall, we can see

two clear gender and age patterns regarding marital status. First, getting married is still normative in China, and most men and women in the sample had completed this social role transition before age 29, and only a small proportion of people aged 35 and above remained single. Second, the differences in the prevalence of widowhood between men and women were trivial at the earlier life stages, but these differences rapidly grew over age. This is consistent with the gender pattern in other countries.

Multivariate Analysis

Table 3 displays the marriage–health relationship by gender and residence as determined with OLS regression with a lagged dependent variable. For urban and rural female, in the OLS regression models without controlling for baseline health status (Model 1a and 2a), the health differences are insignificant for urban women, but significant for rural women at the $p < 0.01$ level. This finding is also applicable to men, showing that health differences between single and married for urban men is trivial, but significant for rural men (Model 3a and 4a). This finding is consistent with prior research in China (Das Gupta et al. 2010) which found that being single is related to poor self-rated health among men. Models 1b and 2b added prior health at baseline survey to test for the presence of selection on prior health condition for women. As expected, prior health status is a strong predictor of subsequent health status. The results are similar to the findings from Models 2a and 2b, suggesting that selection on prior health conditions does not explain the health gaps between single and married rural women. With regard to men, prior health condition is incorporated in Models 3b and 4b. The results for urban men remain unchanged, while the health gaps between rural single and married men decreased by about 25%, implying the presence of positive health selection, i.e., healthy men are more likely to get married. This finding supports hypothesis 2, which states that marital selection explains the health differences between single and married, particularly for men. However, health selection does not fully explain the health differences between single and married men in rural areas. Moreover, the findings in Table 3 also partially support hypothesis 5, which states that being married is healthier than being unmarried among the rural population, but not among the urban population. Nonetheless, there are no substantial differences between married and widowed for all subgroups.

In Table 3, I mainly consider whether the health benefits of marriage can be explained by the influence of selection on baseline health status. In Table 4 fixed-effects models are applied to further examine whether the observed health differences are due to selection on unobserved time-invariant factors. The coefficient of rural single women changed from − 0.094 in Model 2b in Table 3 to − 0.014 in Model 1b in Table 4 and was no longer statistically significant. Similarly, the coefficients of rural single men are also insignificant with the FE estimations (Model 2b). The disappearance of the health disadvantage among singles in rural areas suggests that, instead of marital protection, time-invariant variables that were not included in the models, e.g., personality, explain the health differences between single and married among the rural population. Although the LDV estimation supports hypothesis 2, which states that selection on baseline health status explains a significant

Table 3 OLS regression with lagged dependent variable estimation of self-rated health with marital status by gender and residence

	Urban Women		Rural women		Urban men		Rural men	
	1a	1b	2a	2b	3a	3b	4a	4b
Current marital status (married as reference)								
Single	− 0.052	− 0.035	− 0.096**	− 0.094***	0.011	0.010	− 0.077**	− 0.058**
	(0.043)	(0.031)	(0.030)	(0.022)	(0.038)	(0.030)	(0.026)	(0.022)
Widowed	0.006	0.005	0.030	0.025	0.073	− 0.015	0.050	0.052
	(0.038)	(0.034)	(0.027)	(0.025)	(0.076)	(0.068)	(0.040)	(0.034)
Baseline self-rated health		0.408***		0.348***		0.430***		0.341***
		(0.014)		(0.009)		(0.013)		(0.009)
Age	− 0.019***	− 0.014***	− 0.020***	− 0.016***	− 0.014***	− 0.010***	− 0.015***	− 0.011***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.003)	(0.002)	(0.002)	(0.002)
Age squared	0.013**	0.011**	0.006*	0.006*	0.005	0.005	0.001	− 0.000
	(0.004)	(0.004)	(0.003)	(0.003)	(0.005)	(0.004)	(0.003)	(0.003)
Employed	0.067**	0.061**	0.078***	0.058***	0.111***	0.096***	0.152***	0.108***
	(0.021)	(0.019)	(0.016)	(0.015)	(0.027)	(0.024)	(0.021)	(0.020)
Household income per capita	0.030**	0.024**	0.026***	0.011 +	0.034**	0.030**	0.037***	0.023***
	(0.010)	(0.009)	(0.006)	(0.006)	(0.011)	(0.010)	(0.007)	(0.006)
Urbanization	− 0.002**	− 0.002***	0.001***	0.001*	− 0.001	− 0.001*	0.001***	0.001*
	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
Constant	2.768***	1.612***	2.818***	1.892***	2.720***	1.513***	2.669***	1.750***
	(0.094)	(0.087)	(0.060)	(0.060)	(0.101)	(0.096)	(0.064)	(0.064)
Person-time Observations	8,186	8,186	17,095	17,095	7,481	7,481	15,881	15,881

+ $<p<0.1$; *$p<0.05$; **$p<0.01$; ***$p<0.001$; robust standard error is presented in parenthesis; all models control for stature, highest level of education, and province dummies

Table 4 Fixed-effects estimation of self-rated health with marital status by gender and residence

	Urban women 1a	Rural women 1b	Urban men 2a	Rural men 2b
Current marital status (married as reference)				
Single	− 0.087	− 0.014	0.109	0.066 +
	(0.086)	(0.111)	(0.066)	(0.038)
Widowed	0.012	0.013	− 0.173 +	0.175**
	(0.065)	(0.042)	(0.097)	(0.061)
Age	− 0.020***	− 0.010***	− 0.015**	− 0.004
	(0.005)	(0.003)	(0.005)	(0.003)
Age squared	− 0.011	− 0.039***	− 0.017*	− 0.042***
	(0.007)	(0.005)	(0.008)	(0.005)
Employed	0.014	0.019	0.025	0.084***
	(0.026)	(0.018)	(0.031)	(0.024)
Household income per capita	0.028*	0.012	0.027*	0.019*
	(0.012)	(0.008)	(0.013)	(0.008)
Urbanization	− 0.001	0.002*	− 0.000	0.002*
	(0.002)	(0.001)	(0.002)	(0.001)
Constant	3.070***	3.227***	3.010***	3.019***
	(0.111)	(0.074)	(0.116)	(0.074)
Person-time observations	8,186	17,095	7,481	15,881
N	2,398	4,430	2,197	4,111

+ $< p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; robust standard error is presented in parenthesis

proportion of the health differences between single and married, particularly for men, the FE estimation suggests that selection on unobserved time-invariant factors explains the health differences for both men and women. This finding is also consistent with prior studies which found that the health benefits of marriage tend to attenuate or disappear once unobserved time-invariant variables are taken into account (Tumin 2018, p. 201). In addition, being widowed is associated with poorer self-rated health among urban men; however, it is only significant at a marginal level. Unexpectedly, being widowed is associated with better self-rated health among rural men. This finding implies that there might be mortality selection, in which healthier rural men are more likely to live longer than their spouses and to better cope with widowhood.

Overall, the results of the LDV estimations partially support hypothesis 1, which states that marriage confers health and displays substantial gender and residential patterns. In urban areas, there are no observed health differences between single and married for both men and women. In rural areas, married women, on average, report better health than single, and this health difference is not explained by selection on baseline health status. However, the health benefits of marriage among rural men are substantially explained by positive selection on prior health status. These findings also partially support hypothesis 5, which states that marriage is important for health among the rural population, but less so for the urban population. Nonetheless,

Table 5 OLS regression with lagged dependent variable estimation of self-rated health with marital status over age by gender and residence

	Urban women 1a	Rural women 1b	Urban men 2a	Rural men 2b
Current marital status (married as reference)				
Single	− 0.034	− 0.030	0.022	− 0.057*
	(0.035)	(0.025)	(0.034)	(0.022)
Single#age	0.001	− 0.011*	− 0.000	− 0.000
	(0.003)	(0.005)	(0.003)	(0.002)
Widowed	− 0.147	− 0.517***	− 0.749*	0.048
	(0.130)	(0.088)	(0.316)	(0.113)
Widowed#age	0.003	0.013***	0.015*	0.000
	(0.003)	(0.002)	(0.006)	(0.003)
Baseline self-rated health	0.408***	0.348***	0.428***	0.341***
	(0.014)	(0.009)	(0.013)	(0.009)
Age	− 0.013***	− 0.010***	− 0.009***	− 0.011***
	(0.002)	(0.002)	(0.002)	(0.002)
Age squared	0.009*	− 0.006*	0.002	− 0.000
	(0.004)	(0.003)	(0.004)	(0.003)
Employed	0.058**	0.055***	0.092***	0.108***
	(0.019)	(0.015)	(0.024)	(0.020)
Household income per capita	0.024**	0.010	0.029**	0.023***
	(0.009)	(0.006)	(0.010)	(0.006)
Urbanization	− 0.002***	0.001*	− 0.001*	0.001*
	(0.001)	(0.000)	(0.001)	(0.000)
Constant	1.606***	1.857***	1.514***	1.749***
	(0.087)	(0.061)	(0.096)	(0.065)
Person-time observations	8,186	17,095	7,481	15,881

+ $<p<0.1$; *$p<0.05$; **$p<0.01$; ***$p<0.001$; robust standard error is presented in parenthesis; all models control for stature, highest level of education, and province dummies

the findings from the FE estimations show that the health differences between single and married disappeared, partially supporting hypothesis 2, which states that selection on time-invariant factors, rather than marital protection, shapes the observed marriage and health relationship in rural areas.

Table 5 tests hypotheses 3 and 4 using the LDV estimation with an interaction term between marital status and age.[4] With regard to women, if the stigmatization of singlehood varies by gender and increases with age, then we would expect to see a negative sign for the interaction between single and age. Again, there is no evidence for marital differences in health over age for urban women, as shown

[4] I also tested for interaction between marital status and age squared, and for curvilinear relationship between marital status and age. However, these interaction terms were not statistically significant, and thus are not included in the final analysis.

in Model 1a, while we see that the interaction between singlehood and age is − 0.011 and significant at $p < 0.05$ for rural women, suggesting that the health of single women deteriorates at a faster pace than it does for their married counterparts in rural China (Model 1b). For men, the interaction terms between single and age are insignificant for both urban and rural men, which supports hypothesis 3, which states that older single women face greater pressure and social stigma, while older single men are more socially tolerated.

Moreover, although there are no health differences between married and widowed rural women, as shown in Model 2b in Table 3, here the results show that being widowed is associated with poorer self-rated health among rural women ($b = -0.517$, $p < 0.001$). In addition, the interaction term between marital status and age is positive and significant ($b = 0.013$, $p < 0.001$), suggesting a convergence of health between married and widowed over age. For urban men, similar to urban women, there are no health differences between single and married, and the health differences between married and widowed are similar to the pattern observed among rural women; viz., a substantial health gap between married and widowed at earlier life stages, which gradually converges over age. Among rural men, the health differences between married and widowed are insignificant and do not change over the life course. This finding partially supports hypothesis 4, which states that health differences between widowed and married are wider at a younger age, but narrower at an older age for women, but not for men, and this pattern is not only applicable to rural women, but also to urban men.

Table 6 further examines hypotheses 3 and 4 with fixed-effects models to control for unobserved time-invariant factors. Despite the fact that selection, not protection explains the health differences between single and married among rural women, this is not the case for health differences between rural married and widowed women. The coefficients of widowed and interactions between widowed and age for rural women were still significant at $p < 0.001$, even after taking into account selection on unobserved time-invariant variables, as displayed in Model 2b. However, there are no appreciable health differences between married and widowed among the other three groups. The findings from Table 6 further validate hypothesis 5, indicating that marriage matters in rural areas, but not in urban areas, particularly for women.

Overall, the results from LDV estimation suggest that singlehood is associated with worse health over age among rural women, but not for other groups. This result supports hypothesis 3, which states that the health differences between single and married are wider for older women, but not for men. Moreover, this pattern is only observed in rural areas. However, hypothesis 3 is not supported by the FE estimation. The significance of the coefficient of interaction term between single and age disappears in the FE estimation. The health differences between the married and non-married participants over the life course also suggest that there are substantial health differences between married and widowed at earlier life stages, but the differences gradually converge over age for both rural women and urban men with the LDV estimations. This pattern only remained persistent after taking into account omitted time-invariant variable bias for rural women. This finding is consistent with

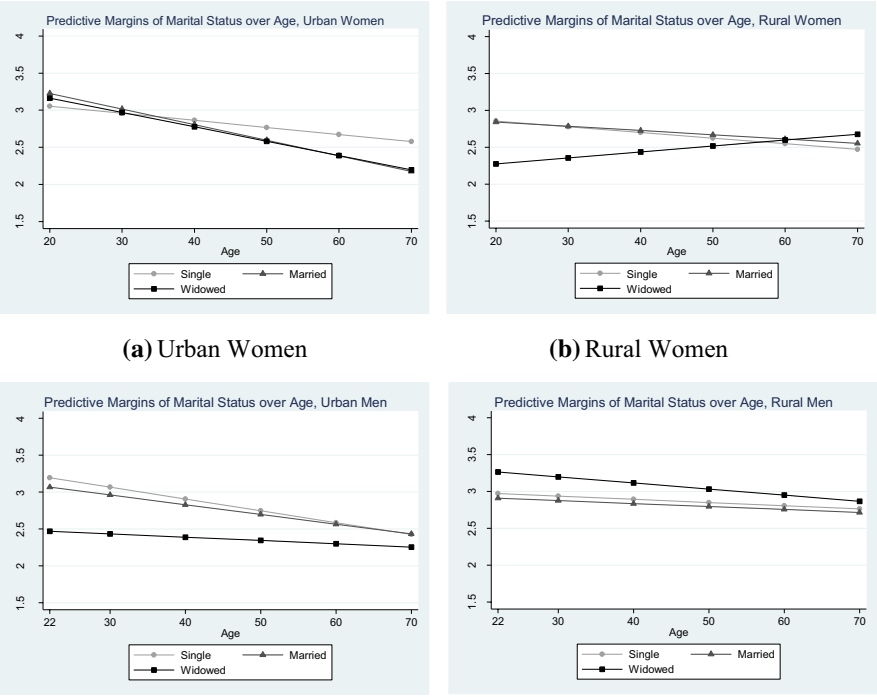
Table 6 Fixed-effects model estimation of self-rated health with marital status over age by gender and residence

	Urban women 1a	Rural women 1b	Urban men 2a	Rural men 2b
Current marital status (married as reference)				
Single	− 0.172 +	0.015	0.127 +	0.063
	(0.098)	(0.113)	(0.076)	(0.040)
Single#age	0.011 +	− 0.002	− 0.003	− 0.000
	(0.007)	(0.009)	(0.005)	(0.005)
Widowed	− 0.062	− 0.601***	− 0.628	0.351 +
	(0.221)	(0.140)	(0.387)	(0.184)
Widowed#age	0.002	0.015***	0.010	− 0.004
	(0.005)	(0.003)	(0.008)	(0.004)
Age	− 0.021***	− 0.005 +	− 0.013*	− 0.004
	(0.005)	(0.003)	(0.005)	(0.003)
Age squared	− 0.010	− 0.050***	− 0.020*	− 0.041***
	(0.008)	(0.005)	(0.008)	(0.006)
Employed	0.017	0.011	0.018	0.063***
	(0.015)	(0.026)	(0.018)	(0.019)
Household income per capita	0.018**	0.029*	0.012	0.022**
	(0.006)	(0.012)	(0.008)	(0.007)
Urbanization	0.002*	− 0.001	0.002*	0.001 +
	(0.001)	(0.002)	(0.001)	(0.001)
Constant	3.161***	3.082***	3.189***	3.011***
	(0.061)	(0.112)	(0.074)	(0.062)
Person-time observations	8,186	17,095	7,481	15,881
N	2,398	4,430	2,197	4,111

+ $<p<0.1$; *$p<0.05$; **$p<0.01$; ***$p<0.001$; robust standard error is presented in parenthesis; all models control for stature, highest level of education, employment status, logged household income per capita, urbanization, and province dummies

hypothesis 4, which states that health differences between widowed and married are wider at a younger age, but narrower at an older age for women, but not for men.

To further illustrate how the marriage–health relationship changes over age by gender and residence, I present predictive margins of marital status on self-rated health over age in Fig. 3 by using the coefficients in Table 6 and holding all other control variables constant. We first see that overall self-rated health gradually declines across different groups, except widowed women in rural areas, which is consistent with the general pattern of declining self-rated health over age as shown in Fig. 1. Among urban women, as shown in panel (a), singlehood is associated with poorer health at age 20, compared to their married counterparts. Interestingly, although hypothesis 3 predicts that the self-rated health among singles should deteriorate at a faster pace than that of their married counterparts, and that the health gaps between single and married should be wider over age, the findings in Model



(a) Urban Women **(b)** Rural Women

(c) Urban Men **(d)** Rural Men

Fig. 3 Predictive margins of marital status on sel-rated health over age by marital status, gender, and residence

1a in Table 6 shown the opposite, but this finding is only significant at a marginal level. We can also see that there is no health difference between widowed and married urban women. As shown in panel (b), there is no substantial difference between singlehood and married among women in rural areas after controlling for omitted time-invariant bias in the FE estimation. However, widowed women display a substantial health disadvantage at mid-40 relative to their married counterparts, and this health difference is gradually convergent over age. For urban men, similar to rural women, the health differences between single and married are insignificant, while we see a substantial health difference between widowed and married among urban men, as shown in panel (c). Nonetheless, this health difference is insignificant at a conventional level. For rural men, the health disadvantage, similar to rural women, disappears in FE estimation; thus, the health difference between widowed and married diminished and is no longer significant. Counterintuitively, widowed men on average report better self-rated health in the FE estimation.

Discussion and Conclusion

This study examines the marriage–health relationship by gender and over age in China as well as how these relationships are contingent on urban and rural areas. Prior studies have suggested that marriage confers health through financial security, social support, and the maintenance of a healthy lifestyle, while the health benefits of marriage attenuate or disappear if selection into marriage is controlled by a more stringent and conservative method. Apart from the methodological considerations, researchers in the USA also suggest that the diminishing health benefits of marriage can be attributed to the lessening social stigma attached to singlehood, the prevalence of cohabitation, and the blurred boundary between cohabitation and marriage, as well as the lessening prevalence of marriage among socioeconomically disadvantaged groups.

It is expected that the health benefits of marriage should be substantial in contexts like China, where early and nearly universal marriage is practiced, there is a strong social stigma attached to being older and single, and marriage remains the only widely approved union type for a long-term and stable relationship. Our findings indicate that, among urban men and women, there are no observed health differences between married and single, while the health differences between single and married in rural areas are primarily explained by selections on omitted time-invariant factors. In addition, based on life course prediction, it is expected that singlehood may suffer from a stronger social stigma and pressure along with age; thus we would expect to see the health differences between single and married increase over age, especially for women. However, this hypothesis is only supported by the LDV estimations for rural women, but not in the FE estimations. Moreover, this study also shows married women on average report better health than widows at earlier life stages, but the health differences gradually converge over age among rural women and urban men in the LDV estimations, while this pattern persists among rural women after taking into account omitted time-invariant factors.

In sum, this study shows that marital selection explains the health differences between single and married among the rural population, that martial protection contributes to the health differences between widowed and married women in rural areas, and that the health benefits are larger at earlier than at older ages. In addition, marriage mainly matters for the rural population and there are no appreciable health differences between married and unmarried among the urban population.

The findings of this study also speak to the gender pattern in the marriage–health relationship. Studies in the USA have mixed findings regarding the bereavement effect on health for men and women and show different gender patterns for blacks and whites (Elwert and Christakis 2006; Williams and Umberson 2004). The evidence from this study shows that the bereavement effects on health vary across gender and are contingent on the rural–urban divide. In urban areas, there are no appreciable health differences between widowed and married for both men and women, while in rural areas, women suffer from a strong bereavement effect if loss of spouse occurs at an early life stage; on the contrary, widowed men on average report better self-rated health. The findings from the urban population are somewhat consistent with findings from high-income and gender-egalitarian societies, but findings from

rural China show a unique pattern, which is aligned with prior research in China and India, two countries which are low- and middle-income, and have a strong patriarchal tradition (Krochalk et al. 2008; Perkins et al. 2016). This distinct gender pattern in rural China can be understood in the context of a strong patriarchal society where men enjoy high status, have more power, and possess a greater share of economic resources, all of which help them to better adjust to and recover from the loss of a spouse, while women heavily depend on their husband's status, power, and economic resources, and thus have more difficulty recovering from the loss of a spouse (Perkins et al. 2016; Sargeson 2012).

The evidence from this study also suggests that it is only among the rural population that marriage has a bearing on health. In urban areas, where marriage and family life are increasingly westernized, there are no observed health differences between married and non-married. Meanwhile, in rural areas marriage remains strongly normative and the health difference between married and non-married remains substantial. These health differences are jointly explained by both marital protection and selection, and vary by gender and at different life stages. By and large, evidence from this study also implies that the rural–urban divide in China not only relates to resource accessibility, mobility, and family life, but also has a bearing on the role of marriage in conferring health.

Furthermore, this study has considered how health benefits of marriage vary across gender and age, and how gender and age variation are contingent on the rural–urban divide in China; nonetheless, the health benefits of marriage are also possibly contingent on other factors. For example, given the dramatic social changes China has undergone over the past few decades, cohort variation in marriage and family values and structures is one possible factor shaping the health benefits of marriage. Pre-marital sex and cohabitation are more acceptable among younger cohorts than older cohorts (Yeung and Hu 2016). Younger cohorts tend to practice love marriage, by contrast to the arranged marriages common among older cohorts (Riley 1994). Moreover, men born after the implementation of the one-child policy face a highly gender-imbalanced marriage market, which would presumably further enhance the importance of socioeconomic status and other favorable characteristics for men in the marriage market (Tucker and Van Hook 2013). Meanwhile, due to the narrowing gender gap in education among younger cohorts, along with the long-standing practice of hypergamy, highly educated women also face a shortage of potential mates (Qian and Qian 2014; Zeng et al. 2014). All these cohort differences in the norms and structures of marriage and family may concurrently shape cohort variations in the marriage–health relationship and require further research.

There are two limitations in this study. First, although the fixed-effects model effectively eliminates unobserved time-invariant factors, it does not handle unobserved time-variant factors. For instance, research has shown that marital quality is a crucial predictor of health and varies over time (Robles et al. 2014; Umberson et al. 2006). In addition, marital quality in China is closely related to whether parents approve of the marriage (Pimentel 2000). It is necessary to examine the role of marital quality in shaping the marriage–health relationship, as well as whether the marriage–health relationship depends on the approval of the marriage in a context with strong parental involvement and control in the mate selection process.

Second, the validity of self-reported health has been challenged because of report heterogeneity; i.e., people with the same level of health may evaluate their health differently. Recent empirical evidence indicates that there is a substantial report heterogeneity across socioeconomic groups in China. Xu and Xie (2016) used anchoring vignettes to investigate whether there is report heterogeneity across different socioeconomic groups, and found a clear heterogeneous report bias. Nonetheless, the evidence is less clear for marital status. Relative to married people, those who are divorced or widowed do not show any report heterogeneity. Similarly, rural single people do not show any report heterogeneity, but urban single people do. In addition, my attrition analysis shows that the coefficients of single-age interaction are significantly different between samples with attrition and no-attrition for both urban men and women, indicating that older singles who are not followed up tend to be unhealthier than those who are followed up (Appendix B). Taken all together, my findings with regard to self-rated health among singles, widows, and widowers in both urban and rural areas are not subject to bias from report heterogeneity and sample attrition, but it is still necessary to interpret the self-rated health differences between single and married over age among the urban population with caution.

Despite its limitations, these analyses were designed to investigate three theoretical perspectives developed to characterize patterns in Western countries. Consistent with findings in the West, the health benefits of marriage are substantially attenuated or diminished if a fixed-effects model is applied, suggesting that selection on an omitted time-invariant variable is at play. Inconsistent with findings from the West, it was found that men tend to be vulnerable to widowhood, and being widowed at an older age is more harmful than being widowed at an earlier age. The findings from this study also suggest that rural women tend to be vulnerable to widowhood, and being widowed at an earlier age is more harmful than being widowed at an older age. However, there are no substantial differences between married and widowed among urban men and women. These findings highlight that the marriage–health relationship in China is contingent on the rural–urban divide. In urban areas, which are more westernized, the health differences between married and unmarried are negligible. Meanwhile, the role of marriage in conferring health remains important in rural areas, particularly for women.

These gender and age patterns of the marriage—health relationship deviate from the patterns seen in the West, but in ways that are understandable given the features of the Chinese marriage market and social norms. My empirical findings demonstrate how marriage, gender, and age intertwine with the rural–urban divide and shape self-rated health in different ways and directions for different groups. Future studies should account for these factors as dynamic and interactive parts and should consider population heterogeneity when aiming to explain the relationship between marriage and health, especially in low- and middle-income contexts with different gender norms and rapid change of marriage norms and behaviors.

From a comparative perspective, this work indicates that the marriage–health relationship shouldn't be expected to be identical across societies, and should be understood with reference to specific social contexts and norms. Theoretically speaking, the findings indicate that there is no single theory able to explain all observed health differences between married and non-married people. Marital protection and

marital selection work together in determining the marriage–health gradient (Lillard and Waite 1995). Moreover, these two mechanisms might work differently for men and women, as well as for those at different life stages, and are deeply shaped by local social contexts.

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Appendices

Appendix A presents the bivariate coefficients between attrition status and all variables used in the analysis with binary logistic estimation. Attrition is defined as not participating in every subsequent wave of the survey. A respondent who participated in every survey is coded as 0, and as 1 otherwise. The results show that poor health, women, lower education, employed, family with higher household income per capita, and living in a less urbanized community are associated with lower log odds of attrition than are excellent health, men, higher educated, unemployed, family with lower household income per capita, and living in a more urbanized community. With regard to marital status, both single and widowed are associated with higher log odds of attrition relative to being married.

As presented in Appendix A, the relation between attrition status and each variable has been identified, and the next step was to test whether the estimations in this study were biased because of sample attrition. Appendix B presents the attrition biased estimations used in this study. The model specifications of the LDV and FE models in Appendix B are identical with the model specification in Tables 5 and 6, respectively, apart from including an attrition status dummy and interaction terms between attrition status and all independent variables. Most of the three-way interaction terms between marital status, age, and attrition status are not statistically significant from 0, except for the single-age-attrition interaction among rural women in the LDV estimation, the single and single-age-attrition interaction among urban men, and the single-age-attrition interaction among urban women in the FE estimation. In addition, interactions between attrition status and age and age squared term are statistically significant at the $p < 0.01$ level among urban men, and are likely to be the result of migration and mortality. This analysis shows that the coefficients of main interest in this study (marital status and the interaction between marital status and age) are not biased due to sample attrition, except single-age interaction among urban women and single and single-age interaction among urban men.

Appendix A: Bivariate coefficients from binary logistic estimations of attrition status with all variables in the analysis

	Coefficients	Standard error
Self-rated health (very poor as reference)		
Poor	− 0.117**	(0.043)
Good	0.011	(0.041)
Excellent	0.020	(0.047)
Female	− 0.217***	(0.018)
Current marital status (married as reference)		
Single	2.056***	(0.059)
Widow	0.358***	(0.038)
Age	− 0.009***	(0.001)
Age squared	0.003**	(0.001)
Self-rated health (very poor as reference)		
Self-rated health at baseline (very poor as reference)		
Poor	− 0.144**	(0.054)
Good	− 0.184***	(0.052)
Excellent	− 0.172**	(0.058)
Highest level of education (primary school and below as reference)		
Upper middle or vocational school	0.190***	(0.021)
College and above	0.348***	(0.024)
Stature (cm)	0.003**	(0.001)
Employed	− 0.194***	(0.009)
Household income per capita	− 0.093***	(0.000)
Urbanization	0.006***	(0.000)
Rural (urban as residence)	− 0.343***	(0.020)
Province (Liaoning as reference)		
Heilongjiang	− 0.716***	(0.046)
Jiangsu	− 0.179***	(0.040)
Shandong	0.087*	(0.042)
Henan	0.065	(0.041)
Hubei	− 0.077 +	(0.041)
Hunan	− 0.049	(0.042)
Guangxi	0.055	(0.040)
Guizhou	− 0.064	(0.041)

$+ < p < 0.1$; $*p < 0.05$; $**p < 0.01$; $***p < 0.001$; robust standard error is presented in parenthesis

Appendix B: Comparison of results between sample with attrition and no-attrition

Model type	Urban women		Rural women		Urban men		Rural men	
	LDV	FE	LDV	FE	LDV	FE	LDV	FE
Current marital status (married as reference)								
Single	− 0.177	− 0.102	0.217*	0.220	− 0.126	− 0.153	− 0.075	0.171*
	(0.118)	(0.218)	(0.102)	(0.220)	(0.093)	(0.134)	(0.082)	(0.073)
Single#age	0.001	0.034**	− 0.030**	− 0.014	0.007	0.013	0.002	− 0.002
	(0.009)	(0.012)	(0.011)	(0.016)	(0.005)	(0.009)	(0.004)	(0.012)
Widowed	− 0.089	− 0.193	− 0.674***	− 0.886***	− 0.847	-1.407*	− 0.129	0.353
	(0.217)	(0.381)	(0.150)	(0.201)	(0.648)	(0.617)	(0.159)	(0.244)
Widowed#age	0.003	0.004	0.017***	0.022***	0.017	0.025+	0.004	− 0.002
	(0.005)	(0.009)	(0.004)	(0.005)	(0.012)	(0.014)	(0.004)	(0.006)
Age	− 0.013**	− 0.030***	− 0.010***	− 0.007	− 0.011*	− 0.036***	− 0.007*	− 0.007
	(0.004)	(0.008)	(0.003)	(0.005)	(0.005)	(0.008)	(0.003)	(0.005)
Age squared	0.006	− 0.000	− 0.012*	− 0.049***	0.005	0.012	− 0.011*	− 0.034***
	(0.008)	(0.013)	(0.005)	(0.008)	(0.008)	(0.013)	(0.006)	(0.009)
Self-rated health at baseline	0.357***	0.288***	0.114***		0.386***		0.268***	
	(0.026)	(0.013)	(0.017)		(0.028)		(0.015)	
Attrition	0.050		− 0.428***		− 0.257		− 0.448***	
	(0.176)		(0.122)		(0.209)		(0.131)	
Single *attr	0.136	− 0.031	− 0.236*	− 0.259	0.169+	0.409*	0.015	− 0.119
	(0.124)	(0.244)	(0.106)	(0.258)	(0.101)	(0.162)	(0.086)	(0.087)
Single*age*attr	0.002	− 0.032*	0.020	0.013	− 0.010	− 0.024*	− 0.002	0.000
	(0.009)	(0.014)	(0.013)	(0.019)	(0.006)	(0.011)	(0.005)	(0.014)

Model type	Urban women		Rural women		Urban men		Rural men	
	LDV	FE	LDV	FE	LDV	FE	LDV	FE
Widow*attr	− 0.062	0.259	0.293	0.496+	0.157	1.093	0.283	− 0.011
	(0.274)	(0.465)	(0.186)	(0.280)	(0.748)	(0.752)	(0.223)	(0.372)
Widow*age*attr	− 0.000	− 0.005	− 0.008+	− 0.013+	− 0.003	− 0.022	− 0.006	− 0.003
	(0.006)	(0.011)	(0.004)	(0.006)	(0.014)	(0.016)	(0.006)	(0.009)
Age*attr	0.001	0.000	0.000	0.003	0.004	0.037***	− 0.005	0.005
	(0.005)	(0.003)	(0.003)	(0.006)	(0.005)	(0.011)	(0.003)	(0.007)
Age squared*attr	0.003	0.009	0.009	− 0.001	− 0.006	− 0.054**	0.015*	− 0.013
	(0.010)	(0.006)	(0.006)	(0.011)	(0.010)	(0.017)	(0.007)	(0.012)
Self-rated health at baseline*attr	0.083**		0.114***		0.060+		0.123***	
	(0.030)		(0.017)		(0.032)		(0.019)	
Constant	1.587***	3.076***	2.048***	3.182***	1.763***	2.990***	3.013***	1.950***
	(0.150)	(0.112)	(0.095)	(0.075)	(0.184)	(0.117)	(0.074)	(0.114)
Observations	8,186	8,186	17,095	17,095	7,481	7,481	15,881	15,881
Number of id	2,398	2,398	4,430	4,430	2,197	2,197	4,111	4,111

+ $<p<0.1$; *$p<0.05$; **$p<0.01$; ***$p<0.001$; robust standard error is presented in parenthesis; all models control for stature, highest level of education, employment status, logged household income per capita, urbanization, and province dummies; and also for interaction terms between these variables and attrition status; LDV represents lagged dependent variable model; FE represents fixed-effects model

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