Remarriage after Divorce and Health in Later Life: Findings from CHARLS in China

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Remarriage after Divorce and Health in Later Life: Findings from
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Abstract:

Background: Marriage has a positive effect on health. After the dissolution of a marriage, the health of divorcees worsens. The focus of this paper is on whether remarriage can help a person regain the health benefits that comes with marriage.

Methods: This study used the national baseline data from the China Health and Retirement Longitudinal Study (CHARLS), a survey conducted from 2011 to 2012, this article applies instrumental variables to deal with the endogenous problems and to investigate the association between remarriage after divorce and late-life health.

Result: According to descriptive statistics, among the 235 middle-aged and elderly respondents with a history of divorce, 46% remarried, 75% of them thought their SRH was fair or bad, 15% of them suffered from ADL impairment and the scale score for depression averaged 9.33 ($SD=7.1$). According to the regression results, compared with divorcees who have not remarried, those who remarry suffer less from depression and have better self-rated health. There are gender differences reflected in the relationship between remarriage after divorce and mental health. Remarriage can promote the mental health of men, but there is no significant correlation between remarriage and the mental health of women.

Conclusion:

Marriage has a protective effect on health, and remarriage can help people regain the health benefits.

Key words: ADL; Depression; Self-rated health; Instrumental variable;

Remarriage after divorce;

Background

It is well known that marriage has a protective effect on health because it provides resources that are beneficial to health [1]. For example, the social, economic and psychological resources shared by married couples will provide certain protective mechanisms for physical health [2], promoting it through the supervision and mutual care associated with the married state [3]. However, the dissolution of marriage breaks the protection mechanism. This not only causes psychological trauma but also affects the physical health of divorcees, who suffer poorer mental health, higher levels of depression [4] and higher suicide rates [5]. Divorcees are more likely to have a heart attack, myocardial infarction, sudden coronary death, diabetes, etc [6].

If divorcees remarry, does their new marriage still have a protective effect on their health? Most of the research on this subject does not strictly distinguish between remarriage after widowhood and remarriage after divorce. Existing research on the health of remarried people generally compares them with people in a first marriage, the divorced, the widowed and the unmarried, but the conclusions are not entirely consistent. For example, in terms of the relationship between remarriage and depression, there is no significant difference in the degree of depression between remarried people and people married for the first time [7]. However, studies also show that remarried people are more depressed and more anxious than people married for the first time [7]. Considering different age groups, remarriage has been shown to improve the health of young people, but the improvement is not obvious for elderly people [8].

This paper uses data collected from 2011 to 2012 the China Health and Retirement Longitudinal Study (CHARLS) to investigate correlations between remarriage and the health of middle-aged and elderly people with a history of divorce. Considering the selectivity and endogenous issues between remarriage and health, instrumental variables are used to solve the endogeneity problem. We found that remarriage after a divorce has a certain protective effect on the mental health of the middle-aged and elderly.

Divorce and Remarriage in China

China has stepped into the 21st century, with the deepening of its economic reforms, improvements in the level of women's education, the aggravation of population mobility, the opening up of the institution of marriage and the simplification of legal divorce procedures. The divorce rate in China has been steadily increasing, with the crude divorce rate rising from 0.98‰ to 3.2‰ in 2016. According to the data of the National Bureau of Statistics on the demographic change of 1‰ in 2005–2014 (see Figure 1), the proportion of widowed and divorced persons is about 7%, while the highest proportion of remarried widows and divorcees is less than 2%. The proportion of the widowed and divorced population in the survey population is larger than that of the remarried population in the same period. Although the attitude of public opinion towards remarriage is becoming increasingly tolerant, the proportion of people who remarry is still relatively low.

[Insert Figure 1 about here]

Divorce and Health

One area of interest in the research on divorce and health is the relationship between divorce and healthy behaviour. The end of a marriage can lead to unhealthy behaviour [9], such as adopting habits like smoking and drinking, performing less physical activity, having a poor diet and experiencing weight loss and poor sleep [9,10,11], as well as reducing one's vegetable intake [12].

Another area of study is the relationship between divorce and health consequences. Changes to marital status have a persistently negative impact on personal wellbeing [13]. Grundy and Holt [14] found that people who were married twice or more had poor health and a higher possibility of disability in old age. Divorcees have higher rates of suicide and mental illness than those who remain married [15]. However, some studies also show that divorce offers more advantages than disadvantages to people whose marriages have been determined to be irreparable [16]. In addition, the life satisfaction of women has been shown to improve after a divorce [17].

Remarriage and Health

The relationship between remarriage and health does not strictly distinguish between remarriage after widowhood and remarriage after divorce, which may introduce some heterogeneity [18]. The conclusions reached by studies vary from country to country. In the United States remarried men had a lower risk of depression, higher life satisfaction [19] and better self-rated health (SRH) in comparison with constantly divorced or widowed men [20]. In Sweden, remarriage following divorce is not associated with a reduced risk of depression identified by pharmaceutical treatment, compared with remaining divorced [21].

The current research on the relationship between remarriage and health focuses on the following three issues.

First, it focuses on health differences between remarried people and people married for the first time. Remarriage does not provide the same health benefits as first marriage [22]. According to a comparative study of remarriage and first marriage, remarried people are more likely to suffer from chronic diseases and restrict their activities than those who are married for the first time, and there is no significant difference in their degree of depression [7]. Other studies have shown that remarried people are more depressed and more anxious than people married for the first time [23]. The remarried nevertheless still reap the emotional benefits from their subsequent marriage [23]. Remarriage provides emotional security by establishing new attachment relationships [24]. However, the benefits of remarriage were found to be short-lived, appearing only in the early stages of the remarriage transition [25].

From the perspective of the risk of death, Tucker et al. [26] found that only women who were separated and divorced were at greater risk of death; there is no difference between remarried people and people married for the first time in this respect.

The second focus is on health differences between remarried and unmarried people. Remarried persons reported fewer depressive symptoms, less distress and less alcohol use compared to persons who did not remarry after the dissolution of their marriage [25]. Remarriage is beneficial for the mental health of men relative to being

unmarried after any type of disruption [27]. Remarriage reduces the amount of alcohol consumed by men [11]. Widowed or divorced people will reduce their consumption of vegetables, but remarriage will increase people's consumption of vegetables [12] and promotes a healthy diet. Remarriage is associated with a reduction in the risk of developing chronic obstructive pulmonary disease (COPD), even after controlling for smoking habits [28], although some studies have shown that the transition from an unmarried status (including widowhood and divorce) to a married status appears to have little effect on healthy behaviour [9]. Compared with people who remain single after divorce and widowhood, remarried men will have a higher body mass index (BMI) due to reduced activity.

Other studies found that people who were divorced and widowed, even if they later remarried, had poorer SRH and higher incidences of chronic disease and activity restriction than those who never experienced marriage [29]. Zhang and Hayward [30] also found that the risk of death for remarried and never-married women did not increase, even if they controlled cardiovascular or other diseases.

The third focus is on health differences within the population of remarried people. Ganong and Coleman [31] studied the health differences between remarried men and women and found that, although remarried women complained more about their health than remarried men did, there was no significant health difference between remarried men and women. Remarrying promotes the health of young people, but in the older age group, remarried people rated themselves as less healthy [8].

Remarriage and Health in China

In China, little research has been conducted on the relationship between remarriage and health. Peng [32] found that the SRH of the remarried was worse than that of people married for the first time among elderly women. Chen and Chen [33] used data from the 2002 and 2005 Chinese Longitudinal Healthy Longevity Surveys (CLHLS) to analyse the effects of marital status on elderly people, and found that remarriage does not alleviate the negative emotions experienced by the elderly. From a functionalist perspective, remarriage can reintroduce the companionship, care and

support of a spouse [34], so remarriage is beneficial to people's health.

Methods

Data

The data used in this article are from the National Survey of the China Health and Retirement Longitudinal Study (CHARLS) conducted from 2011 to 2012. In this survey, a stratified (by per capita GDP of urban districts and rural counties), multistage (county/district, village/community, household), PPS (probability proportionate to size sampling) and random sampling strategy was adopted. With the sole exception of Tibet, all the counties and districts in China are covered in this sample. The sample contains 450 villages/residents' committees in 150 counties and districts throughout the country. As many as 17,708 people from 10,257 households containing at least one person aged 45 or above responded to the questionnaire, with a response rate of 80.51%. The questionnaire consists of eight parts, from which the information about family members, health status, personal income and household are included in our analysis. As this article focuses on middle-aged and elderly people with a history of divorce, we include 235 individuals after deleting outliers and cases with severe logical inconsistencies.

Of the 17,708 respondents to CHARLS, 235 (0.013%) were divorced. Because this is a small sample size for the purposes of this study, I have consulted the data from the National Bureau of Statistics of China, whose 2011 population change survey found that, of 956,619 respondents over 15 years old, 12,915 (0.013%) were divorced. Because the proportion of divorcees in both surveys is the same (0.013%), the CHARLS data are deemed accurate and acceptable for this study.

Instrumental Variable Method

Cross-sectional data analysis suggests that remarriage and health may have a mutually causal relationship: one's health will affect one's choice to remarry, and remarriage will, in turn, affect one's health. Perhaps there are omitted variables in our model; these often lead to endogenous problems. If the traditional OLS regression is used, the regression estimation will be biased. We therefore use the instrumental variable

method to solve the endogeneity problem.

In this paper, remarriage after divorce is the endogenous variable. To improve the estimation, the instrumental variable Z must be introduced. Z must satisfy two conditions: relevance (the instrumental variable is highly correlated with the endogenous variable) and exogeneity (the instrumental variable is uncorrelated with the error term). The instrumental variable probability model is completed in two stages. The first stage is the regression between the instrumental variable Z and the endogenous variable S :

$$S_i = \gamma_0 + \gamma_1 Z_i + \gamma_2 X_i + \varepsilon \quad (1)$$

The second stage is the regression between the interpreted variable Y^* and the fitted values ($\hat{S}_i$) of the first-stage regression:

$$Y_i^* = \beta_0 + \beta_1 S_i + \beta_2 X_i + \varepsilon_i, \quad Y_i = 1(Y_i^* > 0) \quad (2)$$

Equation (1) is regressed in the first stage, and then the fitted value $\hat{S}_i = \hat{\gamma}_0 + \hat{\gamma}_1 Z_i + \hat{\gamma}_2 X_i$ of s is obtained. In the second stage, the s in equation (2) is replaced by $\hat{S}_i$ and obtains an unbiased estimator.

Dependent Variables

Depression

The Center for Epidemiologic Studies Depression Scale (CES-D) was used to evaluate the degree of depression in the questionnaire. The CES-D profile is mainly used to measure and assess the degree of depression in middle-aged and elderly people. The scale includes a total of 10 items relating to the respondent's feelings and behaviour during the last week: "I was bothered by things that don't usually bother me"; "I had trouble keeping my mind on what I was doing"; "I felt depressed"; "I felt everything I did was an effort"; "I felt hopeful about the future"; "I felt fearful"; "My sleep was restless"; "I was happy"; "I felt lonely"; and "I could not get going". Each question offers four options: rarely or none of the time (<1 day); some or a little of the time (1–2 days); occasionally or a moderate amount of the time (3–4 days); and most or all of the time (5–7 days). For negative problems, the four options are recorded as 0,

1, 2 and 3 points respectively. For positive questions scored in reverse, they are recorded as 3, 2, 1 and 0 points. The total score ranges between 0 and 30 points, with a higher score representing a greater degree of depression.

Self-rated health (SRH). This was measured by the question: “How would you rate your health status?” There are five possible answers to this question: very good, good, fair, poor and very poor. The question was asked twice, at the beginning and at the end of the survey. This article takes the answer at the end into account, as the respondents may be clearer at that time about what “health condition” refers to. The SRH variable is treated as a binary variable, with very good and good set to 0, and fair, poor and very poor set to 1.

ADL Functional Status

ADL functional status is an index that indicates the individual functional status of middle-aged and old people when they deal with activities of daily living (ADL) on their own. According to the international standard of Katz’s ADL index, ADL functional status contains six indices: the functional statuses of eating, dressing, transferring, bathing, using the toilet and continence. In this article, respondents who have no difficulties in all six activities are classified as “ADL active,” while the others are regarded as “ADL impaired”. ADL impaired respondents were assigned the number 1, and ADL active respondents were assigned 0.

Independent Variable

The variable “Remarriage after Divorce” was obtained based on two questions: “What is your current marital status?” – which included six items: married with spouse present, or married but not living with spouse temporarily for reasons such as work, separation, divorce, widowed or never married; and “Why did your first marriage end?”, to which there were two possible answers: death of the spouse or divorce. We combined the data for these two questions. Those who were currently married but whose first marriage ended in divorce were classified as “remarriage after divorce”. These respondents were assigned a value of 1, while those who had not remarried were set to 0.

Control Variables

In this paper, we control for variables such as past life habits, characteristics of adolescence, social support and demographic characteristics.

Past life habits include whether the respondent ever smoked or drank, and whether they participated in social activities.

Characteristics of adolescence include the respondent's residence type before age 16 (0 = village, 1 = city/town) and health condition before age 15 (0 = good, 1 = fair or bad).

Demographic characteristics include age, education, personal income, whether the respondent is an agricultural worker, their household registration type (rural or urban) and the region in which they live (Eastern, Central and Western China).

Social support is measured by whether the respondent is or is not living with one of their children, and the number of their children.

Instrumental Variables

There are two instrumental variables: whether there were children (minors) at the time of the divorce, and the respondent's age at the time of the divorce. A valid instrumental variable must satisfy two conditions: relevance and exogeneity. The first condition pertains to the instrumental relevance; whether there were minors at the time of the divorce is related to remarriage. For a single mother after a divorce, the high cost of raising a child will accelerate the act of remarriage [35]. Divorced mothers are at a disadvantage in the marriage market and are less likely to remarry [36]. There is a relationship between a person's age at the time of divorce and remarriage. Childless women under the age of 25 at the time of divorce are more likely to remarry [37]. According to the 2000 census in China, Shi [38] found that the remarriage rate was highest among people aged 30–44. In other words, the younger a person is at the time of their divorce, the easier it is for them to remarry. The other condition is exogeneity. Whether there are minor children at the time of the divorce and the respondent's age at the time of the divorce are not directly related to the health of middle-aged people. In particular, there was no direct relationship between age at

the time of divorce, the presence or absence of minors at the time of divorce, and the current health of those who divorced at an early age. In the following empirical results, the two instrumental variables are tested respectively.

[Insert Table 1 about here]

Results

Descriptive Statistics Results

As shown in Table 1, among the 235 middle-aged and elderly respondents with a history of divorce, 46% remarried, 75% of them thought their SRH was fair or bad, 15% of them suffered from ADL impairment and the scale score for depression averaged 9.33 ($SD=7.1$).

Table 2 shows a series of correlations between instrumental variables and remarriage after divorce. At the time of divorce, 60% of people had children (minors), and the average age of divorce was about 36. The average age of divorce was 30 for those who remarried, and 40 for those who did not. The younger the divorcee, the easier it is for them to remarry. Among divorcees with minors, 40.14% remarried and 59.86% remained divorced. This indicates that the presence of minors affects the divorcees' re-entrance into the marriage market.

[Insert Table 2 about here]

Regression Results

Table 3 shows the regression results of the relationship between remarriage after divorce and the degree of depression. Model 1 is the result of multiple linear regression, and the results show that there is no statistically significant relationship between remarriage after divorce and degree of depression. Considering the causal relationship between remarriage and health, as well as factors such as missing variables in the measurement, the remarriage variables may be endogenous and the instrumental variables may be introduced. Model 2 uses 2sls to build the model. Model 3 uses the limited information maximum likelihood estimation to correct the variance bias of the estimator caused by weak instrumental variables. Model 4 uses the generalised moment estimation method (GMM) to estimate. Model 5 is estimated

using the iterative generalised moment estimation method (IGMM).

The results show that the people who remarried after divorce had lower degrees of depression than middle-aged and elderly people who did not remarry. From Table 2, we find that the correlation between the instrumental variables and independent variables is strong. This is because, in the first stage, the F statistic is 51, which exceeds the test standard value of 10 [39]. Second, through the endogeneity test, the P value of the test result is less than 0.05, so the explanatory variable can be considered as an endogenous variable. These also indicate the exogenous of the instrumental variables in this paper. The instrumental variable group is suitable. It is necessary to abandon the OLS model and use the results of the instrumental variable method.

[Insert Table 3 about here]

Table 4 presents the regression for the effect of remarriage after divorced on depression by males and females. Models 1 through 4 are the results of using instrumental variables. Model 1 and Model 2 are regression results of 2sls and GMM estimation used by men with divorce experience. The results show that, for men, there is a significant statistical correlation between the degree of depression and remarriage after divorce. Men who remarried after divorce were less depressed than men who did not. Model 3 and Model 4 present the regression results of women with divorce experience using 2sls and GMM estimation. The results show that, for women who have experienced divorce, remarriage after divorce is not (statistically) significantly related to the degree of depression.

[Insert Table 4 about here]

Table 5 is the regression for people who remarry after divorce on SRH. Model 1 is the regression of the probit; the result shows that remarriage after divorce is not (statistically) significantly related to SRH. Model 2 is the regression result of the first stage of the instrumental variable. Divorcees with children (minors) are less likely to remarry. The older the divorcee, the less likely they are to remarry.

Model 3 is the result of using the instrumental variables. The association between remarriage after divorce and SRH is statistically significant. Compared with

middle-aged and elderly people who were divorced, the SRH of people who remarried after divorce was likely to be better. According to Wald test of exogeneity ($p=0.03$), it is indicated that the explanatory variable (remarriage after divorce) is an endogenous variable, and the instrumental variables are appropriate. We also see (in Table 5) that women's SRH is worse than men's, so we conducted a regression of the relationship between remarriage and SRH in both groups of women and groups of men. However, there was no statistical correlation between remarriage after divorce and SRH for both men and women, and the regression results are not listed in this paper due to space constraints.

[Insert Table 5 about here]

Table 6 shows the results of regression for the impact of marriage after divorce on the ADL impaired. Model 1 is the binary probit regression model, Model 2 is the regression result of the first stage of the instrumental variable and Model 3 is the result of using the instrumental variables. According to the result of Wald test of exogeneity, the endogenous test is not passed, so the regression result of the instrumental variable method needs to be abandoned. As can be seen in Model 1, the result shows that remarriage after divorce is not (statistically) significantly related to the ADL impaired.

[Insert Table 6 about here]

Discussion

Marriage is the most important life event in the lives of many people, and has a protective effect on health. The dissolution of marriage has a varying degree of influence on emotional, physical and mental health. From the perspective of remarriage after divorce, this paper analyses the protective effect of marriage on health and solves the causal inference, the problem of bias and the problem of endogeneity through the instrumental variables method. We found that people who remarried after divorce had a low degree of depression and good SRH, but the relationship between remarriage after divorce and the ADL impaired was not significant. Remarriage after divorce has a positive effect on men's mental health, but

there is no statistically significant correlation between remarriage and the mental health of women.

We find that, with minimal gender differences, those who remarry after divorce have low degrees of depression. There is a negative correlation between marital dissolution and mental health. Divorce is a painful process in which conflicts between husband and wife can even translate into domestic violence [40, 41]. These negative behavioural and emotional experiences, as well as child-rearing issues, intertwine with each other to increase anxiety and negative emotions. However, remarriage can restore the loss of emotion and life, as well as the benefits of marital life [7]. Marriage provides intimate companionship, emotional interaction between husband and wife, mutual help in daily life, satisfaction of the individual's emotional needs and the promotion of individual happiness and satisfaction. For the middle-aged and elderly people who remarry after divorce, the social support of their spouses is particularly important. This is because people who remarry after divorce are less likely to receive more care from their children than those who have been divorced or widowed. Marriage is the main source of social support [42,43]. Spouses provide emotional support (empathy and love), device support (resources and help), information support (recommendations) and evaluation support (feedback), all of which reduce stress and depression and increase trust in intimate relationships. Although divorce can destroy or weaken social support networks, remarriage promotes mental health by regaining the social support network within a marriage.

There were gender differences in the relationship between remarriage and depression after a divorce. Men who remarried after divorce had lower levels of depression, possibly because men's daily lives become irregular after divorce and men are more likely to drink alcohol. In marital relationships, men tend to receive more day-to-day care from their wives, who manage their husbands' health-related lifestyle behaviours such as drinking, smoking, taking drugs and sleeping conditions [9][43]. At the same time, the wife will take care of her husband's daily life and manage her husband's health care, so a man who remarries receives living care, reducing his

degree of depression. There was no correlation between remarriage after divorce and depression in women. This may be because women see more of an improvement in economic life after remarriage. Unlike men, women's degree of depression is reduced by economic improvement; however, for women, the quality of marriage is more important for their satisfaction in life and the improvement of their psychological welfare [45].

Remarried people, compared with people who have been divorced, have better SRH. SRH is a comprehensive evaluation index including mental health and physical health. The SRH of respondents was better following remarriage: this may be due to spouses' emotional support, which reduces depression and makes them more inclined to a good subjective evaluation. It is also possible that the various resources and support provided by marriage for health evaluation will alleviate the negative effects of divorce and promote the tendency of remarried people to have good SRH. Couples share social support networks and social resources as well as the financial burden of the family [45]; marriage also increases personal wealth [46] and reduces the risk of personal exposure to death. At the same time, marriage increases access to health care, with spouses providing each other with health knowledge and monitoring unhealthy behaviour (alcoholism, smoking, substance abuse, etc.).

We find no correlation between remarriage and ADL impairment. Although remarriage has a certain protective effect on health, there may be a problem of selectivity. Unhealthy people are less likely to enter the remarriage market, and healthy people are more likely to remarry [47]. Although remarried people may suffer from being ADL impaired, those who are able to enter a second marriage may be in better health, which may offset the relationship between remarriage and ADL impairment.

Limitations

There are some limitations to our study. First, the small sample size may affect the stability of the research results. Second, although the use of the instrumental variable partly solves the endogeneity of the variable, the selectivity is not well solved because

the health variable we used was based on the current health condition of the individuals surveyed and their health status at the time of divorce is unknown. We are therefore unable to test whether people who are healthy are more likely to choose to remarry. Third, due to limited data, it was impossible to obtain data on variables such as personality characteristics, marital quality and reasons for divorce. These factors are important and will be further analysed in future research.

Conclusion

Marriage has a protective effect on health. Remarriage after divorce is benefits for health in later life, and remarriage can help middle-aged and elderly people regain the health benefits.

Abbreviations

ADL- activities of daily living; **CHARLS**-China Health and Retirement Longitudinal Study; **SRH**-self-rated health; **COPD**- chronic obstructive pulmonary disease; **BMI**- body mass index; **CLHLS** - Chinese Longitudinal Healthy Longevity Surveys; **GDP**- Gross Domestic Product; **PPS**- probability proportionate to size sampling; **OLS**- ordinary least squares; **CES-D** -Center for Epidemiologic Studies Depression Scale; **GMM** - the generalised moment estimation method; **IGMM** -the iterative generalised moment estimation method.

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Author's contributions

XL conceived the idea, performed statistical analysis, interpreted the results and drafted the manuscript. QJ revised the conceptualized idea, advised on methodology of analysis, assisted in result interpretation, and critically reviewed the manuscript. TG and XC advised on methodology of analysis, assisted in result interpretation. All authors have read and approved the final manuscript.

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the study.

Availability of data and materials

The dataset used for analysis and reaching the conclusions of this study is available

online (<http://charls.pku.edu.cn/zh-CN/page/data/2015-charls-wave4>).

They are released upon request subject to approval.

Ethics approval and consents to participate

All procedures performed in CHARLS involving human participants were in accordance with the ethical standards of Biomedical Ethics Committee of Peking University. All participants provided written informed consent.

Consent for publication

Not applicable

Competing interest

The authors declare that they have no competing interest

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Figure 1 The proportion of widowed, divorced and remarriage,2005-2017(2015-2017 sample data on remarriage data not announced)

Source: website of the National Bureau of Statistics

<http://data.stats.gov.cn/easyquery.htm?cn=C01>

Table1. Definition and Descriptive Statistics of Variables

Variables	Definition and measurement	Mean/%	Std.Dev.
The score of depression	0-30	9.33	7.08
ADL Impaired	0=ADL active 1=ADL Impaired	15%	
Self-rated health	0=good 1=fair and poor health	75%	.
Marital status	0= divorced 1=remarried	46%	
Minor children in divorce	0=no 1=yes	60%	
Age at divorce	17-65	35.98	10.20
Life habits			
Drinking	0=no 1=yes	41%	
Smoking	0=no 1=yes	48%	
Participate in social activities	0=no 1=yes	55%	
Characteristics in adolescence			
Residence before 16 years old	0=village 1=city/town	30%	
Health during childhood up to and including 15	0=good 1=fair and poor health	29%	
Social support			
Living with child	0=no 1=yes	52%	
Number of children	0-10	2.22	1.53
Demographic variables			
Gender	0=male 1=female	40%	
Household registration type	0=rural 1=urban	43%	
Age	45--87	57.55	9.87
Education	0=illiterate 1=primary school 2=junior middle school 3=senior high school or above	12% 39% 26% 23%	
Work	0=other 1=Engaged in agricultural work	37%	
Region	0=Eastern region 1=Central region 2=Western region	36% 33%	
Personal income (ln+1)	0-11.61	4.29	4.69

Table2. The relation between the instrumental variable and independent variable

	Divorced	Remarried	P
Age at divorce (mean)	40.69	30.54	0.000
No minor children n (%)	41 (44.09%)	52 (55.91%)	
Have minor children n (%)	85 (59.86%)	57 (40.14%)	0.018

Table3 Regression for Remarried after Divorce on Depression

	Model 1 Ols	Model 2 2sls	Model3 lmile	Model 4 gmm	Model5 igmm
Remarried	-0.500 (-0.51)	-3.894** (-2.08)	-3.990** (-2.11)	-3.501* (-1.94)	-3.475* (-1.93)
Demographic variables					
Household registration type	-0.465 (-0.28)	-0.632 (-0.39)	-0.637 (-0.39)	-0.645 (-0.39)	-0.647 (-0.39)
Age	0.0833 (1.52)	0.0840 (1.56)	0.0841 (1.56)	0.0815 (1.43)	0.0814 (1.43)
Gender	0.352 (0.28)	0.605 (0.48)	0.613 (0.49)	0.478 (0.38)	0.458 (0.37)
Education					
Primary school	-1.075 (-0.68)	-0.705 (-0.45)	-0.695 (-0.44)	-0.807 (-0.47)	-0.825 (-0.48)
Junior middle school	-2.525 (-1.35)	-2.170 (-1.17)	-2.160 (-1.17)	-2.084 (-1.06)	-2.093 (-1.07)
Senior high school and above	-5.012* (-2.45)	-4.975* (-2.47)	-4.973* (-2.47)	-4.900* (-2.38)	-4.922* (-2.39)
Work	-1.186 (-1.00)	-0.817 (-0.69)	-0.807 (-0.68)	-0.814 (-0.63)	-0.800 (-0.62)
Personal income	-0.156 (-1.36)	-0.143 (-1.26)	-0.142 (-1.26)	-0.139 (-1.29)	-0.139 (-1.29)
Characteristic in adolescence					
Residence before 16 years old	-1.433 (-0.92)	-1.860 (-1.20)	-1.872 (-1.20)	-1.751 (-1.24)	-1.725 (-1.22)
Health during childhood up to and including 15	1.368 (1.37)	1.313 (1.34)	1.312 (1.33)	1.340 (1.32)	1.332 (1.32)
Life habits					
Drinking	0.720 (0.69)	1.126 (1.08)	1.137 (1.09)	0.930 (0.90)	0.921 (0.89)
Smoking	-1.781 (-1.55)	-1.884* (-1.67)	-1.887* (-1.67)	-1.880* (-1.70)	-1.888* (-1.71)
Participate in social activities	0.349 (0.37)	0.748 (0.78)	0.759 (0.79)	0.628 (0.62)	0.619 (0.61)
Social support					
Living with child	-0.533 (-0.55)	-0.375 (-0.39)	-0.371 (-0.39)	-0.228 (-0.24)	-0.222 (-0.23)
Number of children	-0.360 (-1.02)	-0.0986 (-0.27)	-0.0911 (-0.25)	-0.109 (-0.30)	-0.109 (-0.29)
Region					
Central region	0.936 (0.77)	1.145 (0.95)	1.151 (0.95)	1.094 (0.87)	1.084 (0.86)
Western region	-0.0441 (-0.04)	0.223 (0.18)	0.231 (0.19)	0.313 (0.27)	0.309 (0.26)
_cons	9.301** (2.19)	9.342** (2.23)	9.344** (2.23)	9.305** (2.06)	9.319** (2.06)
Over identification test		1.623	1.622	1.991	2.029
First-stage F		39.992	39.992	46.171	46.171
Shea's partial R-squared		0.27	0.27	0.27	0.27
Minimum eigenvalue statistic		39.992	39.992	39.992	39.992
10% critical values		19.93	19.93	19.93	19.93
Test of endogeneity		4.45**		3.902**	3.902**
N	235	235	235	235	235

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Table4. The Regression for Remarried after Divorce on Depression by Male and Female

	male		Female	
	Model1 2sls	Model2 gmm	Model 3 2sls	Model4 gmm
Remarried	-4.062* (-1.92)	-3.645* (-1.68)	-0.507 (-0.17)	-0.636 (-0.20)
Demographic variables				
Household registration type	-2.173 (-1.09)	-2.024 (-1.16)	1.967 (0.73)	1.171 (0.38)
Age	0.0872 (1.26)	0.0865 (1.28)	0.181* (1.93)	0.185* (1.76)
Education				
Primary school	0.665 (0.29)	0.497 (0.22)	-2.183 (-1.04)	-1.772 (-0.79)
Junior middle school	-0.297 (-0.12)	-0.292 (-0.12)	-3.709 (-1.33)	-2.658 (-0.97)
Senior high school and above	-3.309 (-1.18)	-3.405 (-1.29)	-5.859* (-1.84)	-4.916 (-1.57)
Work	-1.084 (-0.79)	-1.136 (-0.80)	-0.948 (-0.45)	-1.281 (-0.56)
Personal income	-0.0889 (-0.65)	-0.0860 (-0.65)	-0.280 (-1.44)	-0.320* (-1.74)
Characteristic in adolescence				
Residence before 16 years old	-0.805 (-0.40)	-0.937 (-0.54)	-2.883 (-1.23)	-2.751 (-1.17)
Health during childhood up to and including 15	2.893** (2.29)	2.954** (2.19)	-1.075 (-0.73)	-1.150 (-0.73)
Life habits				
Drinking	1.362 (1.10)	1.235 (0.96)	1.920 (1.06)	1.721 (1.02)
Smoking	-2.941** (-2.25)	-2.835** (-2.26)	0.855 (0.40)	0.766 (0.40)
Participate in social activities	1.139 (0.95)	1.140 (0.91)	-0.281 (-0.19)	-0.256 (-0.16)
Social support				
Living with child	-1.492 (-1.25)	-1.392 (-1.15)	1.445 (0.98)	1.822 (1.30)
Number of children	-0.329 (-0.69)	-0.373 (-0.85)	-0.224 (-0.39)	-0.227 (-0.38)
Region				
Central region	1.666 (1.00)	1.572 (0.85)	0.439 (0.26)	0.470 (0.28)
Western region	2.419 (1.46)	2.467 (1.42)	-2.331 (-1.23)	-2.280 (-1.36)
_cons	7.942 (1.48)	7.837 (1.41)	4.655 (0.68)	4.152 (0.60)
N	140	140	95	95
Over identification test	0.521	0.948	/	/
First-stage F	29.276	31.748	/	/
Shea's partial R-squared	0.326	0.326	/	/
Minimum eigenvalue statistic	29.276	29.276	/	/
10% critical values	19.93	19.93	/	/
Test of endogeneity	4.39**		0.02	

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Table5 The Regression for Remarried after Divorce on Self-Rated Health

	Model1 Probit	Model2 The first stage regression	Model3 Ivprobit
Remarried	Coef. 0.0134 (0.06)	Coef	Coef. -0.713* (-1.87)
Demographic variables			
Household registration type	0.00597 (0.02)	-0.0456 (-0.49)	-0.0167 (-0.05)
Age	0.0159 (1.31)	-0.00195 (-0.61)	0.0157 (1.32)
Gender	0.563** (2.12)	0.0487 (0.68)	0.587** (2.26)
Education			
Primary school	-0.219 (-0.56)	0.0181 (0.20)	-0.147 (-0.39)
Junior middle school	-0.512 (-1.18)	0.0875 (0.83)	-0.453 (-1.08)
Senior high school and above	-0.666 (-1.42)	-0.0105 (-0.09)	-0.681 (-1.50)
Work	-0.456* (-1.71)	0.103 (1.55)	-0.382 (-1.45)
Personal income	-0.0147 (-0.62)	0.00891 (1.37)	-0.0110 (-0.48)
Characteristic in adolescence			
Residence before 16 years old	-0.132 (-0.40)	0.0226 (0.25)	-0.229 (-0.71)
Health during childhood up to and including 15	0.455** (2.02)	-0.0483 (-0.86)	0.438** (1.98)
Life habits			
Drinking	0.0727 (0.34)	0.149* (2.56)	0.150 (0.71)
Smoking	0.0892 (0.37)	-0.0879 (-1.35)	0.0643 (0.28)
Participate in social activities	-0.0842 (-0.41)	0.101 (1.91)	0.00814 (0.04)
Social support			
Living with child	0.321 (1.53)	0.0427 (0.78)	0.350* (1.71)
Number of children	-0.00984 (-0.12)	0.0989*** (5.03)	0.0438 (0.54)
Region			
Central region	0.00841 (0.03)	0.0306 (0.44)	0.0726 (0.29)
Western region	0.231 (0.87)	0.0140 (0.20)	0.277 (1.09)
Instrumental variable			
Minor children in divorce		-0.211*** (-3.90)	
Age at divorce		-0.0227*** (-8.60)	
_cons	-0.115 (-0.12)	1.090*** (4.08)	-0.0912 (-0.10)
athrho			0.390* (2.08)
Insigma			-0.960*** (-20.81)
Wald test of exogeneity			4.31**
N	235		235

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Table6 The Regression for Remarried after Divorce on ADL Impaired

	Model 1 Probit	Model2 The first stage regression	Model3 Ivprobit
	Coef.	Coef.	Coef.
Remarried	0.301 (1.25)		0.643 (1.53)
Demographic variables			
Household registration type	-0.226 (-0.53)	-0.0467 (-0.50)	-0.218 (-0.52)
Age	0.0233 (1.81)	-0.00180 (-0.56)	0.0229 (1.79)
Gender	0.0635 (0.19)	0.0486 (0.68)	0.0577 (0.18)
Education			
Primary school	-0.374 (-1.13)	0.0184 (0.21)	-0.403 (-1.22)
Junior middle school	-0.323 (-0.78)	0.0885 (0.84)	-0.348 (-0.84)
Senior high school and above	-1.311* (-2.23)	-0.00894 (-0.08)	-1.274* (-2.17)
Work	-0.00759 (-0.03)	0.103 (1.55)	-0.0569 (-0.20)
Personal income	-0.0290 (-0.95)	0.00882 (1.36)	-0.0292 (-0.96)
Characteristic in adolescence			
Residence before 16 years old	0.454 (1.01)	0.0229 (0.26)	0.494 (1.11)
Health during childhood up to and including 15	-0.110 (-0.43)	-0.0475 (-0.84)	-0.113 (-0.45)
Life habits			
Drinking	0.0125 (0.05)	0.148* (2.55)	-0.0157 (-0.06)
Smoking	-0.0494 (-0.18)	-0.0872 (-1.34)	-0.0446 (-0.16)
Participate in social activities	0.127 (0.54)	0.101 (1.90)	0.0899 (0.38)
Social support			
Living with child	-0.106 (-0.45)	0.0419 (0.76)	-0.117 (-0.50)
Number of children	0.0608 (0.77)	0.0984*** (5.01)	0.0273 (0.32)
Region			
Central region	-0.0924 (-0.29)	0.0302 (0.44)	-0.100 (-0.32)
Western region	-0.0306 (-0.10)	0.0136 (0.20)	-0.0620 (-0.20)
Instrumental variables			
Minor children in divorce		-0.202*** (-3.62)	
Age at divorced		-0.0228*** (-8.68)	
_cons	-2.186* (-2.11)	1.084*** (4.05)	-2.161* (-2.09)
athrho			-0.192 (-0.96)
lnsigma			-0.960*** (-20.81)
Wald test of exogeneity			0.92
N	235	235	235

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$