The impact of retirement on quality of life and healthcare expenditure among Chinese elders

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Abstract. The impact of retirement on the quality of life and healthcare expenditure among the elderly is a crucial dimension for evaluating the effectiveness of retirement system reforms. If retirement results in a decline in quality of life or an increase in healthcare expenditure, then delaying retirement may offer multiple benefits. Conversely, the potential compensatory effects of delayed retirement may need to be reconsidered. Existing cross-national studies report inconsistent conclusions regarding these impacts. This paper used China Family Panel Studies data and adopted the Fuzzy Regression Discontinuity (FRD) non-parametric estimation method to test the effects of retirement. Our results reveal a pronounced gender divergence: retirement exerts no significant effect on men's well-being or healthcare usage, yet significantly reduces women's quality of life while increasing their healthcare expenditure. Path analysis identifies post-retirement income loss as the primary mechanism, explaining both aggregate effects and gender heterogeneity. Specifically, men maintain income stability across retirement, whereas women experience severe income contractions that directly drive well-being declines. Consequently, from this perspective, delaying retirement or retired but still working would not have a negative impact on the quality of life for the elderly. These findings provide valuable insights for assessing the potential impacts of retirement reform in China.

1 Introduction

China's population structure is shifting to an "inverted trapezoidal" shape. The huge size of the aging population and the extended life expectancy continue to expand the top of the population pyramid, and the declining working population and birth rate are narrowing to the bottom at an accelerating rate. According to the National Health Commission estimates that in the next 30 years, China's working population will decline by about 170 million, but the population aged 65 and over will rise to 380 million. At the same time, the number of newborns dropped sharply to 9.54 million in 2024, the lowest level since 1962, with the possibility to further decline. The demographic transition will directly cause two concerns, one is the gap in pension accounts, and the other is the shortage of labor. Faced with great pressure, China's

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progressive delaying retirement policy has been formally implemented on January 1, 2025.

Delaying the retirement age, which entails extending working lives and postponing the age for pension entitlement, is primarily aimed at increasing labor supply while reducing pension expenditures. However, it must be emphasized that this anticipated benefit hinges on how retirement influences both older adults' quality of life and their use of medical services. If retirement lowers quality of life and raises medical utilization, delaying retirement would yield a reinforcing, double dividend. Conversely, if retirement enhances quality of life and reduces medical use, the fiscal gains from later retirement could be partly offset.

Theory offers competing predictions: on the one hand, quality of life may rise through greater leisure and diminished work stress, and the other hand, according to social capital theory and Malthusian theory, or fall through loss of purpose and reduced income. The utilization of medical services is also affected by the time cost of medical treatment, self-reported health status and income changes. Empirical findings are equally mixed, documenting positive effects [1,2], negative effects [3,4], and inconclusive relationships [3,5]. Although the literature is extensive, the consequences of retirement are tightly intertwined with pension rules, income levels, and cultural norms, making country-specific evidence essential [6–8]. Some Chinese scholars have also studied this issue, although not many, of which the closest to this paper is Liu and Lang' analysis [9]. Building on Liu's insights, this paper focuses more sharply on quality of life and medical utilization, and it explicitly investigates the pathways through which retirement may exert its effects.

In addition, in the related discussion about retirement effect, two issues are often mentioned. First is model endogeneity. Omitted variables (such as subjective life expectancy, family environment and personality traits) and measurement errors (such as retirement identification) especially reverse causality or reciprocal causality and may cause model endogeneity. The reverse causality or reciprocal causality between retirement and health exists theoretically [10,11], i.e., retirement may influence health, and health may conversely influence the retirement decision, and in particular, unexpected health impacts may have a greater effect on the retirement decision. Endogeneity means that the causal effect of retirement on health cannot be identified by a simple contrast before and after retirement. Regression discontinuity (RD), being one of the methods to control and reduce endogeneity biases, is extensively used with fewer assumptions and this paper will use the RD framework to identify causality. The second is the instrumental variable selection. In the RD design about retirement effect, statutory retirement age is often used as an instrumental variable, but even though China has a statutory retirement age, the regulations also include special circumstances that allow early retirement and postponing retirement, and whether to retire before or after the statutory retirement age is not a matter of 0 or 1. To address this, this paper uses the fuzzy regression discontinuity (FRD) model and tests the results' robustness.

Based on the above considerations, this paper builds the FRD model and uses China Family Panel Studies (CFPS) data to test the retirement effect on elderly people's health, life satisfaction and healthcare expenditure, and further explore the main impact path and factors of improving elderly life quality. Compared with the existing literature, this study makes three primary contributions: First, we simultaneously examine retirement's impact across three interconnected dimensions—health, life satisfaction, and healthcare expenditure-thereby refining understanding of delayed retire-

ment policies' welfare implications. Second, our fuzzy regression discontinuity (FRD) design addresses endogeneity concerns arising from non-random retirement timing (e.g., early/late retirement), significantly enhancing empirical credibility. Third, our contextually grounded analysis of China's retirement landscape yields locally relevant policy insights with direct applicability to pension reform.

2 Methods

2.1 Data resource

The data comes from Chinese Family Panel Studies (CFPS, 2022). CFPS is a national, large-scale, and multidisciplinary social follow-up survey conducted by the Social Science Survey Center of Peking University, and more information about the project can be found on the Peking University https://opendata.pku.edu.cn/dataverse/CFPS website. According to the retirement system setting and research content, we select women aged 48-55 and men aged 58-65 as the study sample. This window aligns with China's statutory retirement ages, and allows for capturing both pre- and post-retirement individuals, ensuring sufficient discontinuity around the cutoff while minimizing confounding from other age-related effects. The total sample size is 11178, excluding the missing sample 1551, the remaining sample size is 9627, of which 5685 urban population as the test group, 3942 rural population as the falsification test.

2.2 Study design

As mentioned above, due to China's clear provisions on the retirement age, the retirement probability has a significant jump at the statutory retirement age, but there are also cases of early or delayed retirement, that is, the retirement probability is significantly increased at the statutory retirement age, but not jump from 0 to 1, so we adopt the fuzzy regression discontinuity (FRD) as follows:

Assume that R_i denotes whether the individual i is retired: 1 for "retired", 0 for "unretired". The outcome variable is y_i, which represents SRH, LS and HE in this paper. The effect R_i on y_i can be expressed as:

$$y_i = (1 - R_i)y_{0i} + R_i y_{1i} = y_{0i} + (y_{1i} - y_{0i})R_1 \tag{1}$$

where y_{0i} is the outcome variable of "unretired" and y_{1i} is the outcome variable of "retired", $(y_{1i} - y_{0i})$ is the difference between the two, i.e., retirement effect, and the jump is deemed as the local average treatment effect (LACE):

$$LATE = E(y_1 - y_0|x = c) = \lim_{x \downarrow c} E(y_1 \mid x) - \lim_{x \uparrow c} E(y_0 \mid x) \tag{2}$$

Where x refers calendar age and C is the statutory retirement age, corresponding to assignment variable and cutoff point in RD respectively; $\lim_{x \uparrow c}$ and $\lim_{x \downarrow c}$ refer to limits on both sides of C , and assuming the conditional expectation function is a continuous function, and its limit is equal to the function value.

Equation 2 shows that retirement probability jumps from 0 to 1 at C. In case the probability of retirement leaps from a to b and $0 < a < b < 1$, which means that retirement probability increases at the statutory retirement age but not all are retired, which is known as fuzzy regression discontinuity. Assuming :

$$\lim_{x \downarrow c} E(R|x) - \lim_{x \uparrow c} E(R|x) = b - a \neq 0$$

$$\text{LATE} \equiv E(y_1 - y_0 \mid x = c) = \frac{\lim\limits_{x \downarrow c} E(y \mid x) - \lim\limits_{x \uparrow c} E(y \mid x)}{\lim\limits_{x \downarrow c} E(R \mid x) - \lim\limits_{x \uparrow c} E(R \mid x)} \tag{3}$$

The numerator of equation 3 is RD, and the denominator denotes the jump $(b-a)$ of retirement probability at the cutoff point. In fact, RD can be deemed as an exception to FRD when $b - a = 1$ .The denominator and the numerator in equation 3 are identical in form, so the FRD can be estimated by RD replacing the outcome variable y with the retirement variable R, and corresponding to the following three models.

$$R_i = \alpha_0 + \alpha_1 E_i + \alpha_2 r_i + \alpha_3 r_i E_i + b_i X_i + \varepsilon_i \tag{4}$$

$$y_i = \beta_0 + \beta_1 E_i + \beta_2 r_i + \beta_3 r_i E_i + b_i X_i + \mu_i \tag{5}$$

$$y_i = \delta_0 + \delta_1 R_i + \delta_2 r_i + \delta_3 r_i R_i + b_i X_i + \tau_i \tag{6}$$

Model 4 and model 5 corresponds to the denominator and numerator in equation 3, and respectively signifies the effect of statutory retirement policies on retirement, the effect of statutory retirement policies on the outcome variable; model 6 corresponds to equation 3 and signifies the effect of retirement on the outcome variables.

Which y refers to outcome variables, representing SRH, LS and HE, and E_i represents the statutory retirement policy variable, the value of which is 1 if men are above the statutory retirement age of 60 and women are above the statutory retirement age of 50, otherwise the value is 0; r_i denotes the distance r_i between age and statutory retirement age, the value of which is positive if men are above the age of 60 or women are above the age of 50, otherwise the value is negative. The models are added with r_i, $r_i E_i$ or $r_i R_i$ to control the age effect, and added with the control variable X_i reflecting individual features, including gender, educational level, marital status, logarithmic income and physical exercise. In Equation (6), δ_1 reflects the effect of retirement on outcome variables, which is the main coefficient of concern herein.

3 Results

3.1 Variables and descriptive statistics

The variables included in this paper and descriptive statistics are shown in Table 1. Dependent variables included life quality (LQ) and healthcare expenditure (HE), in which LQ is reflected by SRH and LS. In the CFPS, SRH is divided into five grades from low to high: very poor, poor, medium, good and very good, and correspondingly, this paper assigns 1 to 5 points respectively, the higher the score, the better the health status. LS, similarly to SRH, as a subjective indicator reflecting a comprehensive assessment of living conditions, is also classified into five grades from very poor to very good, and is also assigned 1-5 points, and the higher the score, the higher the satisfaction. HE, using the logarithm of "all medical expenses in the past year" in CFPS as measure index.

The core explanatory variable is retirement or not. If retire, set to 1, otherwise set to 0, and to rehired or continue to work after retirement is identified as non-retirement and set to 0. The covariate variables include three categories, one is demographic

Table 1. Variable and variable description

Variable	Variable description	Men		Women	
		Mean	Std.	Mean	Std.
Dependent Variables					
SRH(self-reported health)	from 1 to 5, the higher, the better	2.601	1.035	2.502	1.067
LS(life satisfaction)	from 1 to 5, the higher, the better	3.431	1.016	3.331	1.073
HE(healthcare expenses)	logarithm of "all medical expenses"	1.985	1.399	2.173	1.401
Explanatory variables					
R (retirement)	1 for retired, 0 for otherwise	0.574	0.498	0.647	0.488
Covariate variables					
Income	Logarithm of "the total income"	6.730	2.094	5.061	2.109
Exefre (exercise frequency)	from 1 to 5, the higher, the higher	2.818	1.523	2.525	1.781
Edu (education)	from 1 to 3, the higher, the higher	1.279	0.572	1.201	0.595
Mari (marital status)	1 for having a spouse, 0 for otherwise	0.932	0.248	0.911	0.284

variables, including age, sex, education (Edu), and marital status (Mari), in which the education level is divided into three levels, and the lowest is junior high school or below, the highest is college degree or above; and marital status is classified into two categories, having a spouse or otherwise. The second is income, where the logarithm of "total income in the past year" in CFPS is used as the indicator value. When the income is 0, it is set to 1, and its logarithm is equal to 0; The third is exercise frequency (Exefre), which in CFPS includes five categories (almost every day, twice or thrice every week, twice or thrice every month, once every month, never), is assigned the values of 5-1 from high to low, the greater the value, the higher the exercise frequency. Main variables and brief description are shown in table 1.

As seen from Table 1, the means of men's SRH and LS are 2.601 and 3.413 respectively, which is greater than moderate health and moderate satisfaction of 2.5. The means of women's SRH and LS are 2.502 and 3.331 respectively, which is also close to or above the moderate level, but slightly lower than that of men. The mean of men's healthcare expenses is 1.985, which is lower than 2.173 of women. It is noteworthy that men's SRH is slightly higher than women's in this study, but in general, men's health status is lower than women's when ADL, IADLs, death rate and other objective indicators are used, which indicates that men are more prone to optimistically evaluating their health, and this conclusion can be supported by the fact that women have more healthcare expenses (2.173) than men (1.985). In the samples, the proportion of retired men is 57.4%, lower than 64.7% of women; men's average income, educational level and physical exercise frequency are higher than women's, and men's married rate is close to women, which the gender differences in indicators are consistent with reality intuition.

3.2 Model assumptions testing

Well RD design includes many assumptions and different approach choices, so we first test the model applicability, then the effect tests and the robustness tests. RD includes

three main assumptions. First, the assignment variable objectivity, i.e., individuals are not free to choose to which group they will belong; second, the continuity of covariates at the cutoff point, otherwise it is hard to tell whether the jump of the outcome variable is due to the core variable or other covariates; third, the jumping of the core variable at the cutoff point. In our study, the assignment variable is age, which comes from ID card information and cannot be selected by individuals, and its objectivity can be satisfied.

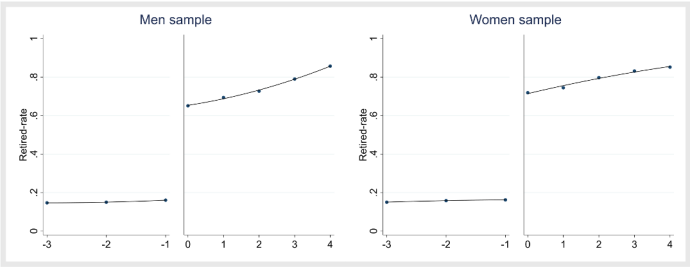
The covariate continuity test is implemented with Stata statistical software under the FRD framework, and the results are shown in Table 2. Bandwidth choice determines the samples that enter the analysis group, and, intuitively, the smaller the bandwidth, the smaller the bias, but the smaller bandwidth, the smaller the sample size may be, resulting in a larger variance, so the optimal bandwidth depends on the balance between bias and variance. In this paper, the IK method proposed by Imbens and Kalyanaraman was selected to determine the optimal bandwidth [11], and then the robustness test was performed by increasing or decreasing the optimal bandwidth. The results show that under the three bandwidths, none of the variables can reject the continuity assumption at the cutoff point, and the continuity assumption of the covariates holds.

Table 2. Variable and variable description

	Men			Women		
Variables	0.5*Optimal bandwidth	Optimal bandwidth	2*Optimal bandwidth	0.5*Optimal bandwidth	Optimal bandwidth	2*Optimal bandwidth
Income	0.674	1.575	1.296	1.083	0.193	0.296
Exefre	0.243	0.381	0.174	0.321	0.430	0.265
Edu	0.153	0.480	0.235	0.443	-0.004	0.028
Mari	0.066	0.210	0.123	0.062	-0.032	-0.101

Note. The optimal bandwidths are set according to the IK standard developed by Imbens and Kalyanaraman (2012).

Finally, the jumping of the core explanatory variable at the cutoff point is tested, that is, to judge whether the retirement rate before and after the statutory retirement age has a significant jump, and he results are shown in figure 2.



Note. The horizontal axis of refers distance (or age) to cutoff point, the dots represent the average retirement rate, and the lines represent the Quartic polynomial fitting curve.

Fig. 1. Retirement rate change with age

As shown in figure 1, the horizontal axis of refers the distance r to the statutory

retirement age c, the vertical axis is the retirement rate r and men retirement rate before the statutory retirement age (corresponding r is 0) increases slowly and reaches approximately 15%; at the statutory retirement age, a significant jump occurs and the retirement rate rises to about 65%. The women retirement rate, similarly to the men sample, slowly increases before the statutory retirement age (is 0), reaches approximately 16% and then has a significant jump rising to about 71% at the statutory retirement age.

Figure 2 shows the obvious transition of the retirement rate before and after the statutory retirement age, but the descriptive evidence cannot yet determine whether the jump comes from other noises. Therefore, it is necessary to further identify the equivalent to test the statutory retirement policy on actual retirement behavior; that is, to test significance of α_1 in equation 4 or the denominator in equation 3. The FRD estimation generally includes parameter estimation and non-parametric estimation. Since parametric estimation relies on a specific function form and its value range is difficult to determine, this paper adopts the local linear approach of non-parametric estimation and triangular kernel function, and selects the IK method to determine the optimal bandwidth by increasing or decreasing the optimal bandwidth to test robustness.

The results in table 3 show that, regardless of the optimal bandwidth or other bandwidths, the assumption of the retirement ratio continuity at the cutoff point is rejected at the 0.05 significance level, and the results with and without covariates are basically the same, and retirement policies increase the retirement ratio of men by about 40% and women by about 50%.

Table 3. Variable and variable description

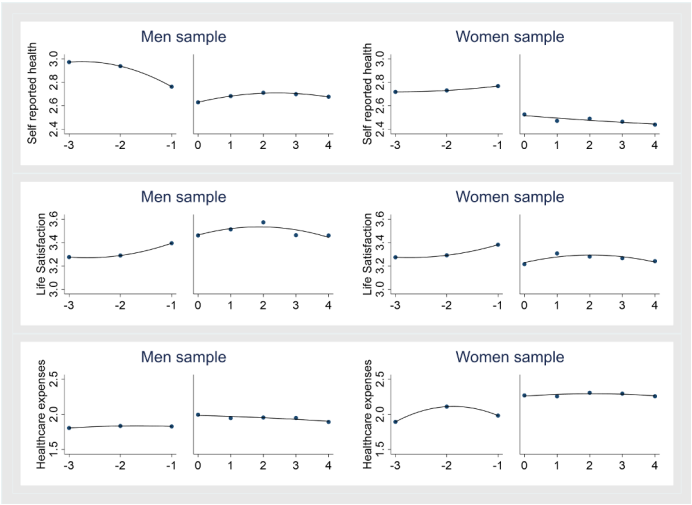
	Men sample			Women sample		
Bandwidth	0.5*Optimal	Optimal	2*Optimal	0.5*Optimal	Optimal	2*Optimal
No covariate retirement policy	-	0.392**	0.402**	0.419***	0.492***	0.476***
With covariate retirement policy	-	0.397**	0.409**	0.418***	0.492***	0.476**

Note. "-" signifies failure to identify, because the sample size is small when the bandwidth is 0.5.

3.3 Retirement effect test

Figure 2 depicts the average SRH, LS and HE, wherein the horizontal axis is r, the vertical axis is mean scores. Table 4 reports further identification results under the optimal bandwidth, in which the optimal bandwidth is determined by the IK approach.

First, analyze SRH. According to figure 2, both men's and women's SRH decline with age, but women's shows a significant jump at the cutoff point. Further identification in Table 4 shows that the retirement effect on SRH for men is insignificant (column 3), but for women declines significantly (column 6); the retirement causal effect on SRH for men is not statistically significant (column 4), but for women it significantly lowers by 0.361 (column 7), equivalent to a decline of 0.3 standard deviations. The conclusion that retirement has little effect on men's health and worsens



Note. The horizontal axis of refers distance (or age) to cutoff point; the dots represent the average score, and the lines represent the Quartic polynomial fitting curve.

Fig. 2. SRH, LS and HE changes before and after retirement

Table 4. Futher identification result

	Men sample			Women sample		
Type (1)	Bandwidth (2)	Equation 7 (3)	Equation 8 (4)	Bandwidth (5)	Equation 7 (6)	Equation 8 (7)
SRH	No covariate					
	2.209	-0.004	-0.018	2.421	-0.091**	-0.361*
	With covariate					
	2.209	-0.046	-0.204	2.421	-0.103**	-0.393*
LS	No covariate					
	2.044	0.161	0.728	2.579	-0.173	-0.687
	With covariate					
	2.044	0.201	0.897	2.579	-0.189	-0.721
HE	No covariate					
	1.954	0.145	0.653	2.097	0.121***	0.480***
	With covariate					
	1.954	0.187	0.823	2.097	0.130***	0.491***

Note. ***, ** and * represent significance levels of 0.01, 0.05 and 0.10, respectively.

women's health implies that from a health perspective, delayed retirement, especially women's retirement age, has no negative externalities.

Then analyze LS. According to figure 2, the average LS of men shows a slow upward trend with age and having no obvious jump at cutoff point. Women's LS is relatively stable, but with an obvious downward jump around the retirement threshold, and men's LS is higher than women. Further identification in Table 4 shows that for women or men, the retirement effects on LS are insignificant (columns 3 and 6) and the retirement causal effect is also insignificant (columns 4 and 7), and the results have no change after a covariate is added.

Finally, we analyze the HE. Overall, for men or women the average HE shows a slow upward trend and have no obvious upward jump at the cutoff point, but women have a larger increase, which is consistent with the conclusion that women's SRH is relatively lower. Further identification in Table 4 shows that the retirement effect on men's HE is insignificant (column 3), but women's HE increases significantly (column 6); the retirement causal effect HE for men is insignificant (column 4), but for women it increases significantly after retirement by 0.480 (column 7), equivalent to an increase of 0.34 standard deviations. The gender differences in retirement effects on HE can be explained by that fact that men assess their own health more optimistically.

3.4 Robustness test

The RD robustness test includes two reverse and forward ideas. The former mainly constructs a control group and uses the same RD framework to test, and an insignificant conclusion of the control group to prove the robustness of the treatment group. Forward ideas re-estimate by changing samples, variables or estimation methods and compare the conclusion consistency to test robustness. This paper uses a Falsification test, a Placebo test, two reverse ideas and change Kernel function forward idea for testing, as shown in Table 5.

Table 5. Robustness test

	Men sample			Women sample		
Test Type	SRH	LS	HE	SRH	LS	HE
Falsification test	-0.552	0.616	0.704	-0.131	-0.739	0.396
Placebo test	-0.637	-0.661	1.045	-0.858	0.957	1.814
Kernel function	0.244	-0.186	1.608	-0.826**	-1.001*	1.365***

Note. ***, ** and * represent significance levels of 0.01, 0.05 and 0.10, respectively.

This work used the rural population as a control group for the Falsification test, and the test logic is that, since retirement policies are mainly applicable to the urban population and the rural population has no retirement constraints, after other variables are controlled, the health, life satisfaction and healthcare expenses of the rural population ought to have no significant difference at the statutory retirement age, and the difference in urban population can be deemed as the retirement effect. The test results in row 2 show no significant difference in the SRH, LS and HE of the rural population, which conversely supports the retirement effect on the urban population.

The Placebo test tests whether retirement effect occurs at other ages. This paper reduces the statutory retirement age by 2 years, namely 48 years for women and 58 years for men and re-estimation. From the result shown in row 3, near the new statutory retirement age, SRH, LS and HE have no significant changes in both men and women, so the differences at statutory retirement age can be expressed as retirement effects, which further indicate the conclusion's robustness.

The Kernel function test, which follows the forward idea, replaces the above triangular Kernel function with a quadratic Kernel function and re-estimate. The results shown in row 4 indicate that the retirement effects on men's SHR, LS and HE are insignificant, women's SHR and LS significantly decline (0.1 significance level) and HE significantly increases, which is basically consistent with the aforesaid conclusion. The three tests support the conclusion's robustness.

3.5 Impact paths analysis

About retirement how affect, in the previous article, we summarized the three influencing paths of lifestyle, psychological state and income. Among them, the psychological state is difficult to quantify, we only discuss the other two. One is the lifestyle, it is generally believed that after retirement can have a healthier lifestyle and thus affect the quality of life, the lifestyle of this article is measured by the frequency of exercise; second, income changes, it is generally believed that income will decrease after retirement and thus affect others. Our test results based on Model 6 and optimal bandwidth are shown in table 6.

Table 6. Impact path analysis

	Men			Women		
	SRH	LS	HE	SRH	LS	HE
Exefre	0.031	0.067	-0.041	0.022*	0.091*	-0.078*
Income	0.040***	0.022*	-0.018	0.048***	0.009**	-0.005
Edu	0.055*	0.090**	-0.118**	0.033	0.073*	-0.065
Mari	0.020*	0.372***	-0.116			

Note. ***, ** and * represent significance levels of 0.01, 0.05 and 0.10, respectively.

It can be seen that income is the main impact path for men, that is to say, the income change after retirement will significantly affect the life quality of men, income increase and the life quality increases, income decline and the life quality decline. The coefficient of physical exercise is also positive but not significant, which means that after retirement, men did not improve the life quality by increasing exercise. For women, the coefficients of income and physical exercise are significant positive, which means that after retirement changes in these two ways will significantly affect women 's life quality.

Based on this, we can try to deduce the gender difference of retirement effect, because income is the main influence path, relative to women, men after retirement are more likely to maintain income stability through other means, so retirement has little effect. In addition, physical exercise is usually beneficial to health, but the effect through exercise is not significant, which may be related to the fact that the exercise frequency of men after retirement has not increased significantly. For women, increased frequency of exercise after retirement has a positive impact on life quality, but the reverse effect of reduced income is greater, so the final effect is negative. In addition, we find educational level has a significant effect on men, and higher educational level, higher life quality and less HE, but no significant effect on women. Another interesting finding is that marital status has a great impact on the life quality for both men and women, and the life quality of those with spouses has been significantly improved.

4 Discussion

This study reveals pronounced gender divergence in retirement effects among Chinese elders, a finding critical to understanding the welfare implications of delayed retirement policies. The absence of significant retirement effects on men's well-being or healthcare expenditure contrasts sharply with women's experiences: retirement

reduces their self-reported health (SRH) by 0.3 standard deviations and increases healthcare expenditure (HE) by 0.34 standard deviations. This gender heterogeneity is primarily driven by post-retirement income loss, which disproportionately affects women due to lower pre- retirement earnings and limited post-retirement income sources (Table 1). Cultural factors-such as men's optimistic health self-assessments despite higher objective morbidity-further contextualize the gender gap in HE (Section 3.1). Our limitations include reliance on subjective health metrics (SRH/LS). Future research should incorporate objective health indicators and explore psychological pathways (e.g., loss of social role).

5 Conclusions

Three primary conclusions emerge: 1) Gender-Specific Effects: Retirement significantly reduces women's quality of life (SRH and LS) and increases their healthcare expenditure but has no statistically discernible impact on men. 2) Primary Mechanism: Post-retirement income loss is the dominant pathway, explaining both the overall negative effects and gender heterogeneity (women experience severe income contractions; men maintain stability). 3) Moderating Factors: Physical exercise improves women's well-being but cannot counteract income-driven declines, and marital status (having a spouse) and higher education consistently enhance life quality for both genders.

6 Implications

The above conclusions have some policy implications: 1) Gender-Targeted Retirement Reforms:Address women's disproportionate income loss by gradually aligning female retirement ages with males and enhancing pension equity. 2) Promote flexible 'bridge employment' (e.g., part-time roles) to mitigate income shocks, particularly for low-income women. 3) Health and Social Support: Scale up community-based exercise programs (e.g., subsidized gym access) to amplify physical activity benefits for women. Leverage the 'spouse effect' by integrating family-centric elderly care (e.g., couples-based social activities) into aging policies. 4) Systemic Adjustments: Invest in lifelong learning to enhance older adults' employability, given education's positive role in life quality.

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