Social causation, social selection, and economic selection in the health outcomes of Chinese older adults and their gender disparities

（所属领域：人口劳动与健康经济）

ABSTRACT

Background The economic selection hypothesis, which argues that the initial economic situation determines both subsequent health and economic conditions, has been drawn into the debate on causation-selection issues. This study aims to construct a path model with self-rated health and depression score of older adults as health outcomes to measure and compare the social causation forces of wealth accumulation, social selection forces of adulthood health, and economic selection forces of childhood economics, and to examine their gender disparities.

Methods Data was obtained from a sample of 19613 older adults aged 45 years or above from the 2014 life history survey and the 2015 routine follow-up survey of the China Health and Retirement Longitudinal Study. Structural equation modeling analysis was conducted employing the full information maximum likelihood estimation method.

Results The presence of social causation, social selection, and economic selection were all statistically supported. In self-rated health, social selection forces held the dominant position, while social causation forces were comparable to economic selection forces. In depression score, social selection still exhibited stronger forces than economic selection, but social causation had forces close to social selection and greater than economic selection. The forces of the three hypotheses in self-rated health did not significantly change with gender, but social causation exerted mightier forces than economic selection within the male group, unlike the female group. The forces of economic selection in depression score were greater in females than males and thus no significant differences were observed among the forces of the three hypotheses in the female group.

Conclusions Social causation, social selection, and economic selection operate simultaneously on the self-rated health and depression score of older adults. However, the force magnitudes of the three hypotheses and/or their rankings differ by health outcomes and gender.

Keywords: Social causation; Social selection; Economic selection; Gender disparities; Health outcomes; Older adults

I. Introduction

For decades, the debate over whether economic conditions influence health in a social causation pattern or health influences economic conditions in a social selection pattern has never ceased. Studies have found abundant evidence supporting both the social causation and social selection hypotheses in different countries and regions, establishing their coexistence as an indisputable consensus (Claussen et al. 2005, Lund and Cois 2018). However, the disagreement on whether social causation or social selection predominates is intensifying, with a comparable number of studies arguing for the advantages of social causation or social selection (Kröger, Pakpahan and Hoffmann 2015).

Previous studies commonly measured the forces of social causation and social selection over a brief time period by predicting the endpoint health using the starting economic conditions and predicting the endpoint economic conditions using the starting health, respectively, and then comparing their magnitudes (Holmes, Austin and Smith 2022, Jokela et al. 2009, Rutter 2003). However, for middle-aged and elderly adults (abbreviated as older adults) in the later stage of their life course, health outcomes may be influenced by health and economic conditions in prior critical periods, such as childhood and adulthood, rendering the results of a short-term study less convincing (Hoffmann, Kröger and Pakpahan 2018). Therefore, numerous researchers have begun to compare the forces of social causation and social selection in the health outcomes of older adults from a life course perspective. A considerable number of them have examined the impact of childhood economic conditions on older age health (Cui, Smith and Zhao 2020, Moody-Ayers et al. 2007, Tani et al. 2016). This causal framework highlights the cumulative nature of childhood disadvantages but does not specify the impact of health status and economic conditions in adulthood on health outcomes in older age, nor their potential mediating roles. There are also some studies comparing social causation with social selection in the transition from childhood to adulthood and from adulthood to older age by separately measuring health status and economic conditions in childhood, adulthood, and older age (Hoffmann, Kröger and Geyer 2019, Hoffmann, Kröger and Pakpahan 2018, Warren 2009). These studies emphasize the relative importance of social causation and social selection at different stages of the life course, but they place health and economic conditions on an equal footing instead of focusing on the health outcomes of older adults and overlook the path-dependence of older age health on earlier life circumstances.

In reality, better health, rather than better economic conditions, should be the primary pursuit for both older adults and researchers. Based on the consensus that social causation and social selection coexist, this study aims to develop a model

using the health outcomes in older age as the only final outcome and retracing the important indicators of health status and economic conditions in adulthood and childhood to measure and compare the forces of social causation and social selection. In addition, the recently proposed economic selection hypothesis was also included in the comparison, as it not only considers the accumulation of disadvantages but also provides the necessary material for constructing the path-dependent model.

A. *Social causation*

The social causation hypothesis posits that the economic conditions of individuals determine their health (Mossakowski 2014). Higher socioeconomic status can promote physical well-being by ensuring access to sufficient food and medical resources (Brown et al. 2004). Poor living conditions and negative self-consciousness resulting from economic hardship contribute to social stress that consistently undermines mental health (Wang et al. 2015). In addition, economic conditions are closely associated with health-related behaviors such as smoking, drinking, eating, sleeping, and substance abuse, which can further affect both physical and mental health (Pampel, Krueger and Denney 2010). Although researchers frequently use income, education, and occupation individually or in combination to assess economic conditions (Kröger, Pakpahan and Hoffmann 2015), we favor adopting wealth accumulation because it can reflect the total economic resources available to older adults and capture the cumulative effects of disadvantages or advantages in the earlier life course. On this basis, we propose:

Hypothesis 1: Older adults who have accumulated more wealth in the past tend to experience better health outcomes in older age (SC1).

B. *Social selection*

The social selection (or social drift) hypothesis assumes that individuals with better health are more capable of achieving and maintaining favorable economic conditions (Blane, Smith and Bartley 1993). Good health can lead to higher incomes because it is associated with extended working hours and greater work efficiency (Liu et al. 2008). Impaired health weakens the ability to function in interpersonal relationships, and this loss of social capital can also lower socioeconomic status (Chai, Schieman and Bierman 2020). Individuals with a favorable health status spend less on healthcare, thus decreasing the risk of wealth depletion (You and Kobayashi 2011). Since social causation cannot be ruled out when

considering social selection, economic conditions determined by social selection will affect health in the next period via social causal pathways. Furthermore, evidence suggests that health in adulthood largely predicts health outcomes in older age (Gold et al. 1995, Nishimi et al. 2021). This direct continuation of health should be attributed to the forces of social selection as well. In conclusion, health status in adulthood may have both a direct effect and an indirect effect mediated by wealth accumulation on health in older age. Given that the high degree of overlap between adulthood and the working age range makes adulthood a critical period for wealth accumulation (Gornick and Sierminska 2021), it is reasonable to suppose:

Hypothesis 2: Older adults who are healthier in adulthood tend to accumulate more wealth before older age (SS1).

Hypothesis 3: Older adults who are healthier in adulthood tend to experience better health outcomes in older age (SS2).

C. *Economic selection*

The economic selection hypothesis suggests that the health and economic conditions of individuals are all determined by the initial economic situation (Bierman et al. 2021). While both social causation and economic selection focus on the role of economic conditions, there are distinct differences between them. First, social causation assumes that economic conditions only affect subsequent health and do not limit the economic conditions to which period in the life course. Second, economic selection stresses the accumulation of disadvantages, believing that initial disadvantages often lead to subsequent disadvantages, resulting in a locked life course trajectory. Ignoring the forces of economic selection can lead to a spurious association between wealth accumulation and older age health, since both may originate from the initial economic situation. Extensive evidence points out that the economic conditions in childhood determine educational opportunities and social resources (Bradley and Corwyn 2002, von Stumm et al. 2020), as well as access to nutrition and healthcare (Ayalneh, Fetene and Lee 2017, Larson 2021). The former is crucial for achieving a favorable socioeconomic position in the future, while the latter lays the essential foundation for normal growth, development, and maintaining health from childhood to adulthood and even older age. Consequently, we propose:

Hypothesis 4: Older adults with better childhood economics tend to experience better health status in adulthood (ES1).

Hypothesis 5: Older adults with better childhood economics tend to

accumulate more wealth before older age (ES2).

Hypothesis 6: Older adults with better childhood economics tend to experience better health outcomes in older age (ES3).

The hypothetical model from a life course perspective can be constructed as illustrated in **Fig. 1**. For health outcomes, self-rated health is regarded as a comprehensive measure that reflects overall physical and mental health, unaffected by cultural differences and individual reporting styles (Hardy, Acciai and Reyes 2014). Nonetheless, individuals typically prioritize physical function when evaluating their health status (Mavaddat et al. 2011). Consequently, we included depression, a prevalent mental health problem among older adults, as a complementary outcome (Zhang et al. 2021). Additionally, we examined gender disparities for social causation, social selection, and economic selection, as both health and economic conditions are closely linked to gender (Read and Gorman 2010).

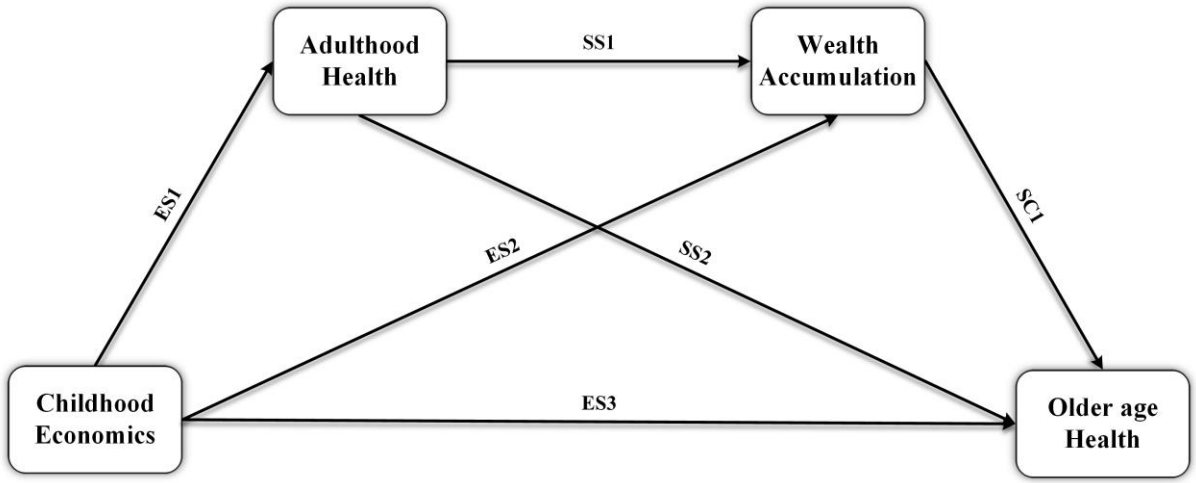

FIGURE 1. HYPOTHETICAL MODEL OF THE SOCIAL CAUSATION, SOCIAL SELECTION, AND ECONOMIC SELECTION

II. Method

A. *Data and sample*

The data were obtained from the China Health and Retirement Longitudinal Study (CHARLS), conducted by the National School of Development of Peking University. The project employed the probabilistic proportional sampling (PPS) method to randomly select 150 counties/districts from 28 provinces in China.

Over 10,000 households were surveyed in the selected 450 villages/communities, providing a high-quality representative sample of older adults aged ≥45 years nationwide. All participants provided written informed consent, and the collection of data on human subjects was approved by the Biomedical Ethics Review Committee of Peking University (IRB00001052–11015). More detailed information about CHARLS can be found elsewhere (Zhao et al. 2014).

The baseline survey of CHARLS was conducted in 2011, with follow-up visits every two to three years. This study utilized the life history data in 2014 and the routine follow-up data in 2015. The former covered the information on demographic characteristics, childhood economic conditions, and adulthood health status for the participants, while the latter covered household assets and debts, along with current physical and mental health status, providing all the analytical materials necessary for testing the hypothetical model. The 2014 dataset comprised 20,654 observations, but we only included 19,613 participants who were 45 years or older by 2015, as only the 2015 dataset provided sampling weights to adjust the representativeness of the Chinese population aged ≥45 years. In 2015, CHARLS conducted a follow-up survey with 17,828 (90.90%) of the participants. However, if we had analyzed a sample without missing values, listwise deletion would further reduce the sample size to 13,558 (69.13%), introducing potential selection bias. Therefore, we applied the approach stated in the Statistical analysis section to address missing values and survey attrition.

B. *Focal measures*

Childhood economics. We measured the childhood economics of participants by assessing the relative financial situation of their households. The following question was asked: "When you were a child before age 17, compared to the average family in the same village/community at that time, how was your family's financial situation?" The answers were (1) "A lot better off than them," (2) "Somewhat better off than them," (3) "Same as them," (4) "Somewhat worse off than them," and (5) "A lot worse off than them." We reverse-coded the responses from 1 to 5 so that higher values represent better childhood economics.

Adulthood health. Adulthood health was measured using five questions: (1) "After you were 16 years old, have you ever received a physical injury that has led to any permanent handicap, disability, or limitations in what you can do in daily life?" (2) "After you were 16 years old, because of a health condition, were you ever confined to bed or home for one month or more?" (3) "After you were 16 years old, because of a health condition, were you ever hospitalized for a month or more?" (4) "After you were 16 years old, were you ever hospitalized more than

three times within a 12-month period?" (5) "After you were 16 years old, because of a health condition, did you leave your job for one month or more?" The options for these questions were (1) "Yes" and (2) "No." We created a dummy variable for each question, where 0 demonstrated the occurrence of the health issue. The measure of adulthood health was the sum of these five variables, ranging from 0 to 5, with higher values indicating better health. Since there were only 84 observations with a value of 0, we also coded them as 1.

Wealth Accumulation. We first calculated the net value of household wealth by adding the value of (1) real estate, (2) equipment, consumption durables, and valuables, and (3) financial assets owned by the participants and their spouses, and subtracting their (4) debt (McKernan et al. 2014). This net value was then taken per capita as a measure of individual wealth accumulation, which reflects the total economic resources at the disposal of older adults. The real estate involved the house in which the participants resided and the other houses. Equipment, consumption durables, and valuables included automobiles, electric bicycles, motorcycles, refrigerators, washing machines, TVs, computers, stereo systems, video cameras, cameras, air conditioners, mobile phones, furniture, musical instruments, valuable decorations, ornaments, treasures and precious metals, antiques, valuable paintings and calligraphic works, and other artistic works, tractors, threshers, tractor tools, water pumps, processing equipment, fixed capital assets used in household production or self-employed activities, and any other durable or fixed assets worth 500 yuan or more. Financial assets consisted of cash at home, deposits in financial institutions, bonds, stocks, funds, housing provident funds, funds provided to the work unit for investment or building apartments, unpaid wages, and other payments not paid by individuals or units. Debts included credit card debts, debts owed to individuals or units, housing loans, private loans, and other loans. All fixed assets were valued at the market price at the survey time. Wealth accumulation values were converted into percentiles based on the magnitude and divided into five equal segments, encoded from 1 to 5, with higher values indicating more wealth accumulation.

Self-rated health. Overall health status was determined by a commonly employed survey question, which asked “Would you say your health is very good, good, fair, poor, or very poor?” with options (1) “Very good,” (2) “Good,” (3) “Fair,” (4) “Poor,” and (5) “Very poor.” The responses were reverse-coded from 1 to 5, with higher values meaning better health.

Depression score. Depressive symptoms were assessed using the ten-item short form of the Center for Epidemiologic Studies Depression Scale (CESD-10). The responses were categorized into four scales: (1) "Rarely or none of the time (<1 day)," (2) "Some or a little of the time (1-2 days)," (3) "Occasionally or a

moderate amount of the time (3-4 days)," and (4) "Most or all of the time (5-7 days)," and assigned values from 0 to 3 accordingly. Reverse-scored items were recoded as necessary. The depression score ranges from 0 to 30, with higher scores indicating more depressive symptoms. Previous studies have demonstrated the satisfactory validity and reliability of CESD-10 among older adults in China (Huang, Wang and Chen 2015).

C. *Control measures*

We selected variables that may affect all focal indicators simultaneously as control variables, specifically: age (years in the 2014 wave) and gender (0 = male; 1 = female), minority (ethnic groups other than Han nationality are considered minorities in China. 0 = no; 1 = yes), household registration (household registration of participants at birth. 1 = none; 2 = agricultural; 3 = non-agricultural), education level of mothers and fathers (asking for the information about biological parents and no formal education was regarded as illiterate. 0 = illiterate; 1 = non-illiterate), health state of mothers and fathers (Did your female/male guardian have a long time be sick on bed when you were young? 0 = non-sickly; 1 = sickly), number of siblings, and the relationship between parents (How would you rate the relationship your parents had with each other when you were growing up? 1 = poor; 2 = fair; 3 = good; 4 = very good; 5 = excellent).

D. *Statistical analysis*

Excluding samples due to missing values and survey attrition may introduce bias if the non-response is not random. To assess this issue, we applied Little's chi-squared test (Little 1988) to examine if the data were missing completely at random (MCAR). The results showed $P < 0.001$, indicating that the data missing mechanism was not MCAR. To reduce potential bias, we conducted structural equation modeling (SEM) analysis adopting the full information maximum likelihood (FIML) estimation method (Muthén and Muthén 2017). This method allows for the analysis of all available information from the entire sample under the assumption that the data are missing at random (MAR), resulting in unbiased and effective parameter estimates (Enders 2022). However, MAR cannot be tested for observed data, and the missing mechanism for these data may also be missing not at random (MNAR). While serious violations of the MAR assumption are uncommon (Schafer and Graham 2002), it is necessary to conduct a sensitivity analysis to examine the robustness of the results (Resseguier, Giorgi and Paoletti 2011). We utilized Markov chain Monte Carlo (MCMC) algorithms to perform multiple

imputations, generating 50 imputed datasets (Schunk 2008). The parameters for each dataset were estimated using the same model, and the estimates were subsequently combined to produce the final results (see Appendix). Minimal differences were found between the results obtained from the sensitivity and main analysis, suggesting that it is safe to incorporate information from samples with missing values.

Analyses were conducted in three stages. In the first stage, we started by measuring the total, direct, and indirect effects of social causation, social selection, and economic selection on self-rated health and depression score (step 1). Then, the differences between the total effects, direct effects, indirect effects, and critical path coefficients of the three hypotheses were calculated and statistically tested to establish the rankings for self-rated health and depression score, respectively (step 2). Finally, we statistically tested the differences in the total effects, direct effects, and indirect effects of the three hypotheses between different health outcomes, in addition to the differences in the differences calculated in step 2 between different health outcomes (step 3). In the second stage, we designated self-rated health as the outcome and repeated the measurements of the three hypotheses in the first stage for both male and female groups. After that, we conducted the same difference tests as in the first stage but the comparison condition shifted from health outcomes to gender groups. In the third stage, we reproduced the analysis procedures from the second stage but used depression score as the outcome.

We utilized sampling weights adjusted for household and individual non-response to enhance the sample representativeness of Chinese older adults aged ≥45 years. To maintain sample size improving statistical power without significantly affecting the representativeness, missing weights were replaced with a minimal value of 1. Furthermore, robust standard errors clustered at the household level were employed to obtain precise test statistics. All reported path coefficients were standardized to facilitate comparisons. Self-rated health, depression score, wealth accumulation, adulthood health, childhood economics, and the relationship between parents were treated as continuous variables. Means (standard deviations, SD) and frequencies (percentages, %) were used to describe continuous and categorical variables, respectively. Data collation was performed using Stata version 17.0, while model development and parameter estimation were performed using Mplus version 8.3. A two-tailed P value of less than 0.05 was deemed statistically significant.

III. Results

A. *Characteristics of the participants*

TABLE 1—SAMPLE DESCRIPTIVES

Characteristics	Mean/N	SD/%
Age, years (N=19613)	59.72	10.44
Gender		
Male	9494	48.41
Female	10119	51.59
Missing	0	0.00
Minority		
No	17971	91.63
Yes	1563	7.97
Missing	79	0.40
Household registration		
None	165	0.84
Agricultural	17248	87.94
Non-agricultural	1767	9.01
Missing	433	2.21
Education level of mothers		
Illiterate	16038	81.77
Non-illiterate	2452	12.50
Missing	1123	5.73
Education level of fathers		
Illiterate	10098	51.49
Non-illiterate	7722	39.37
Missing	1793	9.14
Health state of mothers		
Non-sickly	16126	82.22
Sickly	2449	12.49
Missing	1038	5.29
Health state of fathers		
Non-sickly	16611	84.69
Sickly	1524	7.77
Missing	1478	7.54
Number of siblings (N=19191)	3.84	1.87
Relationship between parents (N=17472)	3.49	1.17
Childhood economics (N=19278)	2.48	0.98
Adulthood health (N=19342)	4.39	1.06
Wealth accumulation (N=17359)	2.95	1.40
Self-rated health (N=17002)	2.58	1.08
Depression score (N=16933)	7.95	6.38

Table 1 shows the characteristics of the study population. Data from 19613 participants aged 59.72±10.44 were included for analysis. Of these, 48.41% were male, 7.97% were members of the minority, and 87.94% had an agricultural

household registration at birth. For their mothers, 81.77% were illiterate and 12.49% were sickly; while for their fathers, 51.49% were illiterate and 7.77% were sickly. They had an average of 3.84±1.87 siblings and the relationship between their parents was rated an average of 3.49±1.17. Their average childhood economics score was 2.48±0.98; adulthood health was 4.39±1.06; wealth accumulation was 2.95±1.40; self-rated health was 2.58±1.08; and depression score was 7.95±6.38.

B. *Tests of the hypothetical model*

Fig. 2 presents the results of the structural equation modeling for self-rated health and depression score. All of the hypothetical paths were supported. The shared paths SS1 = 0.035 ($P < 0.01$), ES1 = 0.059 ($P < 0.001$), and ES2 = 0.089 ($P < 0.001$). The paths leading to self-rated health were SC1 = 0.107 ($P < 0.001$), SS2 = 0.160 ($P < 0.001$), and ES3 = 0.054 ($P < 0.001$), while for depression score SC1 = –0.159 ($P < 0.001$), SS2 = –0.142 ($P < 0.001$), and ES3 = –0.082 ($P < 0.001$).

When self-rated health was the outcome, the total effects of social causation, social selection, and economic selection were 0.107 ($P < 0.001$), 0.164 ($P < 0.001$), and 0.074 ($P < 0.001$), respectively. Social selection had a greater total effect on self-rated health compared to social causation ($d = 0.057$, $P < 0.001$) and economic selection ($d = 0.090$, $P < 0.001$), whereas there was no significant difference between the total effects of social causation and economic selection. Both social selection and economic selection exhibited greater direct effects rather than indirect effects. The direct effect of social selection on self-rated health was greater than that of social causation ($d = 0.053$, $P < 0.001$) and economic selection ($d = 0.106$, $P < 0.001$), while social causation further exerted a greater direct effect than economic selection ($d = 0.053$, $P < 0.01$). Childhood economics had a greater direct impact on wealth accumulation compared to adulthood health ($d = 0.054$, $P < 0.001$), resulting in a larger indirect effect on self-rated health via wealth accumulation ($d = 0.006$, $P < 0.01$).

When examining depression score as the outcome, the total effects of social causation, social selection, and economic selection were –0.159 ($P < 0.001$), –0.148 ($P < 0.001$), and –0.105 ($P < 0.001$), respectively. In comparison to economic selection, total effects for social causation ($d = 0.054$, $P < 0.01$) and social selection ($d = 0.043$, $P < 0.01$) were significantly stronger. There was, however, no statistically significant difference between the total effects of social causation and social selection. Consistent with the findings for self-rated health, the direct effects of social selection and economic selection on depression score were greater rather than the indirect effects. Social causation ($d = 0.076$, $P < 0.001$) and

social selection (d = 0.060, P < 0.001) exhibited greater direct effects on depression score compared to economic selection, but no significant difference was observed between them. The impact of wealth accumulation on depression score was significantly stronger than that of childhood economics on adulthood health (d = 0.099, P < 0.001). Since childhood economics had a greater direct effect on wealth accumulation than adulthood health (d = 0.054, P < 0.001), its indirect effect on depression score via wealth accumulation was also significantly mightier (d = 0.009, P < 0.001).

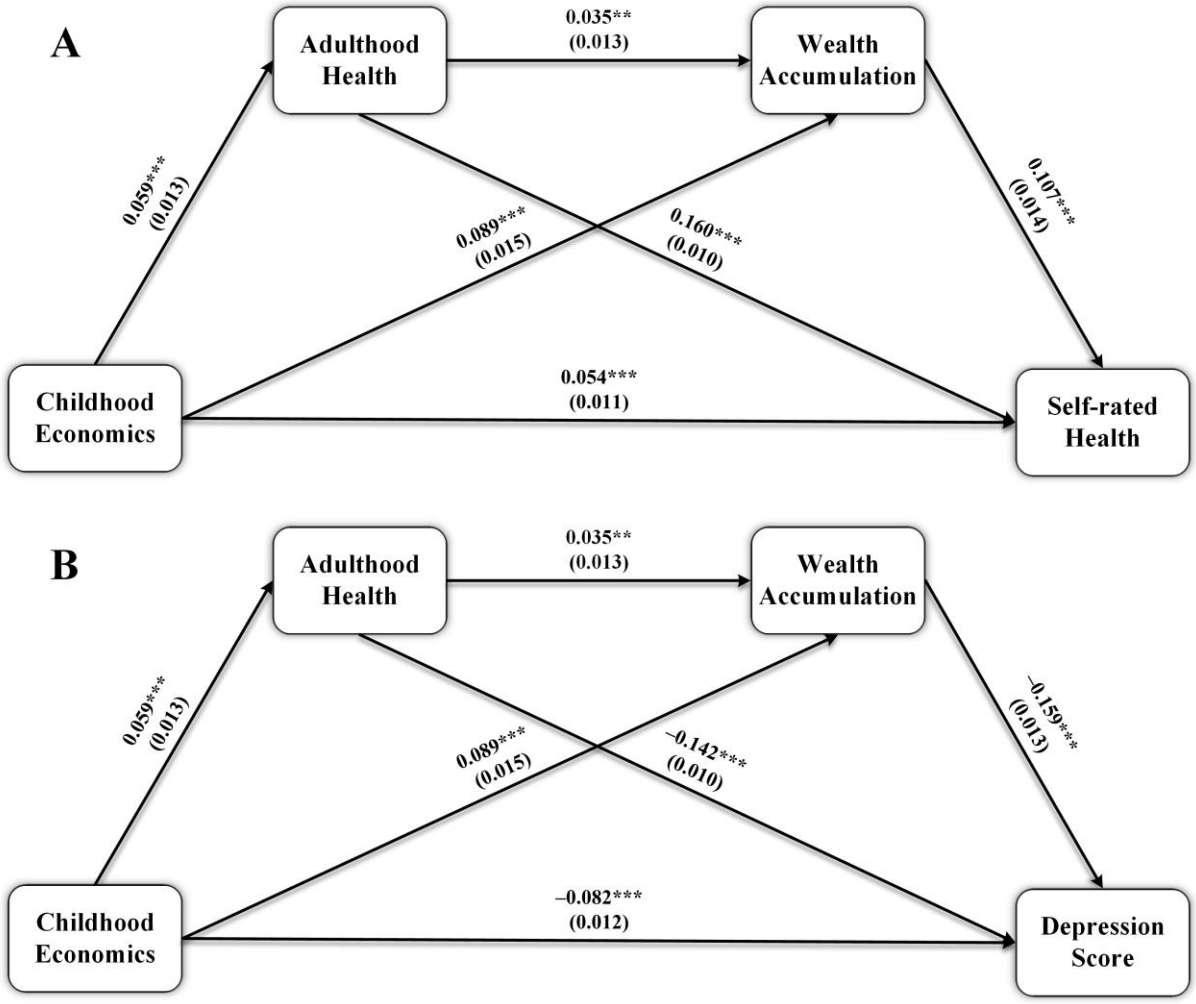

FIGURE 2. THE SEM RESULTS FOR (A) SELF-RATED HEALTH AND (B) DEPRESSION SCORE

Notes: Robust standard errors clustered at the household level are reported in parentheses. **P < 0.01, ***P < 0.001.

TABLE 2—EFFECT DECOMPOSITION AND COMPARISON OF SOCIAL CAUSATION, SOCIAL SELECTION, AND ECONOMIC SELECTION FOR SELF-RATED HEALTH AND DEPRESSION SCORE

	Self-rated health			Depression score			P value
	Estimate	S.E.	P value	Estimate	S.E.	P value	
Effect decomposition							
Social causation							
Total effect (TSC)	0.107	0.014	***	–0.159	0.013	***	***
Social selection							
Total effect (TSS)	0.164	0.010	***	–0.148	0.010	***	
Direct effect (DSS)	0.160	0.010	***	–0.142	0.010	***	
Total indirect effect (ISS)	0.004	0.002	*	–0.006	0.002	*	*
Economic selection							
Total effect (TES)	0.074	0.011	***	–0.105	0.012	***	*
Direct effect (DES)	0.054	0.011	***	–0.082	0.012	***	*
Total indirect effect (IES)	0.019	0.002	***	–0.023	0.002	***	*
ES1×SS2 (IES1)	0.010	0.002	***	–0.008	0.002	***	
ES2×SC1 (IES2)	0.010	0.002	***	–0.014	0.003	***	***
ES1×SS1×SC1 (IES3)	<0.001	<0.001	**	>–0.001	<0.001	**	*
Effect comparison							
Total effects							
|TSC| – |TSS|	–0.057	0.013	***	0.011	0.015		
|TSC| – |TES|	0.034	0.020		0.054	0.019	**	
|TSS| – |TES|	0.090	0.014	***	0.043	0.015	**	**
Direct effects							
|SC1| – |ES1|	0.048	0.025		0.099	0.023	***	***
|SC1| – |ES3|	0.053	0.020	**	0.076	0.020	***	
|SC1| – |SS2|	–0.053	0.014	***	0.016	0.016		
|ES2| – |SS1|	0.054	0.015	***	0.054	0.015	***	
|ES3| – |SS2|	–0.106	0.013	***	–0.060	0.014	***	**
Indirect effects							
|IES2| – |ISS|	0.006	0.002	**	0.009	0.002	***	**

Notes: *P < 0.05, **P < 0.01, ***P < 0.001.

The total effects of social causation (P < 0.001) and economic selection (P < 0.05) on self-rated health were weaker than on depression score, as shown in Table 2. Due to this, the difference between the total (P < 0.01) and direct effects (P < 0.01) of social selection and economic selection was more pronounced in self-rated health. Nevertheless, the difference between social causations in later (SC1) and earlier (ES1) life courses (P < 0.001), along with the difference between the indirect effects of childhood economics and adulthood health through wealth accumulation (P < 0.01), were more pronounced in depression score.

C. *Gender disparities for self-rated health*

Fig. 3 shows that the impact of adulthood health on wealth accumulation was significantly weaker for males (β = 0.012, P > 0.05) than for females (β = 0.059, P < 0.001) and the coefficient for males was not statistically significant. A distinctive characteristic of female older adults was the statistically significant indirect effects of social selection on self-rated health through wealth accumulation (β = 0.005, P < 0.05) and of economic selection on self-rated health through the consecutive mediators of adulthood health and wealth accumulation (β < 0.001, P < 0.01). The direct effect of wealth accumulation on self-rated health was significantly stronger than that of childhood economics on adulthood health (d = 0.070, P < 0.05) and self-rated health (d = 0.075, P < 0.001) in the male group.

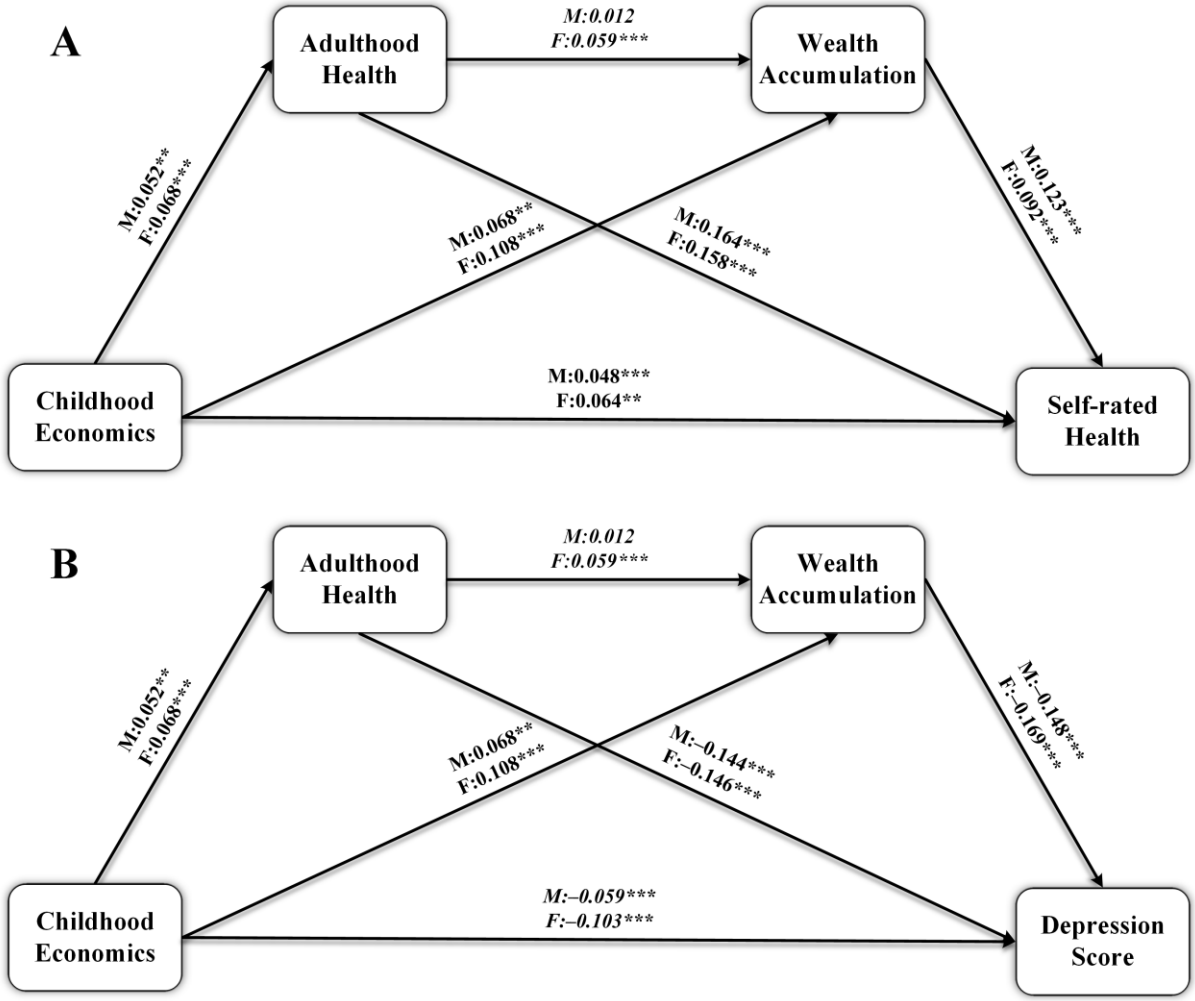

FIGURE 3. THE SEM RESULTS OF DIFFERENT GENDER GROUPS FOR (A) SELF-RATED HEALTH AND (B) DEPRESSION SCORE

Notes: Italics indicate the statistically significant differences between male and female groups. M: male, F: female. **P < 0.01, ***P < 0.001.

Additionally, there was a sequential decline in the total effects of social selection, social causation, and economic selection within the male group, while the ordering within the female group aligned with the results for the whole sample. However, statistical tests did not support the differences between gender groups, particularly in terms of the total effects of social causation, social selection, and economic selection (Table 3).

TABLE 3—THE COMPARISON OF SOCIAL CAUSATION, SOCIAL SELECTION, AND ECONOMIC SELECTION IN SELF-RATED HEALTH BETWEEN MALE AND FEMALE

	Male			Female			P value
	Estimate	S.E.	P value	Estimate	S.E.	P value	
Effect decomposition							
Social causation							
Total effect (TSC)	0.123	0.017	***	0.092	0.016	***	
Social selection							
Total effect (TSS)	0.165	0.014	***	0.163	0.014	***	
Direct effect (DSS)	0.164	0.013	***	0.158	0.014	***	
Total indirect effect (ISS)	0.001	0.002		0.005	0.002	*	
Economic selection							
Total effect (TES)	0.065	0.012	***	0.085	0.021	***	
Direct effect (DES)	0.048	0.011	***	0.064	0.021	**	
Total indirect effect (IES)	0.017	0.003	***	0.021	0.003	***	
ES1×SS2 (IES1)	0.009	0.003	***	0.011	0.003	***	
ES2×SC1 (IES2)	0.008	0.004	*	0.010	0.002	***	
ES1×SS1×SC1 (IES3)	<0.001	<0.001		<0.001	<0.001	**	
Effect comparison							
Total effects							
|TSC| – |TSS|	–0.043	0.016	**	–0.072	0.022	***	
|TSC| – |TES|	0.058	0.019	**	0.007	0.030		
|TSS| – |TES|	0.101	0.018	***	0.078	0.018	***	
Direct effects							
|SC1| – |ES1|	0.070	0.029	*	0.024	0.027		
|SC1| – |ES3|	0.075	0.021	***	0.028	0.030		
|SC1| – |SS2|	–0.041	0.016	**	–0.066	0.023	**	
|ES2| – |SS1|	0.056	0.024	*	0.050	0.021	*	
|ES3| – |SS2|	–0.116	0.018	***	–0.094	0.018	***	
Indirect effects							
|IES2| – |ISS|	0.007	0.003	*	0.005	0.002	*	

*Notes:**P < 0.05, **P < 0.01, ***P < 0.001.

D. *Gender disparities for depression score*

TABLE 4—THE COMPARISON OF SOCIAL CAUSATION, SOCIAL SELECTION, AND ECONOMIC SELECTION IN DEPRESSION SCORE BETWEEN MALE AND FEMALE

	Male			Female			P value
	Estimate	S.E.	P value	Estimate	S.E.	P value	
Effect decomposition							
Social causation							
Total effect (TSC)	–0.148	0.016	***	–0.169	0.016	***	
Social selection							
Total effect (TSS)	–0.146	0.015	***	–0.156	0.015	***	
Direct effect (DSS)	–0.144	0.014	***	–0.146	0.014	***	
Total indirect effect (ISS)	–0.002	0.002		–0.010	0.003	**	*
Economic selection							
Total effect (TES)	–0.076	0.014	***	–0.132	0.017	***	**
Direct effect (DES)	–0.059	0.013	***	–0.103	0.017	***	*
Total indirect effect (IES)	–0.018	0.004	***	–0.029	0.003	***	*
ES1×SS2 (IES1)	–0.008	0.003	**	–0.010	0.002	***	
ES2×SC1 (IES2)	–0.010	0.005	*	–0.018	0.002	***	
ES1×SS1×SC1 (IES3)	>–0.001	<0.001		–0.001	<0.001	**	*
Effect comparison							
Total effects							
|TSC| – |TSS|	0.002	0.021		0.012	0.018		
|TSC| – |TES|	0.072	0.017	***	0.037	0.027		
|TSS| – |TES|	0.069	0.019	***	0.024	0.023		
Direct effects							
|SC1| – |ES1|	0.096	0.028	***	0.101	0.026	***	
|SC1| – |ES3|	0.089	0.018	***	0.066	0.028	*	
|SC1| – |SS2|	0.004	0.022		0.022	0.020		
|ES2| – |SS1|	0.056	0.024	*	0.049	0.021	*	
|ES3| – |SS2|	–0.085	0.019	***	–0.043	0.022	*	
Indirect effects							
|IES2| – |ISS|	0.008	0.004	*	0.008	0.003	**	

Notes: *P < 0.05, **P < 0.01, ***P < 0.001.

Similarly, when depression score was the outcome, the mediating pathways ISS ($\beta = –0.010$, $P < 0.01$) and IES3 ($\beta = –0.001$, $P < 0.01$) were likewise only active for females, and their coefficients were significantly different between gender groups ($P < 0.05$). Furthermore, social causation ($d = 0.072$, $P < 0.001$) and social selection ($d = 0.069$, $P < 0.001$) held stronger total effects on depression score than economic selection within the male group, whereas the total effects of the three hypotheses were not significantly different from each other within the

female group. Notably, the total effect ($P < 0.01$), direct effect ($P < 0.05$), and total indirect effect ($P < 0.05$) of economic selection on depression score were all significantly greater for females than for males (Table 4).

IV. Discussion

To our knowledge, this study is the first to construct a path model that simultaneously incorporates social causation, social selection, and economic selection hypotheses, with health in older age as the final outcome. Based on a life course perspective, the model considers not only the cumulative effects of economic disadvantages in childhood but also the roles of adulthood health and wealth accumulation in the path dependence of health outcomes in older age. As hypothesized, the evidence demonstrates that social causation, social selection, and economic selection coexist. However, the competition results among these three hypotheses differ by health outcomes and genders. Our findings offer new insights into the contrast between social causation, social selection, and economic selection and their gender disparities.

Our study most clearly supports the social selection hypothesis in self-rated health because both the total and direct effects of adulthood health on self-rated health were significantly greater than those of wealth accumulation and childhood economics, similar to the results of the study first proposing the economic selection hypothesis (Bierman, et al. 2021). Although adulthood health can influence self-rated health in older age indirectly via wealth accumulation, more than 95% of the social selection forces operated through the direct pathway, highlighting the strong continuity of adulthood health. We discovered that the social causation forces of wealth accumulation in self-rated health were not significantly superior to the economic selection forces of childhood economics. In other words, economic disadvantages in the early life course even have no less effects on self-rated health than the current living circumstances determined by wealth accumulation. Past studies have similarly underlined that the social gradient of health in the later life course is sown decades earlier in childhood (Case, Lubotsky and Paxson 2002, Ferraro and Shippee 2009). Indeed, the pathway from childhood economics to adulthood health can also be viewed as social causation in the earlier life course, with a coefficient not significantly different from the pathway from wealth accumulation to self-rated health. In contrast, a European study observed stronger social causation forces in the transition from working age to older age compared to the transition from childhood to working age (Hoffmann, Kröger and Pakpahan 2018). There are two potential explanations for this discrepancy. First, the indicators of health status and economic conditions used in these two studies were

different. Second, the majority of older adults struggled to survive during childhood because of being born in impoverished China in the 20th century, making childhood economics more influential on adulthood health. Notably, childhood economics was a stronger predictor of wealth accumulation than adulthood health, exerting a greater indirect effect on self-rated health in older age. As a result, we should not undervalue the continuity from childhood economics to wealth accumulation, as its contribution even surpasses that of health status during the working age period.

When the outcome was depression score, the most notable variation was a nearly 50% increase in social causation forces, bringing it into close proximity to the forces of social selection. A longitudinal study provides consistent evidence that social causation mechanisms are better at explaining changes in the mental health of older adults than in their physical health (Seifert, Seddig and Eckhard 2022). This increase also resulted in the social causation forces stemming from wealth accumulation in the later life course prevailing over the social causation forces stemming from childhood economics in the earlier life course. The limited explanatory power of childhood economics may be due, in part, to the fact that adulthood health tends to mirror physical health. We acknowledge that this is a limitation of this study, namely the difficulty of accurately measuring the depressive symptoms of participants in their adulthood in a retrospective survey. Despite this, there was no significant decline in the social selection forces of adulthood health. These results remind us that adulthood health is not only a reliable predictor of physical health in older age but also tightly linked to the risk of depression. We also found that while economic selection was still supported by the least evidence, its total effect on depression score increased by more than 40% similarly to social causation. These findings reinforce the conclusion of previous studies that depression in older age is highly correlated with both recent socioeconomic status and childhood economics (Morrissey and Kinderman 2020, Xue et al. 2021, Zhou et al. 2021). Furthermore, childhood economics affected the depression score of older adults primarily through a direct pathway, which aligns with a study conducted in Japan (Tani, et al. 2016). The study found that a low childhood socioeconomic status is positively associated with depression in older age, even after adjusting for potential mediators such as educational attainment, adulthood socioeconomic status, disease state, health behaviors, and social relationships. Given that the contribution of childhood economics to self-rated health was also mainly embodied in the direct pathway, we speculate that the influence of childhood economics on older age health may have a lengthy latent period. That is, economic conditions in childhood may be mapped directly to health outcomes in older age, independent of other events or risk factors during adulthood, which is

also known as the latency hypothesis/process (Aartsen et al. 2019, Lyu and Burr 2016).

The gender disparities are prominently manifested in that the effect of adulthood health on wealth accumulation in the male group was only about one-fifth of that in the female group and not statistically significant. We believe that this may be due to gender inequalities in family financial responsibilities and social norms. The participants in this study reached adulthood in an era when Chinese males typically had to earn most of their household income through manual labor (Matthews and Nee 2000). Meanwhile, social norms for males, such as the expectation that males must be successful and resilient, may lead males to sacrifice their health for more wealth rather than risk losing their self-esteem or being looked down upon for failing to provide adequate financial resources for their families (Lohan 2007). Consequently, wealth accumulation among males may frequently come at the cost of health losses in adulthood, which can offset the positive gains that health brings to wealth. The feeble link between adulthood health and wealth accumulation in the male group also rendered all indirect effects on self-rated health via this pathway insignificant, severely impairing the path dependence of self-rated health on adulthood health and childhood economics. In addition, the effect of wealth accumulation on self-rated health was much stronger than the direct effect of childhood economics on adulthood health and self-rated health, indicating that the social causation in the later life course is more competitive for males and their self-rated health is more easily influenced by recent economic conditions. Owing to these, social causation exhibits stronger forces than economic selection in self-rated health in the male group. As a comparison, the social causation forces of wealth accumulation and economic selection forces of childhood economics are comparable in self-rated health among the females, which is consistent with the whole sample analysis. Another study also found that childhood economics has only 40% of the effect of recent household income per capita on the self-rated health of male older adults, while the two effects are very similar for female older adults (Nicholson et al. 2005). However, the differences in the total effects, direct effects, and indirect effects of social causation, social selection, and economic selection between gender groups did not satisfy the predetermined significance level. Hence, it is imprudent to conclude that the effects of the three hypotheses on the self-rated health of older adults vary by gender.

Due to the weak association between adulthood health and wealth accumulation, the impact of adulthood health and childhood economics on depression score in the male group is also less reliant on indirect pathways. However, unlike when the outcome was self-rated health, the total effects, direct effects, and total indirect effects of childhood economics on depression score were significantly

greater in the female group compared to the male group. On this basis, the forces of economic selection in the depression score of females increase to a level that can rival those of social causation and social selection, while the comparison results in males are identical to the whole sample, with economic selection remaining in the lowest position. In fact, existing studies have widely supported a stronger relationship between economic conditions and depression in females (Dohrenwend et al. 1992, Simmons et al. 2008). Furthermore, the Survey of Health Aging and Retirement in Europe discovered that childhood economic status has more than double the predictive power for depression risk in females compared to males (Angelini, Howdon and Mierau 2019). Although the complete mechanisms are not yet known, the social and material disadvantages experienced by females during childhood are certainly one of the major causes (Alvarado et al. 2007). Therefore, it is imperative for the government to implement effective measures based on the consideration of long-term benefits to improve the material living conditions of females during childhood to decrease their depression risk in older age.

This study has several limitations. First, the data utilized in this study span a long period of time and avoid the issue of heavy survey attrition, but these are achieved at the expense of employing retrospective data that may be subject to recall bias. Although retrospective measures of health and economic conditions are generally reliable (Haas 2007, Havari and Mazzonna 2015), the possibility of results being affected cannot be ruled out. Specifically, measurement errors in childhood economics can diminish its association with indicators in adulthood and older age, potentially leading to the underestimation of economic selection forces. Second, to prevent excessive missing data from influencing the representativeness of the results, we only considered the highly concerned depressive symptoms. Future research could concentrate on other common mental health issues in older adults, such as anxiety, loneliness, cognitive impairment, and dementia. Lastly, given that all information was self-reported by the participants, this may introduce reporting bias.

V. Conclusions

In self-rated health, the forces of social selection are dominant, while social causation is comparable to economic selection. In depression score, social causation and social selection exert similar forces, both of which are mightier than the forces of economic selection. The forces ranking of social causation, social selection, and economic selection in the self-rated health of females and depression score of males are consistent with the whole sample. However, social causation

outperforms economic selection in the self-rated health of males, while the forces of economic selection are stronger and thus comparable to those of social causation and social selection in the depression score of females.

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APPENDICES

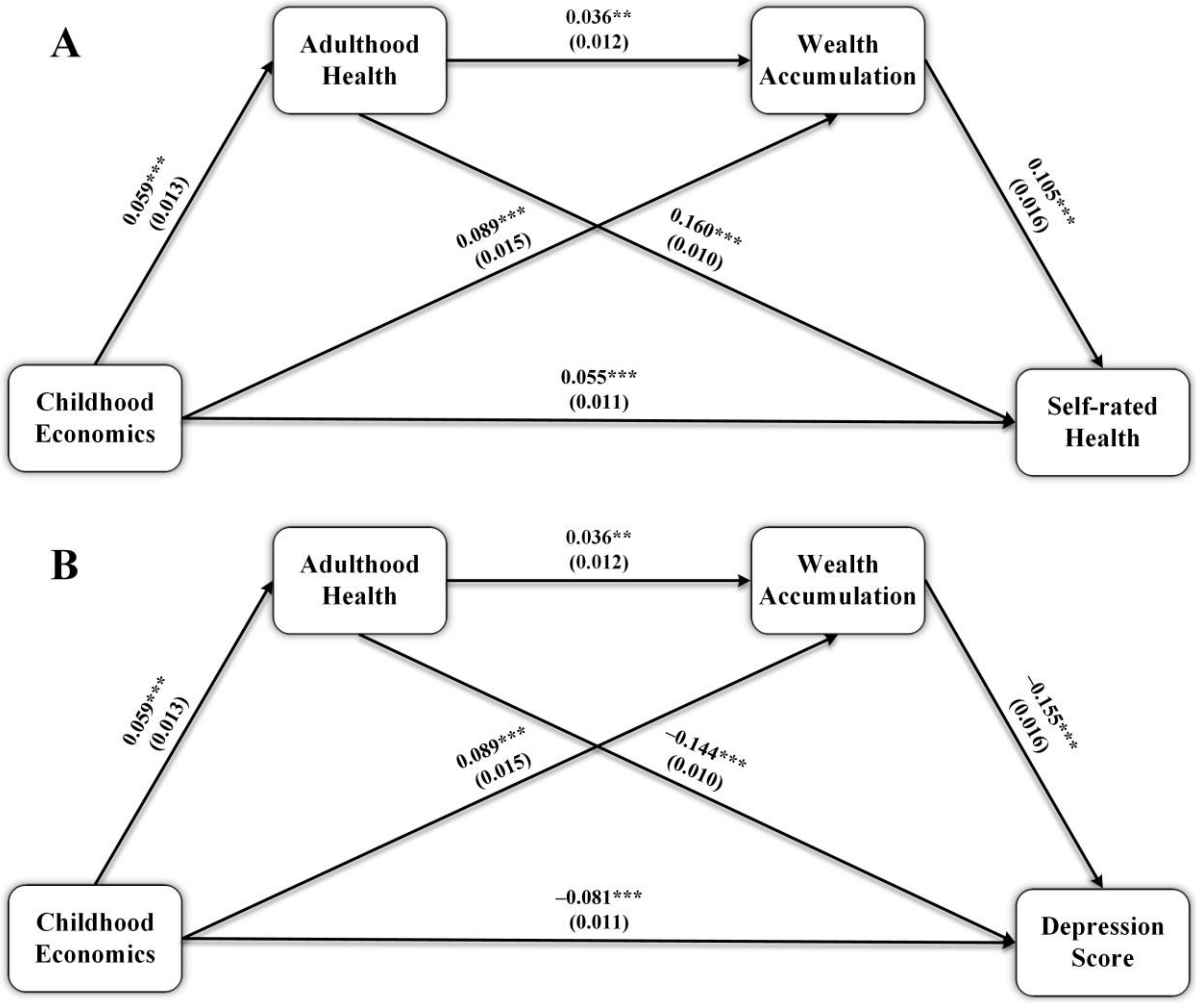

FIGURE A1. THE SEM RESULTS FOR (A) SELF-RATED HEALTH AND (B) DEPRESSION SCORE BASED ON MULTIPLE IMPUTATION (IMPUTATIONS = 50)

Notes: Robust standard errors clustered at the household level are reported in parentheses. **P < 0.01, ***P < 0.001.

TABLE A1—EFFECT DECOMPOSITION AND COMPARISON OF SOCIAL CAUSATION, SOCIAL SELECTION, AND ECONOMIC SELECTION FOR SELF-RATED HEALTH AND DEPRESSION SCORE BASED ON MULTIPLE IMPUTATION (IMPUTATIONS = 50)

	Self-rated health			Depression score			P value
	Estimate	S.E.	P value	Estimate	S.E.	P value	
Effect decomposition							
Social causation							
Total effect (TSC)	0.105	0.016	***	–0.155	0.016	***	***
Social selection							
Total effect (TSS)	0.164	0.010	***	–0.150	0.010	***	
Direct effect (DSS)	0.160	0.010	***	–0.144	0.010	***	
Total indirect effect (ISS)	0.004	0.002	*	–0.006	0.002	*	*
Economic selection							
Total effect (TES)	0.074	0.011	***	–0.104	0.012	***	*
Direct effect (DES)	0.055	0.011	***	–0.081	0.011	***	*
Total indirect effect (IES)	0.019	0.002	***	–0.023	0.003	***	*
ES1×SS2 (IES1)	0.010	0.002	***	–0.009	0.002	***	
ES2×SC1 (IES2)	0.009	0.003	***	–0.014	0.003	***	**
ES1×SS1×SC1 (IES3)	<0.001	<0.001	**	>–0.001	<0.001	**	*
Effect comparison							
Total effects							
|TSC| – |TSS|	–0.059	0.017	***	0.006	0.019		
|TSC| – |TES|	0.031	0.021		0.052	0.020	**	
|TSS| – |TES|	0.090	0.014	***	0.046	0.015	**	**
Direct effects							
|SC1| – |ES1|	0.045	0.027		0.096	0.026	***	***
|SC1| – |ES3|	0.050	0.022	*	0.074	0.021	***	
|SC1| – |SS2|	–0.056	0.018	**	0.011	0.020		
|ES2| – |SS1|	0.053	0.015	***	0.053	0.015	***	
|ES3| – |SS2|	–0.105	0.014	***	–0.063	0.015	***	*
Indirect effects							
|IES2| – |ISS|	0.006	0.002	**	0.008	0.003	**	**

Notes: *P < 0.05, **P < 0.01, ***P < 0.001.

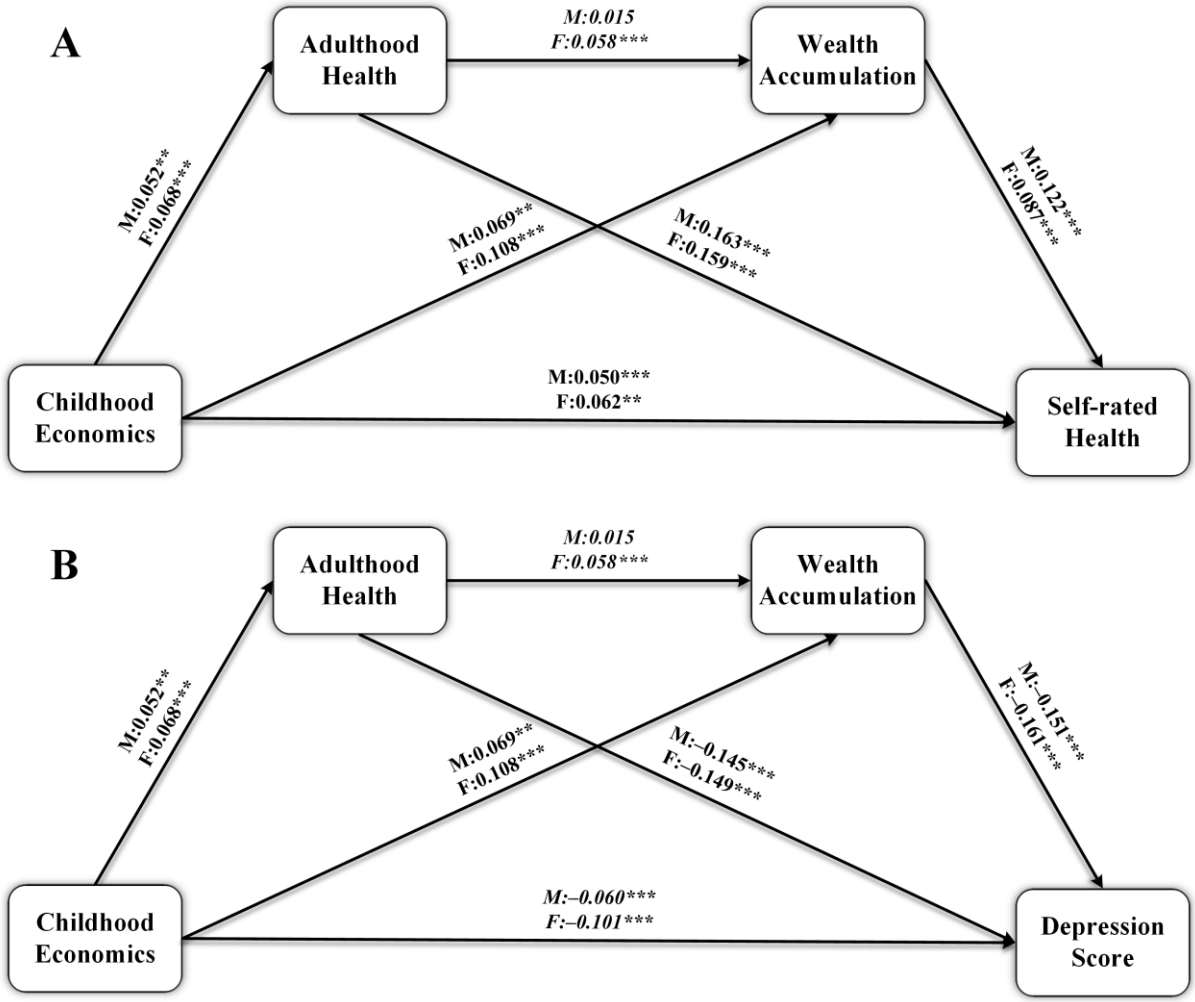

FIGURE A2. THE SEM RESULTS OF DIFFERENT GENDER GROUPS FOR (A) SELF-RATED HEALTH AND (B) DEPRESSION SCORE BASED ON MULTIPLE IMPUTATION (IMPUTATIONS = 50)

Notes: Italics indicate the statistically significant differences between male and female groups. M: male, F: female. **P < 0.01, ***P < 0.001.

TABLE A2—THE COMPARISON OF SOCIAL CAUSATION, SOCIAL SELECTION, AND ECONOMIC SELECTION IN SELF-RATED HEALTH BETWEEN MALE AND FEMALE BASED ON MULTIPLE IMPUTATION (IMPUTATIONS = 50)

	Male			Female			P value
	Estimate	S.E.	P value	Estimate	S.E.	P value	
Effect decomposition							
Social causation							
Total effect (TSC)	0.122	0.017	***	0.087	0.023	***	
Social selection							
Total effect (TSS)	0.165	0.015	***	0.164	0.015	***	
Direct effect (DSS)	0.163	0.014	***	0.159	0.015	***	
Total indirect effect (ISS)	0.002	0.002		0.005	0.002	*	
Economic selection							
Total effect (TES)	0.067	0.013	***	0.083	0.019	***	
Direct effect (DES)	0.050	0.013	***	0.062	0.019	**	
Total indirect effect (IES)	0.017	0.003	***	0.021	0.003	***	
ES1×SS2 (IES1)	0.008	0.003	**	0.011	0.003	***	
ES2×SC1 (IES2)	0.008	0.004	*	0.009	0.003	***	
ES1×SS1×SC1 (IES3)	<0.001	<0.001		<0.001	<0.001	*	
Effect comparison							
Total effects							
|TSC| – |TSS|	–0.043	0.017	**	–0.077	0.030	*	
|TSC| – |TES|	0.055	0.020	**	0.004	0.033		
|TSS| – |TES|	0.098	0.019	***	0.081	0.019	***	
Direct effects							
|SC1| – |ES1|	0.070	0.028	*	0.019	0.032		
|SC1| – |ES3|	0.072	0.022	***	0.025	0.033		
|SC1| – |SS2|	–0.041	0.017	*	–0.072	0.031	*	
|ES2| – |SS1|	0.055	0.026	*	0.050	0.021	*	
|ES3| – |SS2|	–0.113	0.020	***	–0.097	0.018	***	
Indirect effects							
|IES2| – |ISS|	0.007	0.004		0.004	0.002	*	

Notes: *P < 0.05, **P < 0.01, ***P < 0.001.

TABLE A3—THE COMPARISON OF SOCIAL CAUSATION, SOCIAL SELECTION, AND ECONOMIC SELECTION IN DEPRESSION SCORE BETWEEN MALE AND FEMALE BASED ON MULTIPLE IMPUTATION (IMPUTATIONS = 50)

	Male			Female			P value
	Estimate	S.E.	P value	Estimate	S.E.	P value	
Effect decomposition							
Social causation							
Total effect (TSC)	–0.151	0.016	***	–0.161	0.022	***	
Social selection							
Total effect (TSS)	–0.147	0.014	***	–0.158	0.014	***	
Direct effect (DSS)	–0.145	0.014	***	–0.149	0.015	***	
Total indirect effect (ISS)	–0.002	0.002		–0.009	0.003	**	*
Economic selection							
Total effect (TES)	–0.078	0.015	***	–0.129	0.016	***	*
Direct effect (DES)	–0.060	0.013	***	–0.101	0.016	***	*
Total indirect effect (IES)	–0.018	0.004	***	–0.028	0.003	***	*
ES1×SS2 (IES1)	–0.008	0.003	**	–0.010	0.002	***	
ES2×SC1 (IES2)	–0.010	0.005	*	–0.017	0.003	***	
ES1×SS1×SC1 (IES3)	>–0.001	<0.001		–0.001	<0.001	**	*
Effect comparison							
Total effects							
|TSC| – |TSS|	0.004	0.021		0.002	0.026		
|TSC| – |TES|	0.073	0.018	***	0.032	0.029		
|TSS| – |TES|	0.069	0.020	***	0.030	0.022		
Direct effects							
|SC1| – |ES1|	0.099	0.028	***	0.093	0.031	**	
|SC1| – |ES3|	0.091	0.018	***	0.060	0.030	*	
|SC1| – |SS2|	0.007	0.022		0.011	0.028		
|ES2| – |SS1|	0.055	0.026	*	0.050	0.021	*	
|ES3| – |SS2|	–0.084	0.019	***	–0.048	0.022	*	
Indirect effects							
|IES2| – |ISS|	0.008	0.004		0.008	0.003	**	

Notes: *P < 0.05, **P < 0.01, ***P < 0.001.