Gender Disparities in the Relationship between Education and Self-Reported Health Across Cohorts in China

Bowen Zhu
School of Public Administration
Hunan Normal University
Lushan Road 36, Changsha, Hunan (China), 410081.
zhubowen92@126.com
(Corresponding author; Telephone number: 8613971275925)

Yiwan Ye
Department of Sociology
University of California, Davis
One Shield Ave, Davis (United States)
ywyec@ucdavis.edu
Abstract

Background: Variation in the relationship between education and health has been studied intensely over the past few decades. Although there is abundant research on gender disparity and cohort variations in the relationship between education and health, based on samples from the U.S. and Europe, research about China is limited. Given the specific social changes in China, the study is designed to analyze the gender difference and cohort variations in the education-health relationship.

Method: Longitudinal, nationwide data from the Chinese Family Panel Studies from the years 2010 to 2016 are statistically analyzed. Self-reported health is measured by respondents’ subjective assessment of their health. The highest level of education earned operationalizes the education measure. Each cohort is defined by a distinct period of social change in China. The age-vector model is used to analyze gender and cohort variations in the association between education and self-rated health.

Results: Men report better health than women, but the relationship between education and health for women is stronger than for men. Educational gaps in self-rated health do not change significantly for cohorts before 1955 and cohorts after 1977, but the gaps become stronger for cohorts between 1956 and 1976. There is gender disparity within the cohort variations in the education-health relationship. For women, the education-health relationship in the 1956-1960, 1967-1976 and 1977-1983 cohorts is significantly stronger than for the 1908-1938 cohort. While not as strong, the education-health relationship remains consistent across all cohorts for men.

Conclusions: The study findings support the resource substitution hypothesis and not the rising importance hypothesis in China. Considering the findings on gender disparity and difference in cohort effects, we discuss the potential influences of the unique social transformation and educational expansion in China.

**Key words:** Education and Health Gap, Gender Disparity, Cohort Effect, Age Vector Model
Background

Over the past few decades, the relationship between education and health has been studied intensely. Education has been found to affect health directly and indirectly by increasing income and improving job outcomes [1-2], enabling a healthy lifestyle and strong social support [3], supporting a sense of control in life, enhancing confidence in problem-solving, and strengthening the ability to cope with stress [4-5]. Although education’s positive effects on health are well-studied, it is also important to analyze who benefits from it and who does not, and any changes in the education-health relationship across population cohorts.

The gender gap in health attracts considerable attention from researchers [6-12]. Their studies show that men tend to report better health experiences and outcomes than women, although the life expectancy for women is longer than men. Social factors – underlying social advantage or disadvantage - rather than biological factors are identified as primary explanations for the gender difference in health [13-14]. Despite advances in gender equality over time, women remain socially and economically disadvantaged in comparison with men, and there are still substantial limits in access to health-related resources for women [15-16]. Compared with men, women face restricted opportunities for paid employment, higher wages, fulfilling work, and authority in the workplace [10]. According to the ‘resource substitution hypothesis’ proposed by Ross and Mirowsky [9-10], men tend to have more access to and benefit more from health-related resources in a patriarchal society compared with women. Women have limited access to health-related resources, and the extent to which they do is continually changing in China. The present paper examines whether the resource substitution hypothesis is supported in the Chinese context.

Social transformation also shapes the relationship between education and health. Throughout the twentieth century, significant social changes have occurred in many countries around the world, including China. Due to dramatic social changes that determine cohort differences, the ‘rising importance hypothesis’ [17] and the ‘diminishing health returns hypothesis’ [18-20] have been tested for exploring the relationship between education and health outcomes across cohorts. Subsequent findings on gender difference and cohort variation revealed how social context shapes educational gaps in health. However, these findings were based on analyses of data from the U.S. and Europe. Both cohort effect and the relationship between education and health are widely studied in the Western democratic context [17-22]. Empirical work on gender and cohort variations by education and health is often absent in the Chinese context, especially after the educational expansion therein.

Compared to the U.S. and Europe, the association between education and health-related resources is more complicated in China due to its drastic socio-political transformation. Prior to the marketization reform in 1979, China was a collective economy where the government assigned salaries and occupations to individuals, making educational attainment irrelevant for job acquisition [23]. During the Reform and Opening-Up periods, it was not uncommon for people without higher education to earn high wages, thereby explaining the weakness of the education-income relationship. However, from 1992 to 2004, the wage returns to education rose steadily and then stagnated, and ultimately declined from 2004 to 2009 due to the educational expansion [24].

Not only is the gendered relationship between education and health-related resources in China idiosyncratic, but also the cohort variations in education. From 1966-1976, the Cultural Revolution had a devastating influence on education, especially for higher education as demonstrated by the college entrance examination system shutting down during that period [25]. It was not until the policy implementation of higher education expansion in 1999 that increased the opportunity of receiving a college education and narrowed the gender gap in educational attainment [26]. According to the Chinese Educational Statistical Report, there were only 0.85 million college
graduates in China in 1999, but four years later, the number of graduates rose to 1.88 million. By 2017, there were around 7.36 million college graduates in China [27]. The likelihood of female high school students getting into colleges has been reported to be the similar to that of male high school students [28]. However, the significant educational advancement in China resulted in a market devaluation of educational credentials, and the influx of college credentials also made the labor market more competitive [29].

These social upheavals and policy changes in China occurred at different time points, and therefore their influences may vary for birth cohorts who came of age in different historical periods. This study aims to examine the education-health relationship from both gender and cohort perspectives in the Chinese context. Data from four waves (2010, 2012, 2014, 2016) of a nationwide survey of adults aged 22-years and older are used to answer the following research questions: (1) Is the education gap in health larger for men or women? (2) Is there any inter-cohort variation in the association between education and health? (3) Is there any gender difference in the relationship between education and health in inter-cohort variations?

**Methods**

**Sample**

We use four waves of data from the Chinese Family Panel Studies (CFPS) from 2010-2016. All four years of CFPS are nationwide surveys of the Chinese population aged 18 years and older. The surveys were administered by the Institute of Social Science Survey at the Peking University of China and were designed to study the historical change of society, economy, population, education, and health in China. The survey collects panel data at the individual, household, and community levels. Respondent selection was guided by implicit stratification and multi-stage probability proportional to size (PPS) sampling. The panel design provides an opportunity for cohort analysis of social and economic change over time. We identified the sample of adults aged 22 years or older in 2010 as the baseline cohort, and the working sample consists of 23,706 individuals in 2010, 26,094 individuals in 2012, 25,724 individuals in 2014, and 25,084 individuals in 2016. In total, there are 27,580 individuals and 100,608 observations between 2010 and 2016. The percentage of individuals surveyed four times is 65.89%, and the percentage of individuals surveyed three times is 34.11%.

**Measures**

The self-reported health variable measures respondents’ subjective assessment of their health. Respondents were specifically asked, ‘How good is your health in general?’ The Likert scale in 2010 includes the response options of ‘very bad,’ ‘bad,’ ‘a little bad,’ ‘fair,’ and ‘good.’ We coded the first of these four items as ‘0’ and “good” health as ‘1.’ The Likert scale from 2012 to 2016 includes the response options of ‘bad,’ ‘fair,’ ‘little good,’ ‘good,’ and ‘very good.’ The first two items were coded as ‘0,’ and the last three answers were coded as ‘1.’ The self-reported health measure is regarded as a valid and reliable measure of health as it encompasses the subjective experience of fatal and nonfatal diseases and the general feeling of well-being [30-31]. The self-reported health variable is highly correlated with objective measures of health, such as mortality, morbidity, or diagnosis from a clinical exam. The self-rated health measure is a salient predictor of morbidity and mortality [32], and an even stronger predictor of physical health, mortality, and chronic diseases [14].

Education was measured by asking, ‘What is the highest degree you have completed?’ Respondents could select one of the following answer categories: ‘not received education,’ ‘primary school,’ ‘junior high school/professional high school,’ ‘senior high school,’ ‘junior
college,' ‘college,' and ‘undergraduate.’ For individuals who were still attending school, they were asked which year they attended at the time of the survey. The answers range from 0 years to 22 years. Given that adults aged 24 years or younger may not have completed their educational careers by the time they were surveyed, we selected samples with respondents aged 25 years or older in an attempt to avoid assessing effects of education on health prematurely [21, 33].

The cohort variable was measured by asking, ‘Which year were you born?’ Based on the birth year, we constructed eight birth cohorts based on historical periods of social change in China during respondents’ formative years beginning at age 10. The cohorts include the Children of Old China who were born before 1939, the Children of New China (1939-1946), the 'Lost' Generation (1947-1955), the Children of Early Cultural Revolution (1956-1960), the Children of Late Cultural Revolution (1961-1966), the Children of Economic Reform (1967-1976), the Children of Early Opening-Ups (1977-1983), and the Children of Late Opening-Ups (1984-1994) [33].

Additionally, employment status, family income, and frequency of physical exercise are important factors affecting health [35-36], so we use them as control variables. For employment status, we used the ‘not employed’ answer as the reference category. We used average family annual income to measure economic background. The frequency of physical exercise was measured by asking, ‘how often do you exercise in the last month?’ The answer options range from ‘never,’ ‘one time a month,’ ‘two or three times a month,’ ‘two or three times a week, and ‘almost every day,’ and they were coded as 0 to 4 respectively.

Models

The longitudinal design in CFPS allows researchers to study between-person and within-person changes over the four survey waves, whereas a repeated cross-sectional design would confound age effect with period and cohort effect due to the collinearity between age, period, and cohort [37]. Hierarchical growth curve models tested for cohort variations in age trajectories [38-39]. We use an age vector model to adjust for age and cohort effect over time because a traditional growth curve model would not accurately map the age sequence of self-rated health for short-term panel data - a 6-year period is too short to estimate the trend for an entire life course. The age vector model measures the between-person differences in age and cohort effects, and estimates within-person effects using the passage of time (i.e., survey waves) rather than the sequence of age [39]. An age vector model is also the preferred method for testing a cohort-level hypothesis with short-term panel data. This model relaxes the linear assumption of age imposed by the traditional growth curve model, allowing for us to model higher polynomials of age between individuals [39].

Since self-reported health is a dichotomous variable in our study, we used a two-level hierarchical binary logistic regression model to estimate the probability of being in good health, adjust for within-person changes at the first level, and adjust for between-person differences at the second level. This model estimates the gender differences for both age trajectories and cohort variations in the association between education and health over the life course. We formulate a series of hierarchical linear models using HLM 7.1 software. The full model (Model 4) that controls for all interaction terms and covariates is described as follows:

The level-1 model characterizes within-individual change across survey waves after controlling for a series of variables at level-2.

\[ \log\left(\frac{\varphi_{t,i}}{1 - \varphi_{t,i}}\right) = \eta_{t,i} = \pi_{0,i} + \pi_{1,i} \times \left(T_{t,i}\right) \]

Where \( \varphi_{t,i} \) is the probability of self-rated health for individual \( i \) at time \( t \) (i.e., survey wave), \( \pi_{0,i} \) is the intercept component, and \( \pi_{1,i} \) indicates the linear growth rates or the slope component. \( T_{t,i} \) denotes the difference between the current survey year and the reference survey year (i.e., 2010).
The level-2 model estimates the between-individual change in health with age, and assesses whether there are patterns in the association between education and health in the age trajectory for gender across different cohorts. Level-2 consists of an intercept component that measures fixed effects for all individuals and a slope equation (i.e., linear growth rate) that measures the changes in fixed effect over time.

The intercept \( \pi_{0i} \) equation is expressed as the following:

\[
\pi_{0i} = \beta_{00} + \beta_{01} \text{Age}_{i} + \beta_{02} \text{Age}_{Sq,i} + \beta_{03} \text{Male}_{i} + \beta_{04} \text{Educ}_{i} + \beta_{05} (\text{Male}_{i} \times \text{Educ}_{i}) + \beta_{06} \sum_{j=1}^{12} \text{Cohort}_{j} + \beta_{07} \sum_{k=13}^{19} (\text{Cohort}_{k} \times \text{Educ}_{i}) \\
+ \beta_{08} \text{Income}_{i} + \beta_{09} \text{Employed}_{i} + \beta_{10} \text{Exercise}_{i} + \gamma_{0i}
\]

Where \( \beta_{00} \) denotes the overall probability of reporting the health of all individuals across survey waves. \( \beta_{01} \) to \( \beta_{09} \) are the fixed coefficients, including the main effects of age, age squared, gender, education, and cohort, and the interaction effects between gender and education and between cohort and education. \( \beta_{08} \) to \( \beta_{10} \) denote coefficients for level-2 predictors: family income, employee status, and frequency of physical exercise. \( \gamma_{0i} \) denotes the variance component for the fixed intercept equation.

The linear growth rate of the period \( \pi_{1i} \) equation is expressed as the following:

\[
\pi_{1i} = \beta_{10} + \beta_{11} \text{Age}_{i} + \beta_{12} \text{Male}_{i} + \beta_{13} \text{Educ}_{i} + \beta_{14} (\text{Male}_{i} \times \text{Educ}_{i}) + \beta_{15} \sum_{j=1}^{12} \text{Cohort}_{j} + \beta_{16} \sum_{k=13}^{19} (\text{Cohort}_{k} \times \text{Educ}_{i}) \\
+ \beta_{17} \text{Income}_{i} + \beta_{18} \text{Employed}_{i} + \beta_{19} \text{Exercise}_{i}
\]

The linear growth rate component includes all of the corresponding variables from the intercept component, except for \( \text{Age}_{Sq,i} \) because we assume the rate of change in age effect is the same across all survey waves. We also do not control for random effect for the slope equation, because we lack the statistical power and we assume the slope coefficients are fixed for all respondents. Lastly, we examine the full model separately for each gender, allowing us to compare the significance of association and general direction between the female-only model (Model 5) and the male-only model (Model 6).

Results

Gender difference: Results for the resource substitution hypothesis

Table 1 shows the descriptive statistics for all the variables in the analytic models. As expected, men on average reported better health status, higher educational attainment, higher income, and higher physical exercise rates than their female counterparts. The sample size for each cohort by gender is shown in Table 2.

|                         | Full sample | Male      | Female     |
|-------------------------|-------------|-----------|------------|
| Sample Size             | 100,608     | 49,213    | 51,395     |
| Self-rated health (good health=1) | 81.89%       | 85.10%    | 77.80%     |
| Age                     | 46.86(14.323) | 47.13(14.28) | 46.61(14.369) |
| Education year          | 6.87(4.677)  | 7.79(4.288) | 5.99(4.814) |
| Log Family income       | 8.66(1.111)  | 8.67(1.106) | 8.65(1.244) |
| Employed                | 56.97%       | 64.40%    | 49.20%     |
| Frequency of physical exercise (0-4) | 3.05(1.567)  | 3.10(1.523) | 3.00(1.607) |

Note: Standard deviation in parentheses.
Table 2: Sample Size for Each Cohort by Gender

| Cohort                      | Sample Size | Male       | Female     |
|-----------------------------|-------------|------------|------------|
| Old China: 1908-1938        | 100,608     | 49,213     | 51,395     |
| New China: 1939-1946        | 8,193(8.1%) | 4,308(8.8%)| 3,885(7.6%)|
| The ‘Lost’ Generation: 1947-1955 | 18,165(18.1%) | 8,886(18.1%) | 9,279(18.1%) |
| Early Cultural Revolution: 1956-1960 | 9,693(9.6%) | 4,868(9.9%) | 4,825(9.4%) |
| Late Cultural Revolution: 1961-1966 | 15,110(15%) | 7,205(14.6%) | 7,905(15.4%) |
| Economic Reform: 1967-1976  | 23,385(23.2%) | 11,224(22.8%) | 12,161(23.7%) |
| Early Opening-Ups: 1977-1983 | 11,020(11.0%) | 5,441(11.1%) | 5,579(10.9%) |
| Late Opening-Ups: 1984-1994 | 10,566(10.5%) | 5,159(10.5%) | 5,407(10.5%) |

Note: Percentage in parentheses.

In Table 3, we present the results from a series of age vector models. Based on the odds ratio in Model 2 for males, men reported better health than women. This model tests the resource substitution hypothesis, which supposes that there is a substantial educational difference in the slope of gender (Model 1). For male respondents, a one-year increase in education yields a change in log odds of 0.07 or an odds ratio of 1.073. Thus, a female with one additional year of education is on average 1.012 times more likely than a male with one additional year of education to report a status of healthy in the survey holding all else constant. In other words, the association between education and health is weaker among men than among women. The gender difference becomes statistically significant in the slope model when some variables are added, but it is not statistically significant in the intercept model. This pattern supports the resource substitution hypothesis and is consistent with the results of related studies in the United States [9].

Cohort variations in education and health: Results for the rising importance hypothesis

In order to understand the cohort variations in self-reported health, we added the cohort variable in Model 2. The odds ratios for each cohort in Model 2 show that the younger cohort reports as healthier than the oldest cohort, and the difference in self-reported health between the oldest cohort and the 1961-1966 cohort is statistically significant.

To test the rising importance hypothesis, which supposes that the association between education and health becomes stronger over time for a given population, we included interaction effects between education and cohort in Model 3. Model 3 reports education-by-cohort interaction effects on health. We found that the association between education and health does not change significantly for cohorts before 1955, and the association becomes stronger for younger cohorts. For the 1956-1960 cohort, a one-unit increase in education yields a change in the log odds of 1.099. The odds ratio for the 1908-1938 cohort is 1.056. The odds ratio of a one-unit education gain for cohort 1956-1960 over the odds ratio of a one-unit education gain for the 1908-1938 cohort is 1.041. In other words, respondents from cohort 1956-1960 with one additional year of education are on average 1.041 times more likely than respondents from cohort 1908-1938 with one additional year of education to report healthy in the survey holding all else constant. With one additional year of education, respondents from the 1967-1976 cohort and the 1977-1983 cohort are on average 1.059 times and 1.064 times respectively more likely to report as healthy compared
with respondents from the 1908-1938 cohort. We also note that the rising trend disappears in the youngest cohort. Based on these findings, the full models do not support the hypothesis of rising importance.

**Gender difference in education and health across cohorts**

We also established full models separately for men and women. Model 4 shows that the odds ratios of the interaction between education and cohort are significantly more than 1 among women for the 1956-1960, 1967-1976 and 1977-1983 cohorts. The results in Model 4 suggest that education’s positive effects on health increased for the 1956-1960, 1967-1976 and 1977-1983 cohorts. Female respondents from the 1956-1960, 1967-1976 and 1977-1983 cohorts with one additional year of education are on average 1.063 times, 1.088 times, and 1.102 times more likely than respondents from the 1908-1938 cohort (P<0.05) to report better health, respectively. The pattern for the relationship between education and health for the female subsample is the same as that of the full sample. As with the rising importance hypothesis, the rising trend also disappears in the youngest cohort. In Model 5, education is not positively related to good health for men (P>0.1). The interactional effects between education and cohort are not statistically significant. In other words, the education effects are the same across all eight cohorts among men, but there is a gender difference in education and health across cohorts.

**Discussion**

This study assesses the resource substitution hypothesis and rising importance hypothesis in the Chinese context. Results reveal that the resource substitution hypothesis is supported in the Chinese context, which is consistent with related U.S. studies. However, compared to previous findings about these two hypotheses from the United States, there are two notable differences in the Chinese context. First, the effect of education on health has not increased from the oldest cohort to the youngest cohort, and the gaps in health remained stable for some cohorts. Second, for the rising importance hypothesis, there is a gender difference in the educational effects on health across cohorts in the Chinese context.

We think potential explanations for the U.S.-China differences lie in the role of sociocultural and policy change. First, the association between education and health-related resources in China may be one of the reasons for the complex trend across cohorts. Eating dinner and drinking wine with friends, colleagues, and superiors is a crucial way to maintain a social network and to obtain resources in Chinese society but can be a negative effect for health outcomes [40]. Before the Reform and Opening-Up, individuals had limited access to food and clothing under the socialist economy. After decades of Opening-Up, more people began to enjoy abundant material prosperity [41]. Individuals with higher education and more purchasing power are more likely to participate in social gatherings, indulge in unhealthy diets, and consume more alcohol [39]. Furthermore, these behaviors are empirically found to be more pronounced among men than women [41], which could possibly be supported by a strong positive relationship between education and drinking in the male sample in our study.

As for the cohort patterns, we argue that the drastic educational landscape changes in China affect the relationship between education and health-related resources. The rapid increase in social and economic benefits from education for the 1967-1976 cohort may be due to the recovery of the college entrance exam in 1977. Although there were less than 1.4 million students who graduated from college prior to 2003, credentials became more critical for finding jobs after the Opening-Up and Reform periods in 1978. Members of the 1967-1976 and 1977-1983 cohorts who graduated from college could acquire well-paying jobs compared with cohort members who did not receive
a college degree. However, with educational expansion starting in 1999 in China, the number of people receiving a college education has been increasing rapidly. According to the Chinese Educational Statistics Report (2018), the number of people receiving a college education rose from 1.08 million in 1998 to 7.62 million in 2017 [27]. Compared with older cohorts, the children of Later Opening-Ups (1984-1994) can receive an education more easily, but the valuation of the same academic degree has decreased. Educational expansion resulted in the phenomenon of over-education, which lessens the income benefits from educational attainment due to the mass of individuals who have similar credentials vying for similar, limited opportunities. Members of the youngest cohort face more competition in the labor market than the members of the Early Opening-Ups, for whom the adverse effects from educational expansion had not caught up. Educational expansion weakens the role of education in improving access to both socioeconomic and health-related resources [29, 43]. The rate of returns for education even declined in 2009 [24]. As a result, the rising trend disappears for the 1984-1994 cohort.

The gender difference in education and health across cohorts can be attributed to women experiencing greater difficulty with gaining access to educational and health-related resources. Results show that the links between education and health are stronger among women than among men in China, which support the ‘resource substitution hypothesis’ from the perspective of cohorts. Women have been in a socially disadvantaged position for decades [44], so they have fewer resources to rely on. On the contrary, men have more resources presently and historically, so education is less important for men than for women. Another possible reason for this gender disparity is females’ disadvantages in the labor market. Due to governmental deregulation of the market, enterprises began to employ more men than women, and discrimination against women in the labor market has increased since the “reform and open-up” [45-46]. Moreover, education is more important for women in securing jobs than for men. Hence, education is more important for women than for men across cohorts.

Although self-reported health is a valid measure of health status [30], it is susceptible to effects based on individual characteristics and cultural contexts. A study found that people with higher education and income tend to report their health optimistically in China [47]. Given its vulnerability to individual and social influences, the association between education and self-reported health may be receiving too much attention in the literature. The vignette method could be incorporated into studies in the future to provide more qualitative information if related items are included in the design of data collection instruments. The relationship between education and health is complex or potentially reciprocal - people with higher education can improve their health, but people may drop out of high school due to severe health problems. The primary goal of our study is to illustrate the demographic and cohort patterns for the education and health association. As such, we cannot establish a causal relationship between education and health, however different methods and data may allow for the conclusion of causal inferences in future studies.

Conclusions

In conclusion, the study investigated how the categories of gender and cohort moderate the returns to education on health, as well as how the gender-cohort interactions condition the education-health associations over time. The results did not support the rising importance hypothesis, especially among men. This different pattern suggests that broad contextual factors such as gender and cohort can significantly shape the education-health patterns across cohorts in China. Our findings show that the gender difference in the association between education and health is significant, but China’s unique history of educational and health development, as well as distinctive dining culture, may have also influenced these education-health patterns. The rapid
social change and the Chinese authoritarian state require various theoretical frameworks to explain
the gender disparity in educational benefits across cohorts.

**Abbreviations**
CFPS: Chinese Family Panel Survey

**Ethics approval and consent to participate**
Not applicable

**Consent for publication**
Not applicable

**Availability of data and materials**
The datasets generated and/or analyzed during the current study are available in the Chinese Family Panel Survey, [http://www.isss.pku.edu.cn/cfps/index.htm](http://www.isss.pku.edu.cn/cfps/index.htm).

**Acknowledgements**
We would like to thank the anonymous reviewers for their helpful comments and suggestions on the manuscript.

**Competing interests**
The authors declare that they have no competing interests.

**Funding**
Funding for this research was supported by Small Research Grant from the Department of Sociology at UC Davis to the second author. We want to thank the Institute of Social Science Survey of Peking University for sharing the data.

**Authors’ contributions and materials**
ZBW provided the background information of the study; documented, analyzed and interpreted the data; discussed the results of the study; and was the major contributor in writing the manuscript. YYW interpreted the data and provided English editing. Both authors read and approved the final manuscript.

**Authors’ information**
Bowen Zhu, PhD of Sociology, Lecturer of School of Public Administration, Hunan Normal University. Yiwan Ye, PhD student, Department of Sociology, University of California, Davis.
### Table 3: Coefficients and Odds Ratios of Age Vector Models for Education, Gender and Cohort Effects on Self-Reported Health

|                      | Full Sample | Female Only | Male Only |
|----------------------|-------------|-------------|-----------|
|                      | Model 1     | Model 2     | Model 3   |
|                      | Model 4     | Model 5     | Model 6   |
| Fixed Effect Component |             |             |           |
| For Intercept        |             |             |           |
| Intercept            | 0.697 2.008 *** | 1.024 2.784 *** | 1.162 3.195 *** |
|                      | -0.041 0.959 *** | ***          | ***       |
| Age (centered at 22) | -0.047 0.954 | -0.046 0.955 | -0.040 0.961 *** |
|                      | 0.001 1.001 *** | ***          | ***       |
| Male                 | 0.446 1.561 *** | 0.392 1.480 *** | 0.392 1.479 *** |
| Education Years      | 0.086 1.089 *** | 0.085 1.088 *** | 0.055 1.056 *** |
|                      | -0.016 0.984 *** | -0.006 0.994 *** | -0.004 0.996 *** |
| Male*Education Years |             |             |           |
| Cohort (Old China 1908-1938) |             |             |           |
| New China: 1939-1946 | -0.109 0.897 | -0.171 0.843 | -0.131 0.877 |
| Early Cultural Revolution: 1956-1960 | -0.172 0.842 | -0.241 0.786 | -0.184 0.832 |
| Economic Reform: 1967-1976 | -0.420 0.657 | -0.709 0.492 | -0.511 0.601 |
| Early Opening-Ups: 1977-1983 | -0.366 0.693 | -0.702 0.496 | -0.388 0.678 |
| Late Opening-Ups: 1984-1994 | -0.131 0.877 | -0.127 0.881 | 0.246 1.279 |
| Interaction: Education*Cohort |             |             |           |
| Education*1939-1946 | 0.016 1.016 | 0.021 1.022 | 0.038 1.038 |
| Education*1947-1955 | 0.013 1.013 | 0.017 1.017 | 0.040 1.040 |
| Education*1956-1960 | 0.038 1.038 | 0.045 1.046 ** | 0.061 1.063 * |
| Education*1961-1966 | 0.018 1.018 | 0.022 1.023 | 0.038 1.039 |
| Education*1967-1976 | 0.057 1.058 *** | 0.059 1.061 *** | 0.084 1.088 *** |
| Education*1977-1983 | 0.062 1.063 *** | 0.058 1.059 ** | 0.097 1.102 *** |
| Education*1984-1994 | 0.024 1.024 | 0.019 1.020 | 0.039 1.040 |
| Family Income        | 0.157 1.170 *** | 0.158 1.172 *** | 0.155 1.168 *** |
| Employed             | 0.262 1.299 *** | 0.166 1.180 *** | 0.393 1.481 *** |
| Taking Exercise      | 0.050 1.051 *** | 0.051 1.052 *** | 0.049 1.051 ** |
For Linear Growth Rate (Time = Survey Waves)

|                         | Estimate 1   | Standard Error 1 | Estimate 2   | Standard Error 2 | Estimate 3   | Standard Error 3 | Estimate 4   | Standard Error 4 |
|-------------------------|--------------|------------------|--------------|------------------|--------------|------------------|--------------|------------------|
| Intercept               | -0.016 0.984*** | -0.059 0.943     | + 0.048 1.049 | 0.016 1.016      | 0.113 1.119   | + 0.016 1.016    |
| Age (centered at 22)    | 0.001 1.001   | 0.001 1.001      | 0.000 1.000   | 0.002 1.002      | -0.002 0.998  |
| Male                    | 0.016 1.016   | 0.016 1.016      | 0.017 1.017   |                  |              |
| Education               | 0.001 1.001   | 0.001 1.001      | 0.002 1.002   | 0.005 1.005      | -0.003 0.997  |
| Male*Education          | -0.003 0.997  | * -0.003 0.997   | * -0.003 0.997 |                 |              |
| Cohort: Old China 1908-1938 |            |                  |              |                  |              |
| New China: 1939-1946    | 0.004 1.004   | 0.014 1.014      | 0.005 1.005   | 0.012 1.012      | -0.002 0.998  |
| The ‘Lost’ Generation: 1947-1955 |      |                  |              |                  |              |
| Early Cultural Revolution: 1956-1960 | 0.035 1.036   | 0.044 1.045      | 0.020 1.020   | 0.072 1.075      | -0.077 0.926  |
| Late Cultural Revolution: 1961-1966 | 0.051 1.052   | 0.031 1.032     | + -0.002 0.988 | 0.036 1.037      | -0.048 0.953  |
| Economic Reform: 1967-1976 | 0.076 1.079   | + 0.084 1.087    | 0.040 1.041   | 0.099 1.104      | -0.048 0.953  |
| Early Opening-Ups: 1977-1983 | 0.085 1.089   | 0.093 1.098     | 0.034 1.034   | 0.092 1.096      | -0.060 0.942  |
| Late Opening-Ups: 1984-1994 | 0.022 1.023   | 0.048 1.050      | -0.019 0.981  | -0.024 0.976     | 0.054 1.055  |
| Interaction: Education*Cohort |              |                  |              |                  |              |
| Education*1939-1946     | -0.003 0.997  | -0.003 0.997     | -0.005 0.995  | -0.003 0.997     |              |
| Education*1947-1955     | 0.003 1.003   | 0.003 1.003      | 0.000 1.000   | 0.003 1.003      |              |
| Education*1956-1960     | -0.002 0.998  | -0.003 0.997     | -0.006 0.994  | 0.002 1.002      |              |
| Education*1961-1966     | 0.003 1.003   | 0.002 1.002      | -0.001 0.999  | 0.001 1.001      |              |
| Education*1967-1976     | -0.002 0.998  | -0.002 0.998     | -0.007 0.993  | 0.000 1.000      |              |
| Education*1977-1983     | -0.002 0.998  | -0.002 0.998     | -0.001 0.999  | -0.004 0.996     |              |
| Education*1984-1994     | -0.003 0.997  | -0.004 0.996     | 0.000 1.000   | 0.018 0.982      | *              |
| Family Income           | -0.006 0.994  | -0.007 0.993     | + -0.004 0.996 |              |
| Employed                | -0.009 0.991  | * -0.006 0.994   | -0.014 0.986  |              |
| Physical Exercise       | -0.008 0.992  | -0.008 0.992     | ** -0.007 0.993 | *              |
| Variance Component      | 1.677***      | 1.679***         | 1.679***      | 1.658***        | 1.605***      | 1.723***        |
| Sample Size             | 100,608       |                  | 51,395        | 49,213          |

Note: + P<0.1, * P<0.05, ** P<0.01, *** P<0.001
All results are based on population-average models with robust standard errors.
Reference
1. Andersen RM. Revisiting the behavioral model and access to medical care: does it matter? Journal of health and social behavior. 1995; 36:1-10.
2. Landerman LR, Burns BJ, Swartz MS, Wagner HR, George LK. The relationship between insurance coverage and psychiatric disorder in predicting use of mental health services. The American journal of psychiatry. 1994; 151:1785.
3. Ross CE, Wu CL. The links between education and health. American sociological review. 1995; 60:719-45.
4. Lin N, Ensel WM. Life stress and health: Stressors and resources. American sociological review. 1989;54: 382-99.
5. Ross CE, Mirowsky J. Why education is the key to socioeconomic differentials in health. Handbook of medical sociology. 2010;6: 33-51.
6. Chen F, Yang Y, Liu G. Social change and socioeconomic disparities in health over the life course in China: A cohort analysis. American sociological review. 2010; 75:126-50.
7. Johnson RJ, Wolinsky FD. Gender, race, and health: The structure of health status among older adults. The Gerontologist. 1994; 34:24-35.
8. Leopold L, Leopold T. Education and health across lives and cohorts: a study of cumulative (dis) advantage and its rising importance in Germany. Journal of health and social behavior, 2018; 59: 94-112.
9. Ross CE, Mirowsky J. Sex differences in the effect of education on depression: resource multiplication or resource substitution? Social science & medicine, 2006; 63: 1400-13.
10. Ross, CE, Mirowsky J. Gender and the health benefits of education. The Sociological Quarterly, 2010; 51: 1-19.
11. Williams, DR, Collins C. US socioeconomic and racial differences in health: patterns and explanations. Annual Review of Sociology. 1995; 21:349-86.
12. Zheng L, Zheng X. The Cohort Variations of Education Related Health Gradients in China: Analysis Based on Growth Curve Model. Population & Economics. 2018; 227:69-79.
13. Braveman P. Health disparities and health equity: concepts and measurement. Annual Review of Public Health. 2006; 27: 167-194.
14. Schoenfeld DE, Malmrose LC, Blazer DG, Gold DT, Seeman TE. Self-rated health and mortality in the high-functioning elderly--a closer look at healthy individuals: MacArthur field study of successful aging. Journal of Gerontology. 1994; 49:M109-15.
15. Rose SJ, Hartmann HI. Still a man's labor market: The long-term earnings gap: Institute for Women's Policy Research. 2004.
16. Ross CE, Bird CE. Sex stratification and health lifestyle: consequences for men's and women's perceived health. Journal of health and social behavior. 1994; 35:161-78.
17. Mirowsky J, Ross CE. Education and self-rated health: Cumulative advantage and its rising importance. Research on Aging. 2008; 30:93-122.
18. Bracke P, Pattyn E, Knesebeck O. Overeducation and depressive symptoms: diminishing mental health returns to education. Sociology of health & illness. 2013; 35:1242-59.
19. Bracke P, Straat V, Missinne S. Education, mental health, and education-labor market misfit. Journal of health and social behavior. 2014; 55:442-59.
20. Delaruelle, K., Buffel, V., & Bracke, P. (2015). Educational expansion and the education gradient in health: A hierarchical age-period-cohort analysis. Social science & medicine, 145, 79-88.
21. Goesling, B. The rising significance of education for health? Social Forces.2007; 85: 1621-44.
22. Lynch SM. Cohort and life-course patterns in the relationship between education and health: A hierarchical approach. Demography. 2003; 40:309-31.
23. Davis-Friedmann D. Intergenerational inequalities and the Chinese revolution: the importance of age-specific inequalities for the creation and maintenance of social strata within a state-socialist society. Modern China. 1985; 11:177-201.
24. Ding X, Suhong Y, Ha W. Trends in the Mincerian Rates of Return to Education in Urban China: 1989–2009. Frontiers of Education in China. 2013; 8:378-97.
25. Deng Z, Treiman DJ. The Impact of the Cultural Revolution on Trends in Educational Attainment in the People's Republic of China. American Journal of Sociology. 1997; 103: 391-428.
26. Zhang Z, Chen Q. College Expansion and Gender Equalization in Higher Education: An Empirical Study Based on 2008 Chinese General Social Survey. Sociological Studies. 2013; 2:173-96.
27. Ministry of Education of the People’s Republic of China. Educational Statistics Yearbook of China. Beijing: China Statistics Press; 2018.
28. Li C. The Changing Trend of Educational Inequality in China (1940-2010): Reexamining the urban-rural gap on educational opportunity. Sociological Studies. 2014; 2:65-89.
29. Mok KH, Wu AM. Higher education, changing labour market and social mobility in the era of massification in China. Journal of Education & Work. 2016; 29:77-97.
30. Mossey JM, Shapiro E. Self-rated health: a predictor of mortality among the elderly. American journal of public health. 1982; 72:800-8.
31. Ross CE, Wu CL. The links between education and health. American sociological review. 1995; 60:719-45.
32. Ferraro KF, Farmer MM, Wybraniec JA. Health trajectories: long-term dynamics among black and white adults. Journal of health and social behavior.1997; 38:38-54.
33. Willson AE, Shuey KM, Elder J, Glen H. Cumulative advantage processes as mechanisms of inequality in life course health. American Journal of Sociology. 2007; 112:1886-924.
34. Shu X, Zhu Y. Uneven transitions: Period-and cohort-related changes in gender attitudes in China, 1995–2007. Social Science Research. 2012; 41:1100-15.
35. Ecob R, Smith GD. Income and health: what is the nature of the relationship? Social science & medicine. 1999; 48:693.
36. Umberston D, Crosnoe R, Reczek C. Social Relationships and Health Behavior Across the Life Course. Annual Review of Sociology. 2010; 36:139-57.
37. Curran PJ, Obeidat K, Losardo D. Twelve Frequently Asked Questions About Growth Curve Modeling. Journal of Cognition & Development. 2010; 11: 121-36.
38. Raudenbush SW, Bryk AS. Hierarchical linear models: Applications and data analysis methods. Sage. 2002.
39. Mirowsky J, Kim J. Graphing age trajectories: vector graphs, synthetich and virtual cohort projections, and virtual cohort projections, and cross-sectional profiles of depression. Sociological Methods & Research. 2007; 35:497-541.
40. Chen Y, Bian Y. Analyzing the Corrosive and Differential Roles of Social Eating in Political Trust: The Side Effects of Guanxi Capital. Chinese Journal of Sociology. 2015; 35:92-120.
41. Lu B. A new stage of the nutrition transition in China. Nutrition Transition. 2002; 5:169-74.
42. Jones-Smith JC, Penny GL, Arjumand S, Popkin BM. Emerging Disparities in Overweight by Educational Attainment in Chinese Adults (1989–2006). International Journal of Obesity. 2012; 36:866-875.
43. Knight J, Deng Q, Li S. China’s expansion of higher education: The labour market consequences of a supply shock. China Economic Review. 2016; 43:127-41.
44. Shu, X. Market transition and gender segregation in urban China. Social Science Quarterly, 2005; 86:1299-323.
45. Zhang Y, Hannum E, Wang M. Gender-based employment and income differences in urban China: Considering the contributions of marriage and parenthood. Social Forces. 2008; 86:1529-1560.
46. Shu X, Bian Y. Market transition and gender gap in earnings in urban China. Social Forces. 2003; 86:1107-1145.
47. Qi Y. Reliability and Validity of Self-Rated General Health. Chinese Journal of Sociology. 2014; 34:196-215.