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Abstract This study investigates the effect of adult children's education on parental healthcare utilization in China. We exploit an arguably exogenous change in children's education, induced by the Compulsory Education Law CEL) reform around 1986. We find that adult children's education reduces parents' outpatient care utilization, but increases their inpatient care utilization, self-treatment use, and dental care. These effects can partly be explained by an increasing awareness of chronic diseases and of quality and price differentials of different treatments, possibly as a result of children's knowledge transfer. Moreover, parents receive more monetary transfers from children and have more economic resources to afford more health services, as their children are better educated. As a result, children's education improves elderly parents' life expectancy.

JEL Codes: I10, I21, I28, J14

Keywords: Education; Healthcare utilization; Upward spillover; China

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Highlights

- We exploit the 1986 China Compulsory Education Laws reform to assess the impact of children's education on their parents' healthcare utilization.
- Parents switch from outpatient to inpatient care for better quality if their children are better educated. They also use more self-treatment, chronic disease management, and dental care.
- The main mechanisms are better knowledge of health and the healthcare system, and more financial support from children.
- The increase in healthcare use raises elderly parents' life expectancy.

1 Introduction

Healthcare underuse is prevalent in developed as well as developing countries (see Asch et al., 2000, and Feng et al., 2020, for evidence on the US and China, respectively). Older people are more vulnerable to the adverse consequences of insufficient use of healthcare services, which can lead to disability and higher mortality (Zhang et al., 2018). Existing research has documented that education is among the most significant determinants of health and healthcare use (e.g., Cutler & Lleras-Muney, 2006).[1] Recent studies have brought in the importance of family members' education for health ad health behavior, especially at a later stage of life. Better educated children can help parents to live longer in both developing and developed countries (Cui et al., 2021; De Neve & Harling, 2017; De Neve & Fink, 2018; Lundborg & Majlesi, 2018) and to maintain a better cognition status in old age (Lee, 2018; Ma, 2019; Ma et al., 2021). They also improve elderly parents' physical health (Liu et al., 2022; Liu, 2021; Yahirun et al., 2017). None of these studies, however, provide causal evidence of the effect of adult children's education on healthcare utilization of their parents.[2] Understanding this effect helps to uncover the complete return to children's education, accounting for parents' healthcare consumption in later life.

1 Previous studies found that education has a positive effect on one's own healthcare consumption. Individuals with higher education use more preventive medical care because of better access (Fletcher & Frisvold, 2009), and are more likely to receive expensive and new prescription drugs (Wang et al., 2007; Weitoft et al., 2008), to have contact with professional doctors and to use advanced technology (Torssander, 2013). Better education also makes mothers more likely to seek maternal health care and reduces health risks related to childbirth (Weitzman, 2017).

2 The only paper describing the relation between children's education and elderly parents' health care use is Ambade et al. (2021). They find that in India, having better educated children is associated with higher chances of utilizing both outpatient and inpatient care.

The underuse of healthcare services may be due to limited resources in healthcare-related knowledge, financial constraints, or time available for healthcare. Children with improved education have the potential to alleviate all these three constraints. First, better-educated children may bring health-related knowledge, helping parents to use healthcare services more effectively. This knowledge transfer channel may work in several ways: First, parents may get a better perception of their actual (objective) health condition; they are more likely to have their disease diagnosed and treated properly; second, parents may adopt a healthier life style and adjust their behavior, e.g., do more physical exercise or engage less in smoking and drinking alcohol; and third, parents may become better aware of the nature of their insurance (e.g., reimbursement rates), the effective price of medical services, and the service quality of different types of healthcare providers.[3]

Second, children with better education might provide more financial support to their elderly parents. They have higher income and are more likely to be time constrained and give monetary support to compensate for limited frequency of visiting or providing informal care. This increases the parents' financial possibilities to use healthcare services if needed.

Third, better-educated children may change the parents' time use and the time available for visiting doctors or hospitals. Children may need parents to take care of the grandchildren if they work more. Alternatively, parents may get more time if, because of their better education, the adult children prefer formal childcare to grandparental care.

This paper provides the first evidence on the causal effects of children's education on parental healthcare utilization in old age, with data from China, with a comprehensive examination of the underlying mechanisms. China provides a particularly relevant setting for this topic. On the one hand, there is a remarkable upward trend in the educational attainment across different generations. Along with the rapid economic development since 1979, China witnessed several reforms and efforts to improve education. The illiteracy rate is 0.6% for those born in the 1980s, versus 29.2% for cohorts born in the 1930s. The proportion of individuals who received at least nine years of education rose from 21.5% for birth cohorts of the 1930s to 91.8% for those born in the 1980s.[4] This gap makes it highly likely that within a family, adult children transfer knowledge or resources to their parents. Moreover, many of the elderly in China rely on their adult children for financial support, partly due to an ungenerous

3 Patients in China can choose their healthcare providers and hospitals, including the top-ranked hospitals.
4 Source: China Population Census., National Bureau of Statistics of China (2010).

public welfare system and the tradition of filial culture. Children's education can therefore be expected to have an important impact on parents' healthcare utilization.

The major challenge to identify the causal effect is the potential endogeneity of children's education due to unobserved characteristics of the family or the parents that affect their own life course and socioeconomic status as well as the educational choices for their children. To address the endogeneity problem, we exploit the natural experiment of China's nine-year compulsory education laws (CELs) and construct instrumental variables for children's education based upon the exposure to these reforms as well as the interaction of exposure with the initial (pre-reform) education level. The latter exploits the fact that children in regions with scarcer initial education resources have larger potential gains due to the CELs. (Duflo, 2001; Ma, 2019).

We use the 2011, 2013, 2015 and 2018 waves of the China Health and Retirement Longitudinal Study (CHARLS) and explore a wide range of healthcare services, including outpatient care, inpatient care, self-treatment use, dental care, health management, and catastrophic health expenditure. We find that the adult children's education has a significant negative effect on out-of-pocket (OOP) outpatient cost, but positively affects the incidence and OOP costs of using inpatient care and self-treatment. We also find that parents with better educated children manage their diseases better without imposing a financial burden on their families. Moreover, children's education improves elderly parents' life expectancy.

Our main results are robust to alternative instruments, additional controls of time-varying province characteristics, controlling for province-specific cohort trends, the effect of One Child Policy, and the choice of focal child, etc.

We then explore the three mechanisms that may explain the effects: knowledge transfer, economic resources, and time use. We find that a higher educated child makes the parent more likely to report chronic diseases and comparing with objective disease indicators based upon biomarkers shows that this is due to higher awareness rather than worse health conditions. Additional support for the knowledge transfer channel is that the positive effect of children's education on parental healthcare use is largest among lower educated parents, the group for which we expect information and knowledge transfer to play the largest role. The information and knowledge transfer channel may also explain why parents with better-educated children use less outpatient care but more inpatient care: Patients usually have a higher reimbursement rate for the inpatient care and better educated children make the parents aware that they can get quality treatment with a lower price if they switch from outpatient to inpatient care. Accordingly, we find that children's education increases the fraction of medical expenses that are reimbursed. Moreover, parents with better educated children are more likely to visit hospitals that are associated with better quality, instead of local community healthcare centers, confirming that parents with better educated children receive higher quality treatment.

Regarding financial support, we find that parents enjoy more economic resources if their children get better educated. They have higher household expenditure and receive more transfers from children, giving them the ability to purchase more healthcare services. On the other hand, we find no evidence that children's education would change parents' time available for seeking timely healthcare services.[5]

This paper is, to our knowledge, the first to provide causal evidence of how an increase in children's education affects parents' healthcare use in old age. We examine the effects in a developing country setting, where healthcare consumption of the elderly is relatively poor and the level of education of the elderly is low. Several existing studies examine the effects of children's education on parents' health outcomes but probing into healthcare utilization provides a more comprehensive picture and may reconcile some mixed findings. Using a similar empirical strategy as we use, Ma (2019) finds no significant effects on several subjective health measures (self-reported health, CES-D mental health, life satisfaction), but a positive effect of children's education on parents' subjective expectations of longevity and peak expiratory flow. Liu et al. (2022) find that children's education reduces parents' chances of having hypertension but has no effect on other chronic diseases (e.g., diabetes). Our results suggest that parents are more likely to report they have some chronic diseases. To reconcile our findings with those of Ma (2019): parents may not feel healthier because they are better informed of having some chronic diseases. On the other hand, they may be confident to live longer because they learn how to manage these diseases.

Our paper also relates to recent work on the health consequences of exposure to health expertise in the family (Artmann, Oosterbeek & van der Klaauw, 2022; Chen, Chen & Polyakova, 2022).[6] Health expertise may benefit family members by bringing health-specific knowledge. Artmann et al. (2022) study whether having children in medical school change parents' healthcare use in the Netherlands, exploiting randomized acceptance into medical school. They found almost no effects on parents' health status and healthcare use in old age. Our setting differs in two ways: First, the

5 Another channel through which available time might play a role is labor supply of the parents. We found a negative effect of children's education, in line with Ma (2019), but could not find a specification supported by the usual tests.
6 Chen et al. (2022) examine the effect of health expertise on health of members in the extended family, including both parents and other relatives. Artmann et al. (2022) focus on the effects on parents, as we do here.

elderly parents in our sample are low educated, with around half of them illiterate. This makes children's education more likely to contribute to parents' healthcare use, providing parents basic knowledge on health and medical care. Second, older parents in China face a public healthcare system where the reimbursement rate[7] is generally higher for inpatient than for outpatient care. Well educated children may help parents to navigate through the healthcare system and figure out medical treatments with lower (net) prices and higher quality.

With the rapid population aging in China, we expect well-designed policies to support the aging society. Our results underline the importance of adult children in parents' healthcare consumption in later life.

The remainder of the paper is organized as follows. Section 2 introduces the Nine-year compulsory education laws. Section 3 describes the data and Section 4 presents the empirical strategy. Section 5 reports main results while Section 6 explores potential mechanisms. Section 7 shows some robustness checks. Section 8 concludes.

2. Institutional background

China's nine-year compulsory education laws (CELs) were enacted in 1986, aiming at protecting the right of all children to receive education and increasing their years of schooling. The laws require free tuitions for the nine years of basic education, to ensure that every child can afford it. Moreover, companies and other organization are forbidden to employ children of compulsory school age, usually 6 to 15 or 16 (Cui et al., 2021). The implementation of CELs was a great success: It substantially enhanced the enrollment rates of both primary school and junior high school.

The first CELs were implemented in 1985 in Shanghai and staggered out over the whole country. Columns (2) and (3) of Table 1 (and Figure A.1) summarize the provincial-level time of implementation and first affected cohorts. The CELs are implemented at different times across provinces. A concern might be that the timing of implementation is non-random across provinces. We use province fixed effects to control for time-invariant differences across provinces. Conditional on these, CELs seem an appropriate natural experiment for analyzing the causal effects of children's education. Huang (2015) and Ma (2019) exploited this to analyze the effects on parents' physical and mental health.

7 The reimbursement rate here is defined as the amount of healthcare cost paid by the insurer (i.e., the government) divided by the total healthcare cost.

Table 1 Introduction of the Nine-year compulsory education law (CEL) in China by province

Province	Actual reform year	First affected birth cohort	Average schooling years of ineligible cohorts		Proportion with less than nine years of education for ineligible cohorts	
			Urban	Rural	Urban	Rural
Beijing	1986	1971	11.923	9.038	0.022	0.118
Tianjin	1987	1972	10.948	8.521	0.083	0.264
Hebei	1986	1971	10.392	8.371	0.096	0.263
Shanxi	1986	1971	10.625	8.299	0.079	0.293
Inner Mongolia	1989	1974	10.493	7.748	0.102	0.436
Liaoning	1986	1971	10.533	7.993	0.068	0.379
Jilin	1987	1972	10.542	7.749	0.085	0.453
Heilongjiang	1986	1971	10.345	7.896	0.093	0.418
Shanghai	1985	1970	11.185	8.553	0.055	0.193
Jiangsu	1987	1972	10.037	8.443	0.110	0.255
Zhejiang	1985	1970	9.302	7.766	0.234	0.421
Anhui	1987	1972	9.130	7.401	0.248	0.475
Fujian	1988	1973	9.492	7.582	0.257	0.498
Jiangxi	1986	1971	9.787	7.496	0.212	0.506
Shandong	1987	1972	10.069	8.008	0.126	0.340
Henan	1987	1972	10.205	8.329	0.112	0.265
Hubei	1987	1972	10.131	7.778	0.129	0.432
Hunan	1991	1976	10.398	8.342	0.094	0.308
Guangdong	1987	1972	9.729	7.924	0.179	0.393
Guangxi	1991	1976	9.934	7.933	0.161	0.413
Hainan	1992	1977	10.466	8.009	0.112	0.352
Chongqing	1986	1971	9.556	7.371	0.220	0.546
Sichuan	1986	1971	9.469	7.297	0.228	0.531
Guizhou	1988	1973	9.069	5.846	0.308	0.717
Yunnan	1987	1972	9.428	6.139	0.292	0.724
Tibet	1994	1979	7.621	2.364	0.504	0.926
Shaanxi	1987	1972	10.580	7.811	0.110	0.393
Gansu	1991	1976	10.535	6.503	0.121	0.571
Qinghai	1989	1974	10.451	5.336	0.147	0.672
Ningxia	1986	1971	10.549	6.683	0.129	0.534
Xinjiang	1988	1973	11.451	7.792	0.086	0.490

Notes: Implementation information is collected from Table 1 in Ma (2019), except for Tibet, Hainan, and Ningxia from Table B1 in Cui et al. (2019). Average schooling year of ineligible cohorts and the proportion with less than nine-years education of ineligible cohorts refer to the six youngest cohorts before the implementation of the compulsory education law. Source: 1% sample of the 2000 Population Census of China (National Bureau of Statistics of China, 2000).

The other columns of Table 1 (plus Figures A.2 and A.3) present urban and rural initial education conditions by province, measured as average schooling years of ineligible cohorts (i.e., cohorts that are at most 6 years older than the first eligible cohorts) and the proportion of ineligible cohorts whose schooling years are less than nine.[8] This reveals substantial rural-urban disparities of initial educational resources across provinces. Average schooling years of ineligible cohorts in rural areas are typically less than nine, while in urban areas, they are approximately two years higher. The CELs may affect the cohorts differently, depending on the initial educational conditions. Specifically, regions with lower initial level of education may benefit more from the reform. We will exploit this to construct our instruments in Section 4.

3 Data

We use data from the China Health and Retirement Longitudinal Study (CHARLS), collected by Peking University. CHARLS biennially collects micro data of individuals aged 45 or above and their spouses, including demographic characteristics, health, health care utilization, income and expenditures, work, and retirement. The national baseline wave was launched in 2011, surveying 17,708 individuals, in 10,257 households in 450 villages/urban communities (Zhao et al., 2013). A useful feature of this dataset is that it not only contains demographic information on children, but also collects elderly's biomarkers, which is helpful to construct objective measures of diseases. Our paper uses all four waves released so far: 2011, 2013, 2015 and 2018.

3.1 Children's education

We assume that the eldest child plays the most important role in the health utilization of the parents, since in the Chinese tradition, the eldest child is the "pampered chief" and usually has the main responsibility to provide care to elderly parents. We use the eldest child's level of education and convert it to years of schooling (Kemptner et al., 2011), ranging from 0 for not completing formal education to 22 for getting a doctoral degree.[9] If there is more than one eldest child (i.e., twins), we choose one randomly. In the total sample of eldest children, 67.78% of the observations have completed nine years of compulsory education. In Section 7 we also use all children's average education instead of the eldest child's education for a robustness check.

8 Both measures are constructed using a 1% sample of the 2000 China Population Census (National Bureau of Statistics of China, 2000).

9 Schooling years are composed of elementary school (6 years), middle school (9 years), high school (12 years), vocational school (12 years), 2 or 3 year college/associate degree (14.5 years), 4 year college/bachelor's degree (16 years), master's degree (19 years) and doctoral degree (22 years).

3.2 Outcome variables

To fully depict the effect on healthcare use, we consider the following four types of care: (1) *outpatient care* and *inpatient care*. We consider dummies for using the type of care or not, frequencies of using the type of care, and out-of-pocket (OOP) expenditures on the type of care. Reported outpatient care refers to the past month, while inpatient care refers to the past year. (2) *Self-treatment*: self-treatment practices like buying over-the-counter (OTC) drugs, taking health supplements, using traditional Chinese herbs, acupuncture treatment, health equipment, etc. We consider a dummy for using self-treatment in the last month and the OOP expenditures on self-treatment. (3) *Health management* and *catastrophic health expenditure (CHE)*: For health management, we include the number of blood pressure examinations in the past year and dummies for whether using medicines to manage hypertension, heart disease, and cancer.[10] For CHE, we define a dummy variable *CHE* to indicate whether individual annual OOP healthcare expenditure is at least 40% of the per capita annual household total non-food expenditure (Fan et al., 2021).[11] (4) *Dental care*: the incidence, frequency of, and OOP expenditures on dentist visits in the past year.[12]

3.3 Control variables

We control for the parent's characteristics, characteristics of the eldest child, and regional characteristics. More specifically, the parent characteristics we include are a dummy for male, age, age squared, years of schooling, marital status, number of living children, a dummy for whether the parent lives in an urban area, and dummies for the parent's childhood health conditions. The child's characteristics we control for are gender, birth province dummies and birth cohort dummies.[13] We also include the initial regional educational attainment, defined as average schooling years of the six youngest cohorts before the implementation of the compulsory education policy by province and separately for rural and urban areas.

10 We trim the blood pressure examination at the top 10 percentile to get rid of outliers.

11 Annual household OOP healthcare expenditure includes costs for outpatient care, inpatient care, self-treatment, and some dental care.

12 Frequency and OOP expenditure variables are set to be 0 if a respondent did not use the corresponding care. For each OOP expenditure variable x, we use the log transformation ln(x+1).

13 Since we restrict the sample to children born and living in the same place, the eldest child's birth province effects not only capture the time-invariant characteristics of the child's place of birth, but also the time-invariant characteristics of the province of residence.

3.4 Mechanism variables

To test the "knowledge transfer" channel, we consider three groups of variables: (1) *correct perception of health*: we check the parents' self-reported *chronic disease incidence* and *undiagnosed disease incidence* (hypertension, dyslipidemia, diabetes) to measure their awareness and correct perception of health issues.[14] We construct the variables on *undiagnosed diseases incidence* by comparing the self-reported disease with the objective status of disease inferred by corresponding biomarkers.[15] (2) *Health behavior and overall health indicators*: dummies indicating whether respondents *smoke*, *drink*, have *light* and *moderate exercise* or not. *Self-reported health* (ranges from 1 very poor or poor to 5 excellent), *mental health* (reversed CES-D score ranging from 0 least healthy to 30 most healthy), and *cognitive condition* (ranging from 0 worst to 5 best). (3) *Health insurance and the net price and quality of health care services*: we check if respondents *switch health insurance*, which probably indicates larger awareness of what the insurance covers and what is the net price of health care use, and the *reimbursed outpatient/ inpatient/ total cost*.[16] For quality of healthcare services, we check the *outpatient/inpatient incidence by type of healthcare provider,* ordered from higher to lower average quality: general hospital, specialized or Chinese medicine hospital, small healthcare center, and other healthcare providers.

For the "economic support" channel: we use the *annual net transfer from children*, calculated as the transfer from children minus that to children.[17] Moreover, we consider annual household per capita expenditures to account for the income condition of the parents, as expenditure is a better welfare measure and has fewer measurement errors than income in developing countries (Smith et al, 2012). Specifically, we consider *total expenditure*, *food expenditure*, *living expenditure*, and *health expenditure*.[18]

14 Throughout the paper, "incidence" refers to a dummy for something happening or not during a reference period that varies. See "Appendix: Definition of Variables."

15 The chronic disease dummy indicates if the respondent has at least one of the following chronic diseases: hypertension, dyslipidemia, diabetes or high blood sugar, cancer or malignant tumor, chronic lung diseases, liver disease, heart relative diseases, stroke, kidney disease, stomach or other digestive disease, emotional, nervous or psychiatric problems, memory-related disease, arthritis or rheumatism, and asthma. In addition, we separately explore the dummies for hypertension, cancer, heart relative diseases, dyslipidemia, kidney diseases, and memory diseases which are the most common and threatening diseases for the elderly. Undiagnosed diseases dummy indicates if the biomarker suggests having a disease but the respondent self-reports to have no such disease. See "Appendix: Definitions of Variables".

16 Reimbursed outpatient cost is calculated as "total outpatient cost last month – OOP outpatient cost last month". Reimbursed inpatient cost is calculated as the difference between total and OOP inpatient costs in the past year. Total reimbursed cost is the annualized (multiplied by 12) reimbursed outpatient cost plus the reimbursed inpatient cost.

17 Transfers and expenditures are measured at the household level.

18 The living expenditure includes communication fee; utilities including water and electricity; fuels; housekeeper, matron, and servants; local transportation; household items and personal daily toiletries plus beauty treatments; entertainment.

For the "time" channel: we check the dummy for *taking care of grandchildren* and *the annual hours spent on grandparenting*. More detailed definitions of outcome, control, and mechanism variables are shown in "Appendix: Definitions of Variables".[19]

3.5 Sample and descriptive statistics

We apply the following sample restrictions: First, we restrict the sample to respondents and spouses aged 40 or above and their eldest child aged 20 or above but less than 55 in the baseline survey (wave 2011), which drops 5315 (20.4%) individuals with 12817 (15.9%) observations. In this way, we keep children that were likely to have completed basic education. Second, we only keep the children who are residing in their birth places, so that they were more likely to get their education in the current province of residence. We drop 846 (4.1%) individuals with 1444 (2.1%) observations whose eldest children's birthplace information is missing, and 1488 (7.2%) individuals with 4294 (6.3%) observations whose eldest children were not born in their current place of residence. We also drop 190 (1%) individuals with 197 (0.3%) observations who have no living child. The final sample has 18,452 individuals with 61,773 observations, covering 447 communities in 126 cities in 28 provinces.

Table 2 reports summary statistics of the main variables. The sample has mean parent's age of 60.7 years. About 48% of them are males. 64% live in a rural area. Their average schooling is 4.7 years, which is not much more than half of the eldest child's average schooling years (8.9). The large majority are married (82.3 %) and 62.4 % of them have two or three children. Among the eldest children, 50.5% of are male. Their exposure to CELs ranges from 0 to 1 with a sample average of 0.6.

As for healthcare utilization, 20.5% of the sample used outpatient care last month, and the average number of doctor visits (zeros included) in the past month is 0.4. The average monthly OOP outpatient cost is 88.6 RMB (13.9 USD).[20] Inpatient care is less often used: 13.8% reported using inpatient care in the past year and average times of hospitalization (zeros included) is 0.2. The average yearly OOP inpatient cost is 481.1 RMB (75.7 USD), about 10% of the sample average of annual earned income after tax in 2011, 4330.4 RMB (681 USD). Conditional on using inpatient health care, the average annual OOP inpatient expenditure is 3485.5 RMB (548.1 USD), smaller than the average annualized OOP outpatient cost of 5186,3 RMB (815.6 USD). Healthcare

19 Throughout the paper, to account for zero values, all "log" variables apply the log(x+1) transformation, if not specially mentioned.

20 The exchange rate is 1 USD=6.359 RMB throughout the paper.

costs take up a substantial share of income, and this is even more so for outpatient care.

Table 2 Summary Statistics

Variables	Observ.	Mean	Std. dev.	Variables	Observ.	Mean	Std. dev.
Variable of Interest				*Parent characteristics*			
Schooling years of eldest child	60,538	8.939	4.609	Age	61,773	60.658	9.178
				Male	61,773	0.481	0.500
Outcome Variables				Own schooling years	61,762	4.734	4.571
Outpatient incidence	59,816	0.205	0.404	Marital status	61,773	Share	
#Doctor visits	59,162	0.443	1.470	Married, not separated		0.823	
Out-of-pocket (OOP) outpatient cost	52,952	88.640	1066.370	Married but separated		0.063	
Inpatient incidence	59,927	0.138	0.345	Divorced, widowed, never married or cohabiting		0.114	
# Inpatient care use	59,908	0.209	0.695	Number of children	61,773	Share	
OOP inpatient cost	54,018	481.070	6349.460	One		0.153	
Self-treatment incidence	59,756	0.548	0.498	Two and three		0.624	
OOP self-treatment cost	59,756	115.574	470.863	Four and five		0.189	
#Blood pressure examination	58,487	2.024	5.026	More than five		0.034	
Hypertension management with medicines	58,015	0.238	0.426	Childhood health conditions	54,072	2.663	1.010
Heart management with medicines	57,035	0.063	0.242	Urban	60,752	0.374	0.484
Cancer management with medicines	59,821	0.005	0.072				
				Child characteristics			
CHE (without dental cost)	36,504	0.258	0.438	Birth year	61,773	1977.550	8.829
Dental care incidence	30,668	0.177	0.381	Male	61,761	0.505	0.500
#Dentist visits	30,548	0.450	1.715	Exposure	61,773	0.578	0.438
OOP dentist visits cost	30,401	104.460	533.108				

Notes: The dental care incidence, number of dentist visits, and OOP dentist visits cost are only asked in 2013 and 2015 waves, while other outcomes are available in all four waves. All outcomes are measured at the individual level.

This relates to the fact that the public health insurance (especially the one for the rural residents) has high copayments in general and limited coverage for outpatient care in particular (Barber & Yao, 2010; Li et al., 2017).

On the other hand, self-treatment as complementary informal healthcare is heavily used. 54.8% reported using some self-treatment in the past month, and the average monthly OOP self-treatment cost is 115.6 RMB (18.2 USD). Health management varies by condition. The average number of blood examinations is 2.0. 23.8% and 6.3% of the sample use medicines to control hypertension and heart related diseases in the past year, respectively, while only 0.5% individuals use medication to control cancer in the past two years. For dental care, 17.7% of all individuals ever visited a dentist in the past year with 0.5 visits on average (zeros included), and average monthly OOP dental cost of 104.5 RMB (16.4 USD).

Mechanism variables and regional characteristics are summarized in Online Appendix Table A.1. Notably, although 73.7% of the parents in the sample report at least one chronic disease, undiagnosed diseases are not uncommon. The sample shares of individuals with undiagnosed diabetes, hypertension, and dyslipidemia are 7.2%, 10.2%, and 35.5%, respectively. The average yearly per capita household expenditure is 12,686.9 RMB (1995.1 USD), and the net annual transfer from children (1476.3 RMB or 232.2 USD) shows that many children provide important financial support to their parent(s).

4 Empirical strategy

The aim is to identify the effect of the children's education on parental healthcare utilization. We first use the linear regression equation:

$$H_{ibpt} = \tau\, ChildEdu_{ibp} + X'_{ibpt}\beta + \delta_p + \theta_b + \omega_t + \varepsilon_{ibpt} \qquad (1)$$

H_{ibpt} is the healthcare utilization outcome of individual i living in province p with the eldest child belonging to cohort b and born in province p, and with all information collected in year t. $ChildEdu_{ibp}$ is years of schooling of the eldest child. τ captures the effect of an additional schooling year on the outcome of the parent. X_{ibpt} is a vector of control variables including demographic characteristics of parents (gender, age and age squared, years of schooling, marital status, number of living children, and childhood health conditions) and child (the gender of the eldest child). It also includes regional characteristics: type of residence (1 means urban and 0 means rural) and the provincial-rural/urban specific average years of schooling of the six youngest ineligible cohorts, which accounts for the difference in initial education levels across provinces and rural/urban regions. δ_p is the child's birth province fixed effect which captures the time-invariant characteristics of the child's place of birth. θ_b is the child's birth cohort fixed effect. ω_t is the survey year fixed effect. Standard errors are clustered at the province-cohort level.[21]

OLS estimates of the parameters in equation (12) may be biased because of omitted variables that simultaneously affect human capital investment to children and healthcare use. To estimate the causal effect of child education, we use 2SLS, exploiting the exogenous variation in children's education created by CELs to create instruments. In particular, we adopt the following first-stage equation:

$$ChildEdu_{ibp} = \alpha_1\, Exp_{bp} + \alpha_2\, Exp_{bp} \times PreLaw_{ibp} + \\ + X'_{ibpt}\alpha_3 + \delta_p + \theta_b + \omega_t + u_{ibpt} \quad (2)$$

$ChildEdu_{ibpt}$ is years of schooling of the eldest child of parent *i*, born in year *b* and province p. The control variables X'_{ibpt} and fixed effects are the same as in equation (1). We construct two instruments for children's education: the intensity of exposure to the CEL Exp_{bp}, and its interaction with $\mathrm{PreLaw_{ibp}}$. Exp_{bp} is a continuous variable with values between 0 and 1; it is 1 for children who are fully exposed to CELs (i.e., were below age 7 when the reform happened) and 0 for those who are ineligible (i.e., were above age 16 at the time of the reform). For children who are partially exposed to the reform, we assume that the exposure intensity follows the linear function:

$$Exp_{bp} = \left(birthyear_{bp} - birthyear_p + 1\right)/10 \quad (3)$$

Here $birthyear_p$ is the birth year of the first cohort that are affected by CELs reform in province p, given in the third column of Table 1.

This functional form of the exposure implies that later-born children are more affected by CELs. It exploits both the geographical and temporal variation of the CELs reform. Given their year of birth, exposure to CELs depends on when CELs were

21 Results with heteroskedasticity robust standard errors are very similar.

introduced in child's birth provinces.

We further exploit the fact that the effect on education of the CELs reform is greater for provinces with less abundant education resources (Duflo, 2001). We construct the variable $PreLaw_{ibp}$ as average years of education for the youngest six unaffected cohorts for urban and rural residents in each province. The smaller $PreLaw_{ibp}$, the scarcer the education resources a region had before the CELs reform, and the larger will be the effect of the reform. We therefore expect the coefficient in equation (3) on Exp_{bp} to be positive, and the coefficient on the interaction $Exp_{bp} * PreLaw_{ibp}$ to be negative.

To check the validity of our first-stage specification, Online Appendix Figure A.4 shows how children's education has changed before and after the introduction of CELs in high and low $PreLaw$ regions. In particular, we first split the sample into two groups, based on the value of $PreLaw$: children from lower 50% $PreLaw$ regions and children from higher 50% regions. For each group, we regress the eldest child's years of schooling on a series of 2-year cohort group dummies, with the same control variables as in equation (1). Figure A.4 depicts the estimated coefficients of the cohort dummies. We normalize the last two ineligible cohorts (those aged 16 or 17 in the CELs implementation year) to 0 on the x-axis and choose them as the reference group. Consistent with our specification, Figure A.4 shows that 1) the increase in years of schooling is larger if children were exposed longer to the CELs; 2) the increase is larger for regions with lower $PreLaw$ levels. Moreover, the insignificant pre-trends before the introduction of CELs in both groups support the notion that when CELs were introduced is unrelated to education levels.

Using both Exp_{bp} and its interaction with $PreLaw_{ibp}$ as the IVs for the eldest child's schooling years allows us to test for overidentifying restrictions, possibly supporting the validity of the instruments. We will also report the first stage Kleibergen-Paap rk Wald F statistic for the relevance condition of the two instruments.

5 Results

5.1 First stage: The effect of CELs on the eldest children's education

Table 3 summarizes first stage results for two specifications. Column 1 includes two IVs, wave dummies, and province and cohort fixed effects; column 2 adds control variables. Results show similar patterns across specifications.

Table 3 First stage results for schooling years of the eldest child

Variables	Schooling years of the eldest child	
	(1)	(2)
Exposure	4.038***	5.094***
	(0.931)	(0.867)
Exposure × prelaw	-0.262***	-0.358***
	(0.081)	(0.077)
Control variables	No	Yes
Observations	45,994	45,994
Wave dummies	Yes	Yes
Province FE	Yes	Yes
Cohort FE	Yes	Yes
F statistic for weak identification	9.42	17.26

Notes: the controls in specification (2) are the parent's gender, age and age squared, schooling years, marital status, number of living children and childhood health conditions, gender of eldest child, type of residence, and average education before the law enforcement. Standard errors clustered at province-cohort level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

We take column 2 as our preferred (richer) specification. The Kleibergen-Paap rk Wald F statistics above 10 suggests that the two IVs are strong. From no exposure to full exposure to CELs, the predicted child education will increase by 3.2 years if *Prelaw* is at its minimum (5.336 years, see Table 1) and by 0.8 years if *prelaw* is at its maximum (11.923 years). The significant difference is in line with the notion that CELs have larger effects in regions with lower initial education levels.

5.2 The effects of the eldest children's education on parental healthcare utilization

Outpatient and inpatient care use

Table 4 presents OLS and 2SLS results for parental outpatient and inpatient healthcare use. The 2SLS estimates are generally larger in magnitude, suggesting that there are omitted variables which are negatively associated with the child's education and positively with parental healthcare use. The p values of the Hansen J statistics are all much larger than 0.05, supporting the joint validity of the instruments.

The 2SLS estimates suggest that one additional schooling year of the eldest child significantly reduces the probability of using outpatient care last month by 1.8 percentage points (pp) and reduces OOP outpatient costs by 7.3%, on average. The child's education does not significantly affect the number of doctor visits.

Inpatient care use, on the other hand, increases with child education. One additional child schooling year increases the probability of using inpatient care in the past year by 2.2 pp, the number of hospital stays by 0.04, and OOP inpatient costs by 11.9%. Since the means of inpatient incidence and the number of times inpatient care is used are just 0.1 and 0.2, these are quite large effects.

Table 4 Effects of children's education on outpatient and inpatient of older parents

Dependent variable	(1) OLS	(2) IV	(3) F statistic for weak identification	(4) p value of Hansen J statistic	(5) Observations
Outpatient incidence	0.001*	-0.018*	15.68	0.400	51,935
	(0.001)	(0.010)			
#Doctor visits	0.002	-0.043	16.32	0.186	51,371
	(0.002)	(0.034)			
Log out-of-pocket outpatient costs	0.003	-0.073*	17.25	0.441	45,994
	(0.003)	(0.041)			
Inpatient incidence	0.000	0.022**	15.66	0.847	51,998
	(0.001)	(0.010)			
#Times of inpatient care	0.000	0.043**	15.65	0.948	51,981
	(0.001)	(0.020)			
Log out-of-pocket inpatient costs	0.002	0.119**	16.00	0.829	46,841
	(0.003)	(0.052)			

Notes: All models control for the parent's gender, age and age squared, schooling years, marital status, number of living children and childhood health conditions, gender of eldest child, type of residence, and average education before the law enforcement, wave, province and cohort dummies. Standard errors clustered at province-cohorts level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

To better understand the drop in outpatient and the increase in inpatient care use, we consider the reasons and types of treatment used in the latest doctor visit and hospitalization in Online Appendix Tables A.2 and A.3. Better child education does not significantly affect the probability of a first doctor visit but reduces the number of follow-up visits significantly. One additional schooling year of the child increases the probability of an outpatient consultation by 0.1 pp, but reduces the probability of a parental medical check-up or immunization by 0.3 pp, drip infusion and treatment for illness by 1.9 pp, and medication by 2.0 pp. In contrast, one more year of child education increases the probability in the inpatient department to use a medical check-up or consultation (1.9 pp), injection (2.6 pp), drip infusion (1.8 pp), medications (1.6 pp), laboratory tests (1.7 pp), surgery (1.0 pp), X-ray (2.0 pp), and traditional treatment (1.0 pp). These results suggest a switching pattern: after the first visit to a doctor, parents with better educated children seem to switch for some services (e.g., medical check, drip infusion, medication) from outpatient to inpatient department. This can be related to the fact that inpatient services are reimbursed to a larger extent than outpatient services under mainstream public health insurance schemes, especially in rural China. Also, the same type of treatment received in inpatient departments can be more comprehensive and better followed up by the same doctor. We will discuss these price and quality incentives in detail in Section 6.

Self-treatment, health management, and CHE

Not only formal healthcare but also self-treatment increases with child education. As shown in column 2 of Table 5, one additional schooling year of the eldest child increases the probability of using self-treatment by 3.4 pp and OOP self-treatment costs by 21.3%. The effects on different types of self-treatment in Table A.4 in the Online Appendix suggest that the increase is mainly driven by the incidence and OOP costs of buying OTC drugs and using vitamins or health supplements. This implies that parents with better educated children are better informed how to buy OTC drugs and have better awareness of their health so that they are more willing to buy health supplements.

Consistent with increased self-treatment, a better educated child also prompts parents to do more health management. As also shown in Table 5, one additional schooling year leads to 14.8% (=0.298/2.014, where 2.014 is the sample mean) more blood pressure examinations, and makes the parent 3.5 pp, 4.4 pp, and 0.4 pp more likely to use medication to manage hypertension, heart disease, and cancer, respectively.[22] Since the prevalence of using medication for hypertension, heart disease and cancer are 24%, 63%, and 0.5%, these are all relatively large effects. Catastrophic health expenditures (CHE) do not significantly change with the eldest child's education level. It seems that parents with better educated children have better awareness and capability of long-term disease management, but this does not lead to more catastrophic medical expenditures.

Table 5 Effects of children's education on self-treatment, health management, CHE, and dentist visits of older parents

Dependent variable	(1) OLS	(2) IV	(3) F statistic for weak identification	(4) p value of Hansen J statistic	(5) Observations
Self-treatment incidence	0.002**	0.034***	15.63	0.835	51,888
	(0.001)	(0.013)			
Log out-of-pocket self-treatment cost	0.009**	0.213***	15.63	0.893	51,888
	(0.004)	(0.071)			
Blood pressure examination	0.022***	0.298***	16.08	0.625	50,549
	(0.005)	(0.094)			
Hypertension management with medicines	0.001*	0.035**	15.91	0.786	50,065
	(0.001)	(0.015)			
Heart management with medicines	0.001	0.044***	15.33	0.022	49,153
	(0.000)	(0.012)			
Cancer management with medicines	0.000	0.004**	15.45	0.816	51,668
	(0.000)	(0.002)			
CHE without dental cost	-0.002***	0.007	14.45	0.767	31,817

22 These findings are consistent with Liu (2021) who finds a positive effect of child education on parental self-reported health.

	(0.001)	(0.013)			
Dental care incidence	0.004***	0.016	15.83	0.794	27,267
	(0.001)	(0.012)			
#Dentist visits	0.011***	0.126**	16.32	0.714	27,162
	(0.003)	(0.049)			
Log out-of-pocket dentist visits cost	0.022***	0.091	16.06	0.597	27,034
	(0.004)	(0.067)			

Notes: All models control for parent's gender, age and age squared, schooling years, marital status, number of living children and childhood health conditions, and for gender of eldest child, type of residence, average education before the law enforcement, wave, province and cohort dummies. Standard errors clustered at province-cohorts level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Dental care use

Dental care has limited coverage by major public health insurance plans. Only basic curative care is covered, such as gum inflammation and pit and fissure sealant. Many common treatments, such as dental implant and root canal therapy, are excluded. Using dental care is often perceived as luxurious and it requires health awareness and knowledge.

2SLS estimates in Table 5 show that one additional schooling year of the eldest child significantly increases dentist visits by 28% (=0.126/0.45, where 0.45 is the sample mean of dentist visits). The OOP dental costs increase by 9%, but this change is insignificant. With better educated children, parents are more likely to have the awareness and knowledge to pay more attention to their teeth and might also be better able to afford this type of care.

In summary, if the child is better educated, parents tend to use less outpatient care, and replace it with more inpatient care, complemented with more self-treatment and health management. They use more dental care as well. The increased healthcare use appears to be non-catastrophic only.[23]

6. Potential mechanisms

In this section we explore the three mechanisms that may explain why better child education can affect parental healthcare utilization (see Section 1): knowledge transfer (correct perception of health, health behavior, price, and quality), economic support, and available time.

23 In Tables A.5 and A.6 in the Online Appendix, we allow for heterogeneous effects by parental and eldest child gender. We do not find much heterogeneity by parental gender (except that the effects of child education on self-treatment are larger for mothers than for fathers). On the other hand, for many outcomes we find that the effects are significantly larger for sons than for daughters.

6.1 Knowledge transfer channel

Correct perception of health

Knowledge transfer from better educated children can help parents to improve the perception of their health and adjust healthcare utilization accordingly. As shown in Table 6, the eldest child's education has a significant positive effect on the likelihood of reporting chronic diseases, particularly hypertension, cancer, heart disease, dyslipidemia, kidney, and memory diseases, suggesting that better educated children increase their parents' awareness of these diseases. In line with this interpretation, one additional schooling year of the eldest child raises the probabilities of having undiagnosed hypertension, dyslipidemia, and diabetes decrease by 1.6 pp, 0.5 pp, and 1.4 pp respectively. In other words, conditional on their own education and other characteristics, parents with better educated children are more likely to discover health problems, and this can induce them to use more healthcare and disease management.

Table 6 Effects of child's education on self-reported and undiagnosed chronic diseases

Dependent variable	(1) IV	(2) F statistic for weak identification	(3) p value of Hansen J statistic	(4) Observations
Chronic	0.036** (0.014)	15.81	0.343	51,926
Hypertension	0.033** (0.016)	16.03	0.706	51,999
Cancer	0.011*** (0.004)	15.88	0.705	51,997
Heart	0.050*** (0.015)	15.89	0.299	51,967
Dyslipidemia	0.019* (0.011)	15.88	0.381	51,654
Kidney	0.020** (0.010)	16.16	0.841	51,966
Memory	0.009* (0.005)	15.99	0.356	51,977
Undiagnosed hypertension	-0.016** (0.008)	18.93	0.780	38,778
Undiagnosed dyslipidemia	-0.005 (0.013)	15.14	0.097	23,396
Undiagnosed diabetes	-0.014* (0.007)	14.89	0.935	21,558

Notes: All models control for parent's gender, age and age squared, schooling years, marital status, number of living children and childhood health conditions, and for gender of eldest child, type of residence, average education before the law enforcement, wave, province and cohort dummies. Standard errors clustered at province-cohorts level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Health behavior

Parents can also benefit from the child's knowledge through healthier behavior and habits, improving their mental and physical health and reducing healthcare use. Table 7 checks this channel. Better child education increases the parent's probability of doing light exercise by 2.8 pp but has no significant effects on smoking, drinking, or social activities. It does not significantly improve parents' self-reported or mental health, except for cognitive conditions, consistent with findings of Ma (2019). Therefore, child education may have some positive impact on parental health behavior, but it seems unlikely to be the main channel for the effect of child education on healthcare use.

Table 7 Effects of children's education on health and health behavior of older parents

Dependent variable	(1) IV	(2) F statistic for weak identification	(3) p value of Hansen J statistic	(4) Observations
Self-reported health	-0.013	16.26	0.274	47,294
	(0.024)			
Mental health	0.016	15.97	0.416	49,185
	(0.186)			
Cognitive condition	0.163***	15.06	0.398	44,208
	(0.041)			
Smoking	0.001	15.61	0.792	49,058
	(0.012)			
Drinking	-0.014	15.75	0.118	51,999
	(0.013)			
Moderate exercise	0.003	15.51	0.968	29,434
	(0.013)			
Light exercise	0.028**	15.44	0.698	29,425
	(0.011)			
Social activity	-0.007	15.38	0.732	50,295
	(0.013)			

Notes: All models control for parent's gender, age and age squared, schooling years, marital status, number of living children and childhood health conditions, and for gender of eldest child, type of residence, average education before the law enforcement, wave, province and cohort dummies. Standard errors clustered at province-cohorts level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Health insurance and the net price and quality of health care services

Knowledge transfer from better educated children can help parents to be better informed about the health insurance scheme. They can switch to the insurance that suits them most or can learn more about their insurance's reimbursement policy and use health care services in a more cost-effective way.

In Panel A of Table 8, we check if better child education influences the parent's probability of switching insurance. We do not find any evidence for this. This is not surprising because the type of public health insurance scheme (e.g., schemes for the rural, the urban employees, and the urban residents) someone is eligible for is predetermined by Hukou (a rural/urban household registration system) and employment status before retirement.[24] It is not easy to switch health insurance.

Table 8 Effects of child education on reimbursed costs, switching insurance, and outpatient/inpatient incidence by type of healthcare providers

Dependent variable	(1) IV	(2) F statistic for weak identification	(3) p value of Hansen J statistic	(4) Observations
Panel A: reimbursed costs and switching insurance				
Ln reimbursed monthly outpatient cost	-0.003 (0.021)	17.10	0.600	45,949
Ln reimbursed annual inpatient cost	0.153*** (0.054)	15.95	0.269	46,799
Ln reimbursed annual outpatient and inpatient cost	0.149** (0.059)	18.03	0.448	41,658
Dummy for switching insurance	-0.016 (0.016)	10.75	0.536	27,518
Panel B: Outpatient incidence by level of healthcare providers				
Outpatient incidence (Outp.) in general hospital	-0.001 (0.006)	15.80	0.110	44,203
Outp. in specialized or Chinese medicine hospital	-0.003 (0.003)	16.51	0.819	42,118
Outp. in small healthcare center	-0.015* (0.008)	15.87	0.010	47,460
Outp. in other healthcare providers	-0.001 (0.001)	15.58	0.642	41,304
Panel C: Inpatient incidence by type of healthcare providers				
Inpatient incidence (Inp.) in general hospital	0.021*** (0.008)	15.33	0.818	48,395
Inp. in specialized or Chinese medicine hospital	0.009** (0.004)	14.57	0.310	45,895
Inp. in small healthcare center	-0.005 (0.005)	13.98	0.318	45,939
Inp. in other healthcare providers	-0.001 (0.001)	14.64	0.304	44,879

Notes: All models control for the parent's gender, age and age squared, schooling years, marital status, number of living children and childhood health conditions, the gender of the eldest child, type of residence, average education before the law enforcement, the wave, province, and cohort dummies. Standard errors clustered at province-cohorts level in parentheses. The variable *switch insurance* is defined as a change of insurance type, we drop observations in the initial year (wave 2011). Panels B and C explain dummies of having outpatient and inpatient visit by type of healthcare providers. Small healthcare center includes community healthcare center, township hospital, health care

24 Private health insurance system is rare and immature in our sample.

post, and village clinic/private clinic. ***p<0.01, ** p<0.05, *p<0.1.

Inpatient care is generally reimbursed to a larger extent than outpatient care, especially in the rural health insurance schemes (Barber & Yao, 2010; Li et al., 2017). In our sample, the average reimbursement rate of inpatient care is 45.7%, compared to only 26.6% for outpatient care. This creates an incentive to switch from outpatient to inpatient services. Table 8 shows that with one additional schooling year of the eldest child, reimbursed outpatient costs do not change significantly, but reimbursed inpatient costs increase by 15.3%. Recalling from Section 5.2 that parents with a better educated eldest child reduce outpatient care and increase inpatient care, it seems that parents with better educated children strategically reduce outpatient services that are not reimbursed and increase inpatient services that are at least partly reimbursed.

In addition to becoming more knowledgeable about the net price, parents may also switch to inpatient care because of quality. Treatments, tests, and check-ups can be more comprehensive and thorough under inpatient treatment, and patients are more closely looked after and treated more promptly. A better educated child can help parents to realize this and can encourage them to use higher quality care. Panels B and C of Table 8 show outpatient and inpatient incidence by type of healthcare provider. General hospital is believed to provide better quality care than specialized/Chinese medicine hospitals or small healthcare centers. With better educated children, parents are less likely to visit small healthcare centers for outpatient care, but more likely to visit specialized/Chinese medicine or general hospitals for inpatient care, switching to better quality care.

In summary, the “knowledge transfer channel”, especially through correct perception of health and more knowledge of price and quality of healthcare, can be important to explain our main findings. To provide further indirect evidence for this, we grouped parents into lower (own schooling shorter than 9 years) and higher educated parents. If knowledge transfer plays a major role, we expect that parents with lower education would benefit more from a better-educated child and show larger effects. Indeed, as shown in Online Appendix Tables A.7 to A.12, the positive effects of child education on discovering chronic diseases and increasing healthcare utilization are mainly driven by lower educated parents.

6.2 Economic support and time channels

Better educated children can provide more economic support to parents for more medical care use. This channel is particularly relevant in our context as Chinese elderly, especially in rural areas, rely primarily on their children's financial support (Cai et al., 2012). As shown in Table 9, with one additional schooling year of the eldest child, the net annual transfer from children increases by nearly 436 RMB (68.5 USD) on average.[25] And better child education increases the parent's household expenditure, a proxy for economic resources (Smith et al., 2012). One additional schooling year of the eldest child increases per capita household expenditure by 17.3%, a slightly larger effect than the 14.7 % found by Ma (2019) (who measured children's education with highest educated child). Living expenditures increase by 9.4% with each additional year of child education, and health expenditures (both direct and indirect) increase by 32.1%. In addition, parents with a better educated child are less likely to forgo inpatient care because of lack of money, as shown in Online Appendix Table A.13. These findings indicate that households with better educated children have more economic resources and are better able to afford health-related expenditures.[26] The economic support can therefore be an important channel to explain our main results.

Table 9 Effects of children's education on economic resources and time use of older parents

Dependent variable	(1) IV	(2) F statistic for weak identification	(3) p value of Hansen J statistic	(4) Observations
Net transfer amount from children	435.890* (253.774)	11.43	0.990	27,471
Ln per capita household expenditure	0.173*** (0.048)	10.57	0.678	21,942
Ln food expenditure	0.075 (0.050)	12.76	0.845	25,063
Ln living expenditure	0.094** (0.048)	11.11	0.956	25,463
Ln health expenditure	0.321*** (0.114)	12.95	0.366	27,436
Take care of grandchild	-0.008 (0.018)	12.40	0.420	24,762
Ln Care time	-0.193 (0.136)	12.39	0.879	23,584

Notes: The survey questions for the variables in this table are only asked to the main respondent in the household. All models control for parent's gender, age and age squared, schooling years, marital status, number of living children and childhood health conditions, for gender of eldest child, type of residence, average education before the law enforcement, for wave, province, and cohort dummies effects. Standard errors clustered at province-cohorts level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

As hypothesized in Section 1, child education might also influence parents' time

25 This finding is consistent with Cui et al. (2021), Lee (2018), and Yahirun et al. (2017), who also find that adult children with higher education provide more financial supports to their parents.
26 The indirect expenditure refers to transportation expenses, nutrition expenses, family accompany expenses, etc. incurred due to medical treatment.

available through, for instance, more grandparenting.[27] Table 9, however, shows no significant effect of child education on the possibility or hours of taking care of grandchildren, so this is unlikely to be an important mechanism in our context. An alternative time channel could be labor force participation or hours worked of the parent (cf. Ma, 2019). Like Ma, we find a negative effect of children's education on the parents' labor supply (See Table A.14 in the Online Appendix). Unfortunately, however, the validity of the instruments for this model is rejected by a Hansen J-test. We therefore do not present detailed results and cannot draw definitive conclusions on this channel.

6.3 Disentangling channels

Knowledge transfer and economic support can both explain the positive effect of the eldest child's education on parental healthcare utilization. In Table A.15, we check whether knowledge transfer still plays a role if we control for the economic support channel, directly controlling for the net transfer received from children, instrumented by the average transfer of parents in the reference group (i.e., parents in the same province, with the same urban or rural status, and born in the same birthyear). Otherwise, the specification is the same as before. Results show that most effects remain even if we control for the transfer amount, suggesting that the knowledge transfer channel works as an important independent mechanism separate from monetary support.

For further evidence of the role of the knowledge transfer channel, we construct the variable *total/OOP/household health expenditures netting out net transfer from children*, transformed using the inverse-hyperbolic sine to deal with negative values. Table A.16 shows that higher child education indeed leads to a significant increase in total health costs, even netting out the transfer, confirming that knowledge transfer plays an independent role.

6.4 Financial and welfare implications

Lastly, we try to shed light on the financial and welfare implications of the effects of child education. Table 10 suggests that with one additional schooling year of the eldest child, parents' total health costs increase by 49.7%. With OOP health costs increasing by 39.5%, most increased health care costs are borne by the individuals themselves. But these health costs appear to be necessary rather than over-treating since with the

27 We also checked whether child education would change the probability of receiving care from children for parents with functional limitations and did not find any significant effects. Results are available upon request.

help of the better educated child, more chronic diseases are discovered. Parents are less likely to be very satisfied with their health, probably because of discovering more diseases, but with better health knowledge and management, parents are more confident that they will survive the next ten years. Therefore, the heavier health cost burden on parents with a higher educated child seems necessary and welfare-improving for the older parents.

Table 10 Effects of children's education on total and OOP health costs

Dependent variable	(1) IV	(2) F statistic for weak identification	(3) p value of Hansen J statistic	(4) p value of Anderson-Rubin F statistic	(5) Observations
Log total cost	0.497*** (0.151)	15.38	0.937		21,437
Log OOP cost	0.395*** (0.139)	15.65	0.504		21,383
Expected survival	0.024* (0.014)	13.68	0.033		41,661
Expected survival in 2011	0.056** (0.026)	8.413	0.329	0.039	9,377
High health satisfaction	-0.025* (0.014)	15.47	0.120		26,232

Notes: "Total cost": annualized total outpatient and self-treatment costs plus inpatient and dental care costs. OOP cost is the OOP counterpart of the total cost. "Expected survival": the respondent's perceived likelihood to survive the next ten years is "maybe", "very likely", or "almost certainly". "Expected survival in 2011" is used to stay away from the variation induced by the same respondent growing older over years and having lower expected survival as s/he gets older. "High health satisfaction" is defined as the probability to be "completely satisfied" or "very satisfied" with own health. All models control for the parent's gender, age and age squared, schooling years, marital status, number of living children and childhood health conditions, gender of eldest child, type of residence, average education before the law enforcement, wave, province, and cohort dummies. Standard errors clustered at province-cohort level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

7 Robustness checks

We conduct a series of robustness checks to address potential concerns about the identification strategy. First, we show that our results are insensitive to using four alternative sets of instruments. In the main analysis, we used exposure of the eldest child to CELs (Exp_{bp}) and its interaction with regional pre-reform education levels ($Exp_{bp} * PreLaw_{ibp}$) as instruments. In the first two sets of alternative IVs, keeping Exp_{bp} the same as in the main analysis, we use interact $Exp_{bp}$with two alternative pre-reform education variables. The first is the proportion with less than nine-years education of the six youngest ineligible cohorts. The second is a dummy indicating whether average schooling years of the six youngest ineligible cohorts is lower than the national average schooling years. Online Appendix Tables A.17 and A.18 report the results. They are similar to the baseline IV results.

In the third set of alternative IVs, instead of using a linear function of child birthyear between the first and last cohort partially affected, we capture exposure with a set of dummy variables derived from adult children's age when CELs were implemented, including a dummy indicating whether they were at most six years old when the CELs were implemented, a dummy indicating they were at least 16 years old when the CELs were implemented, and five other dummies measuring exposure in 3-year age bins between 7 and 15 years (7-9;10-12;13-15). We multiply these dummies with the prelaw education level to construct additional instruments based upon interactions. The results are shown in Table A.19. Though the first-stage F statistic is smaller than 10, the point estimates (shown together with p value of Anderson-Rubin F statistic) are close to those in the main analysis. The fourth alternative set of IVs adds an additional IV, Exposure interacted with the eldest child's gender, while keeping Exposure and ExpPreLaw the same. The results are shown in Table A.20. They are similar to those in the main analysis.

Another concern is that there might be additional time-varying provincial characteristics, correlated with both the timing of CELs and the outcomes. We additionally control for the log of GDP per capita, member of doctors and hospital beds per 10,000 population to account for provincial time-varying confounders.[28] We also include the sample share covered by health insurance in the same province and parental birth cohort, to control for the local health insurance development. The results, reported in Table A.21, are again very similar to the baseline.

Moreover, we consider the sensitivity of including province-specific childbirth cohort linear trends and controlling for the potential confounding effect of the One Child Policy. The One Child Policy (OCP) was implemented after 1978 with differential enforcement strictness across regions and time; we additionally control for the fine amounts for the above-quota births (Ebenstein, 2010) to capture the effect of the OCP. Table A.22 and A.23 report the two sets of results, respectively. The results are similar to the baseline.

Another concern is including only the eldest child in the empirical analysis. It is possible that all children's education levels matter for parental healthcare use decisions in the old age. Therefore, we include all child-parent pairs, and use the inverse of the number of children in a family as regression weight (Lundborg & Majlesi, 2018). The results are presented in Table A.24 They are very similar to our baseline estimates.

28 Data comes from National Bureau of Statistics (2009). Missing values imputed with linear interpolation.

Finally, we check if attrition due to the death of the parent matters in our setting. We find that adult child's education has no impact on parents' probability of existing the survey due to death, as shown in Table A.25.[29] Thus, the effect of attrition due to death on the estimated effects is likely to be minimal.

8 Conclusion and discussion

This paper investigates how and why parents change their healthcare utilization if they have a better-educated eldest child. To address the endogeneity of the eldest child's education level, we exploit the quasi-random variation in children's education induced by the introduction of compulsory education laws around 1986.

The IV estimates show that parents with better-educated children decrease outpatient care but increase inpatient care. They tend to switch to more cost-effective health care with better quality. They also use more disease management, self-treatment, and dental care.

As to the underlying mechanisms, our findings support the conjecture that better-educated children provide both knowledge and financial transfer to their elderly parents. On the one hand, they make parents more aware of chronic conditions. They are also more likely to figure out the "effective price" of health care services and make their parents use better care by visiting higher quality hospitals. On the other hand, we find that with better-educated children, parents receive more monetary transfers from their children leading to more economic resources so that they can afford more health services.

Our results have several policy implications. The healthcare utilization among older people in most developing countries is far below the needed level. The findings in this paper suggest that improving children's education not only benefits the children's generation but can also prompt parents to use medical services more cost-effectively. Policy measures should help older people with less-educated children to achieve the same cost efficiency and quality. Relevant interventions could provide those older people with more information on medical knowledge and the current healthcare system, or a more generous cost-sharing health insurance policy.

Our findings depend on changes in children's education at the lower end of the distribution. In future research, it might be interesting to see how the changes at the

29 We only have the "death" information in wave 2013. We construct the dummy variable "die" indicating if the parent died and exited the survey between waves 2011 and 2013.

upper end (for instance, by exploiting higher education expansion policies) affect parents' healthcare utilization. Besides, with the continuing growth in individuals' education and wealth, it would also be worth seeing whether the observed effect of children's education will persist.

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Appendix: Definitions of Variables

Details of outcome variables

(1) Outpatient incidence: 1 if respondent used outpatient care in the past month, 0 otherwise.

(2) #doctor visits: number of doctor visits in the past month.

(3) Out-of-pocket (OOP) outpatient cost: OOP expenditure on outpatient care in the past month.

(4) Inpatient incidence: 1 if the respondent used inpatient care in the past year, 0 otherwise.

(5) # inpatient care use：number of hospital stays during the past year.

(6) OOP inpatient cost: OOP expenditure of inpatient care in the past year.

(7) Self-treatment incidence: 1 if the respondent used self-treatment (OTC drugs, prescribed drugs, traditional herbs or medicines, tonic/health supplement, health care equipment, other self-treating practices) in the past month, 0 otherwise.

(8) OOP self-treatment cost: the out-of-pocket expenditure of self-treatment in the past month.

(9) Blood pressure examination: the number of blood pressure examinations in the past year, trimmed at the 90^{th} percentile to get rid of outliers.

(10) Hypertension management with medicines: 1 if the respondent is using Chinese traditional medicine or Western modern medicine to treat or control hypertension now, 0 otherwise

(11) Heart management with medicines: same as (10) but for heart disease.

(12) Cancer management with medicines: same as (10) but for controlling or relieving symptoms of cancer in the past two years.

(13) CHE without dental cost: 1 if individual “annual OOP healthcare expenditure” (costs for outpatient care, inpatient care, and self-treatment) is at least 40% of per capita annual household total non-food expenditure, 0 otherwise.

(14) to (16) are only available in waves 2013 and 2015:

(14) Dental care incidence: a dummy variable indicating if the respondent used dental care in the past year.

(15) # dentist visits: number of dentist visits in the past year.

(16) OOP dental care cost: out-of-pocket expenditure on dentist visits in the past year.

Details of control variables

1. Demographic characteristics

We control for a dummy for males, age and age squared, years of schooling (derived from the education level), marital status (married, married but separated, other including divorced, widowed, never married and cohabitated), number of living children(1, 2 and 3, 4 and 5, more than 5), and the childhood health conditions on a scale from 1 to 5 (1: much healthier; 2: somewhat healthier; 3: about average; 4: somewhat less healthy; 5: much less healthy).

2. Child characteristics

We control for the following characteristics of the eldest child (besides years of schooling): dummy for males, birth province dummies, birth cohort dummies.

3. Regional characteristics

We control for a dummy for urban. Moreover, to account for the initial different education levels across provinces and urban and rural areas, we include average schooling years of the six youngest cohorts before implementation of the CEL by province and urban/rural.

Details of mechanism variables

(1) Self-reported health: 1 = very poor or poor, 2 = fair, 3 = good, 4 = very good, 5 = excellent.
(2) Mental health: constructed based on reversed CES-D score (ranges from 0 to 30), a larger value means better mental health.
(3) Cognitive condition: values range from 0 to 5. The scores for performing the following five tasks (1 point for each correctly performed task): specify the day of month, month, year, and the day of week, and whether the respondent is able to copy an assigned picture.
(4) Chronic disease: 1 if the parent reported to be diagnosed with at least one of the following chronic diseases: hypertension, dyslipidemia, diabetes or high blood sugar, cancer or malignant tumor, chronic lung diseases, liver disease, heart relative diseases, stroke, kidney disease, stomach or other digestive disease, emotional, nervous or psychiatric problems, memory-related disease, arthritis or rheumatism, and asthma; 0 otherwise.
(5) Hypertension: dummy for diagnosed with hypertension or not.
(6) Cancer: dummy for diagnosed with cancer or not.
(7) Heart: dummy for diagnosed with heart related disease or not.
(8) Dyslipidemia: dummy for diagnosed with dyslipidemia or not.

(9) Kidney: dummy for diagnosed with kidney disease or not.
(10) Memory: dummy for diagnosed with memory related disease (e.g., cerebral atrophy, dementia, Parkinson's disease)
(11) Undiagnosed hypertension: 1 if systolic blood pressure is equal to or larger than 140 mmHg but the respondent self-reports not to be diagnosed with hypertension.
(12) Undiagnosed dyslipidemia: 1 if total cholesterol≥200 mg/dl or triglyceride≥200 mg/dl or high-density lipoprotein cholesterol≤40 mg/dl or low-density lipoprotein cholesterol≥130 mg/dl but the respondent self-reports having no dyslipidemia.
(13) Undiagnosed diabetes: 1 if glucose is equal to or larger than 126mg/dl but the respondent self-reports not being diagnosed with diabetes.
(14) Smoke (drink): 1 if the respondent smokes or drinks.
(15) Moderately (Lightly) exercise: 1 if the respondent has weekly moderate (light) physical exercises.
(16) Social activity: 1 if the respondent participates in any social activities including interacting with friends, playing Mahjong, chess, cards, going to community club, sports event, participating in a social group or some other sort of club, taking part in a community-related organization, voluntary or charity work, attending an educational or training course, etc.
(17) Reimbursed monthly outpatient cost: calculated as total outpatient cost last month minus OOP outpatient cost last month.
(18) Reimbursed annual inpatient cost: calculated as the difference between total and OOP inpatient costs in the past year.
(19) Reimbursed annual outpatient and inpatient cost: annualized (multiplied by 12) reimbursed outpatient cost plus the reimbursed inpatient cost.
(20) Switch of insurance: 1 if the respondent has changed to a different type of health insurance (available in waves 2013 to 2018 only).
(21) Outpatient (Inpatient) incidence in general hospital: dummy indicating whether the respondent went to a general hospital for outpatient (inpatient) care in the latest visit.
(22) Outpatient (Inpatient) incidence in specialized or Chinese medicine hospital: dummy indicating whether the respondent went to a specialized hospital or a Chinese medicine hospital for outpatient (inpatient) care in the latest visit.
(23) Outpatient (Inpatient) incidence in small healthcare center: dummy indicating whether the respondent went to a small healthcare center for outpatient (inpatient) care in the latest visit. A small healthcare center includes community healthcare center, township hospital, health care post, and village clinic/private clinic.
(24) Outpatient (Inpatient) incidence at other healthcare providers: dummy indicating whether the respondent went to other healthcare providers for outpatient (inpatient) care in the latest visit.
(25) Net transfer from children: the amount of transfer from children minus the transfer

to children in the past year. We trim the annual transfer at the top 1.5 percentile and bottom 1 percentile to get rid of outliers.
(26) Annual household per capita total expenditures: annualized per capita expenditures including food expenditure, non-food expenditure, and other non-food consumption.
(27) Food expenditure: the annual household food expenditure, including purchased food and food eaten from own production, meals eaten out, and alcohol and cigarettes/tobacco consumed.
(28) Living expenditure: annual household living expenditures including expenditures on communication, utilities including water and electricity, fuels, housekeeper, matron, and servants, local transportation, household items and personal daily toiletries plus beauty treatments, entertainment.
(29) Health expenditure: annual household out-of-pocket health-related expenditures, including indirect expenditures like medical induced transportation fee, hiring caregivers, nutrition fee, etc.
(30) Take care of grandchild: dummy for taking care of grandchild in the past year.
(31) Care time: the number of hours spent on taking care of grandchild in the past year. For those who take care of multiple grandchildren, we take the maximum.

Details of further outcome variables

(1) Total cost: annualized total outpatient and self-treatment costs plus total inpatient and dental care costs.
(2) OOP cost: annualized OOP outpatient and self-treatment costs plus OOP inpatient and dental care costs.
(3) Expected survival (in 2011): is defined as the probability of the respondent thinking herself or himself "maybe", "very likely", or "almost certainly" would survive the next ten years. "Expected survival in 2011" is only using "Expected survival" and observations in 2011, to keep away from the variations induced by the same respondent growing older over years and having lower expected survival as s/he gets older.
(4) High health satisfaction: dummy "completely satisfied" or "very satisfied" with one's own health.

Online Appendix: Additional Data Description and Results

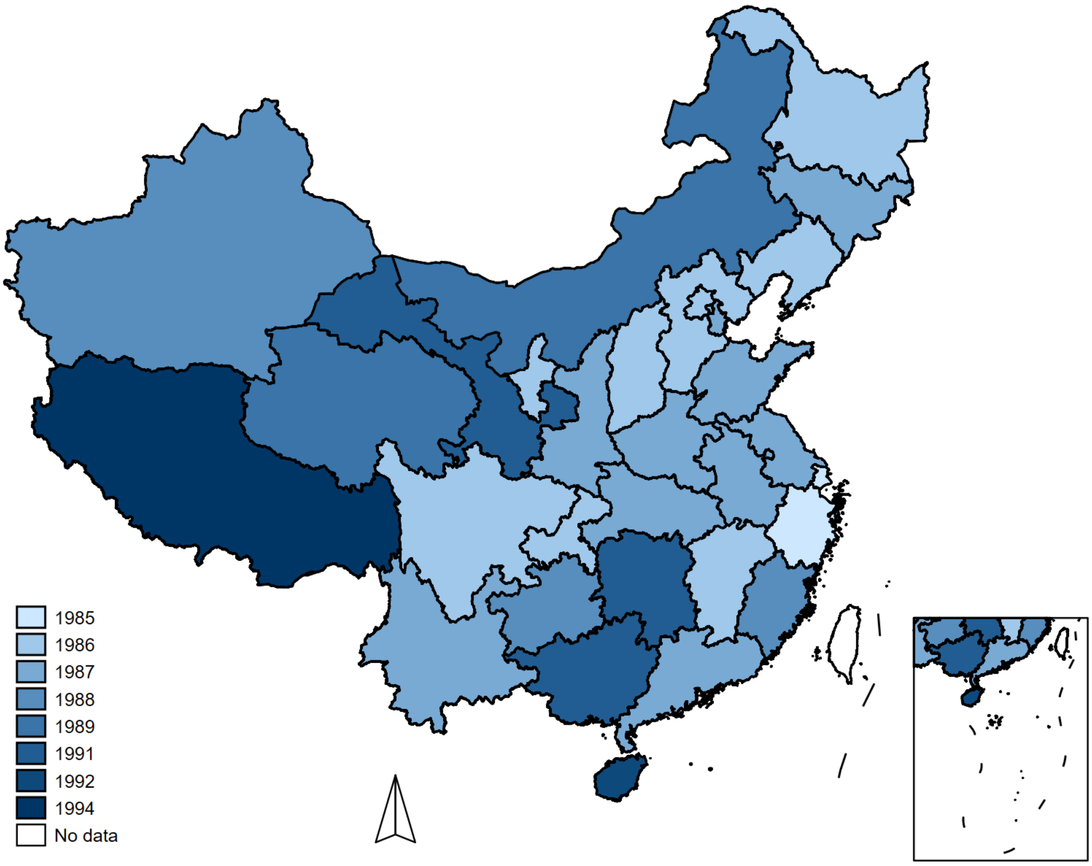

Figure A.1: Implementation years of Nine-year compulsory education laws in China

Notes: The data on the CELs implementation year in China is collected from government policy documented by the authors.

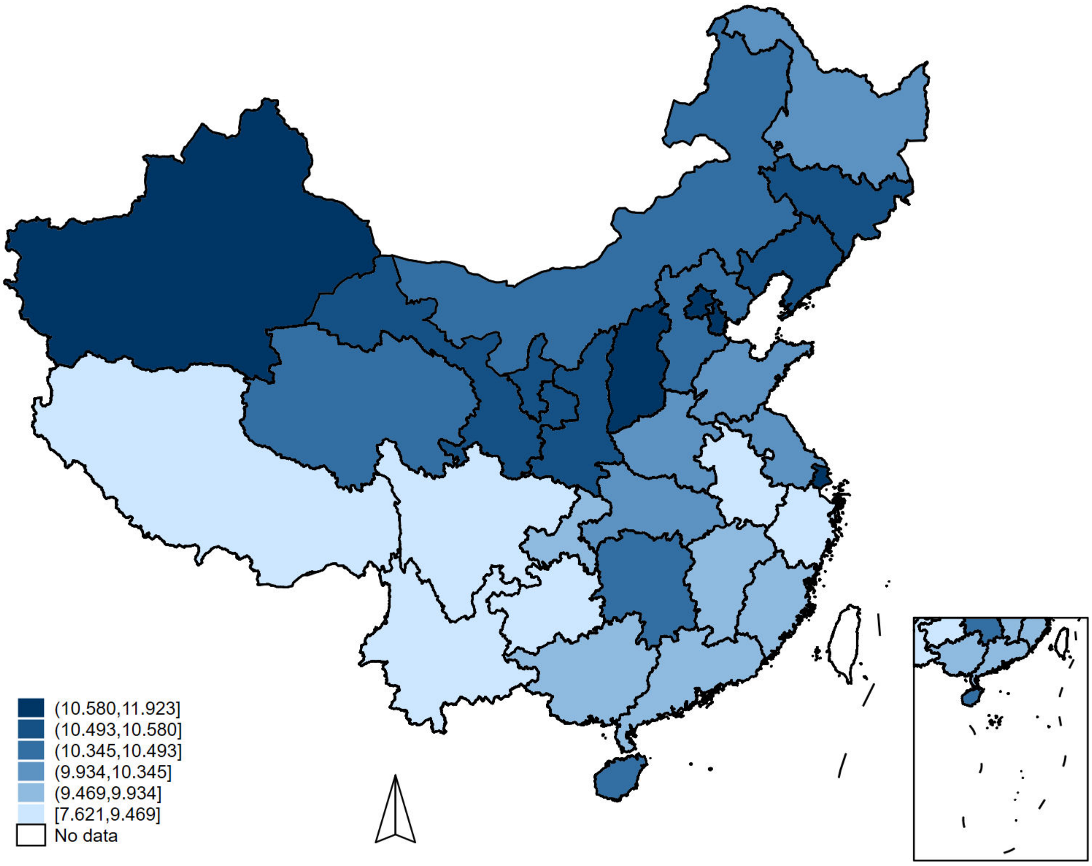

Figure A.2: Average schooling years of ineligible cohorts in urban

Notes: The data on the average schooling year of ineligible cohorts refer to the six youngest cohorts before the implementation of the compulsory education law. Source: 1% sample of the 2000 Population Census of China (National Bureau of Statistics of China, 2000).

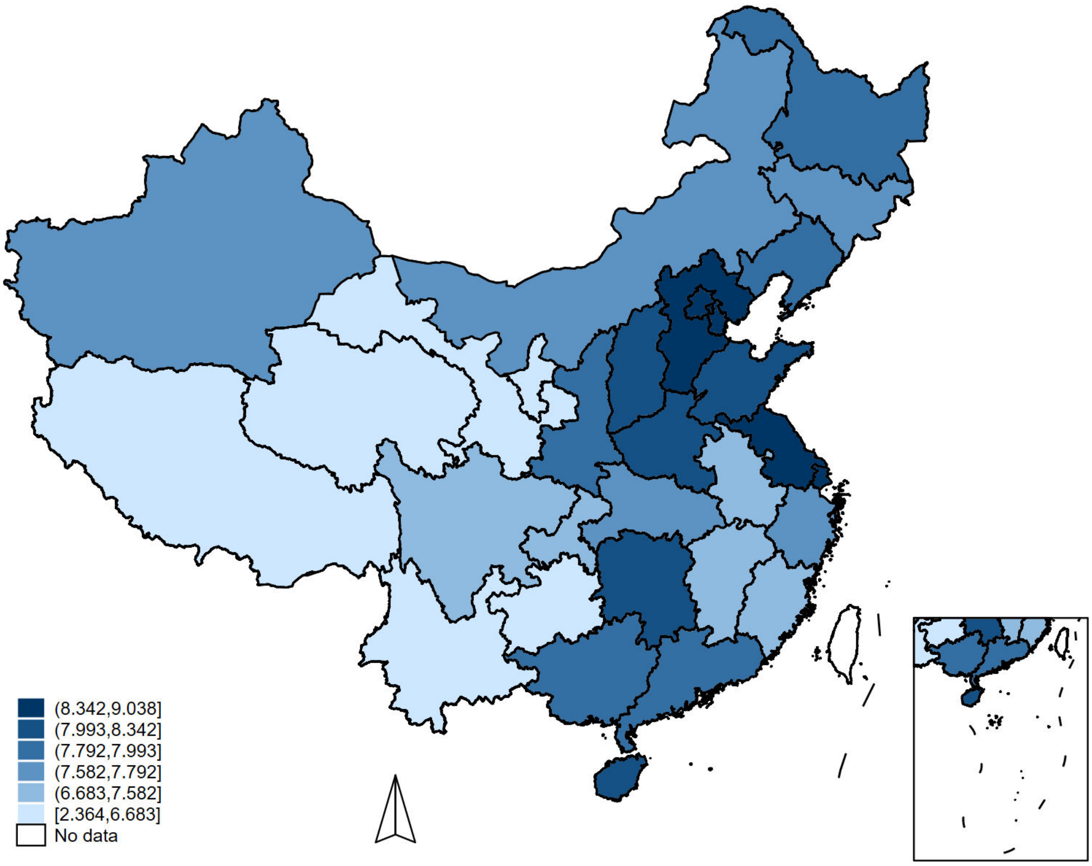

Figure A.3: Average schooling years of ineligible cohorts in rural

Notes: The data on the average schooling year of ineligible cohorts refer to the six youngest cohorts before the implementation of the compulsory education law. Source: 1% sample of the 2000 Population Census of China (National Bureau of Statistics of China, 2000).

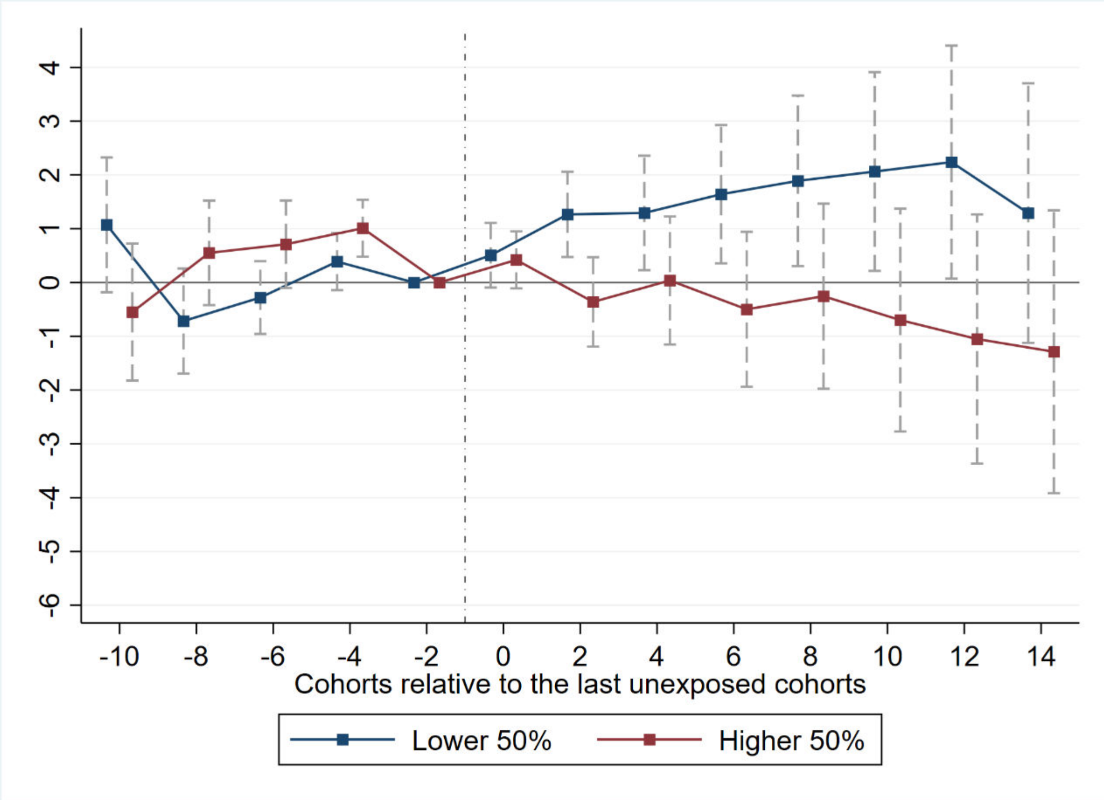

Figure A.4: Coefficients of the time dummies in children's education equation, by regional pre-law average education years

Notes: This figure plots the estimated coefficients and 95% confidence intervals from the regression of the eldest child's years of schooling on a series of 2-year cohort dummies, where the first two ineligible cohorts (aged 16 and 17) are chosen as the reference group ("-2" in the x-axis). The blue line represents the estimation results for the sample containing children from the lower 50% prelaw level, i.e., the regions with fewer initial education resources. The red line is for the sample containing children from the higher 50% prelaw level.

Table A.1 Summary statistics for mechanism variables and regional characteristics

Variables	Observation	Mean	Std. dev.	Variables	Observation	Mean	Std. dev.
Regional characteristics				*Knowledge transfer - health behavior and health (continued)*			
Per capita provincial GDP	61,773	546.013	504.282	Lightly exercise	33,247	0.809	0.393
Beds per 10,000 population	61,773	18.059	8.538	Social activity	57,271	0.479	0.500
Doctors per 10,000 population	61,773	10.598	5.683	Self-reported health condition	53,785	2.133	0.925
Insurance proportion	60,751	0.959	0.040	Mental health	55,812	21.757	6.266
				Cognitive condition	50,215	3.682	1.323
Mechanism Variables							
Knowledge transfer - perception of health				*Knowledge transfer - actual healthcare price*			
Chronic	60,090	0.737	0.440	Reimbursed outpatient cost	52,932	32.370	658.261
Hypertension	60,202	0.309	0.462	Reimbursed inpatient cost	54,002	411.838	5628.499
Cancer	60,217	0.013	0.114	Total reimbursed cost	48,048	677.832	9277.161
Heart relative diseases	60,181	0.150	0.357	Switch of insurance	30,329	0.172	0.377
Dyslipidemia	59,797	0.144	0.351				
Kidney	60,178	0.073	0.260	*Economic support*			
Memory disease	60,200	0.024	0.152	Net transfer amount from children	31,707	1476.310	6492.037
Undiagnosed hypertension	44,151	0.102	0.302	Per capita household expenditure	25,162	12686.855	22362.208
Undiagnosed dyslipidemia	26,591	0.353	0.478	Food expenditure	28,843	17398.777	53790.027
Undiagnosed diabetes	24,404	0.072	0.259	Living expenditure	29,203	4844.477	9862.219
				Health expenditure	32,058	4838.362	17402.987
Knowledge transfer - health behavior and health							
Smoke	56,517	0.264	0.441	*Time*			
Drink	59,958	0.338	0.473	Take care of grandchild	28,106	0.480	0.500
Moderately exercise	33,255	0.527	0.499	Care time	26,780	1121.907	2038.668
				Employment	59,128	0.657	0.475
				Work day	58,697	128.885	134.982

Notes: The "economic support" and "time" variables are measured at the household level, while the remaining mechanism variables are at the individual level.

Table A.2 Effects of children's education on different outpatient care use of older parents

Dependent variable	(1) IV	(2) F statistic for weak identification	(3) p value of Hansen J statistic	(4) Observations
First visit	-0.002	15.86	0.903	45,730
	(0.007)			
Follow-up visit	-0.020**	16.23	0.227	45,946
	(0.008)			
Consultation	0.001*	16.41	0.200	51,306
	(0.001)			
Medical check-up or immunization	-0.003*	16.41	0.033	51,306
	(0.002)			
Treatment for Illness	-0.019**	16.41	0.580	51,306
	(0.009)			
Injection	-0.006			
	(0.006)	15.41	0.043	31,742
Laboratory test	-0.000			
	(0.005)	15.18	0.955	31,326
Surgery	0.002			
	(0.002)	14.83	0.469	30,304
X-ray	-0.003			
	(0.005)	15.67	0.572	31,606
Medications	-0.020**			
	(0.010)	15.75	0.335	36,135
Drip Infusion	-0.019**			
	(0.008)	15.41	0.333	33,035
Traditional treatment	-0.001			
	(0.003)	14.34	0.235	30,427

Notes: All models control for the gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of the eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, and cohort fixed effects. Standard errors clustered at province-cohorts level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.3 Effects of children's education on different inpatient care use of older parents

Dependent variable	(1) IV	(2) F statistic for weak identification	(3) p value of Hansen J statistic	(4) Observations
Medical check-up/consultation	0.019**			
	(0.008)	15.36	0.624	36,117
Injection	0.026***			
	(0.008)	15.90	0.674	36,312
Laboratory test	0.017**			
	(0.009)	14.73	0.821	36,899
Surgery	0.010**			
	(0.005)	14.03	0.944	35,045
X-ray	0.020**			
	(0.009)	16.73	0.928	36,984
Medications	0.016*			
	(0.010)	15.42	0.934	37,832
Drip Infusion	0.018*			
	(0.010)	15.02	0.875	38,056
Traditional treatment	0.010***			
	(0.004)	14.08	0.342	34,313

Notes: All models control for the gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects. Standard errors clustered at province-cohorts level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.4 Effects of children's education on different types of self-treatment of older parents

Variables	(1) IV Over-the-counter medicines	(2) IV Vitamins/health supplements	(3) IV Log out-of-pocket over-the-counter medicines cost	(4) IV Log out-of-pocket vitamins/health supplements cost
Schooling years of eldest child	0.036***	0.005	0.181***	0.044**
	(0.012)	(0.005)	(0.061)	(0.021)
Observations	51,888	51,888	51,226	51,754
Wave dummies	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Cohorts FE	Yes	Yes	Yes	Yes
F statistic for weak identification	15.63	15.63	15.56	15.52
p value of Hansen J statistic	0.640	0.202	0.719	0.695

Notes: All models use 2SLS method and control for the gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects. Standard errors clustered at province-cohorts level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.5 Heterogeneous effects analysis by gender of the parent

Variables	(1) IV	(2) IV	(3) IV	(4) IV	(5) IV	(6) IV
Panel A	Outpatient incidence	#Doctor visits	Log out-of-pocket outpatient cost	Inpatient incidence	#Times of inpatient care	Log out-of-pocket inpatient cost
Schooling years of eldest child	-0.011	-0.033	-0.058	0.025**	0.047**	0.128**
	(0.010)	(0.035)	(0.042)	(0.010)	(0.020)	(0.052)
Schooling years of eldest child # parent is male	-0.004*	-0.003	-0.009	-0.002	-0.003	-0.003
	(0.002)	(0.008)	(0.010)	(0.002)	(0.004)	(0.011)
Observations	51,935	51,371	45,994	51,998	51,981	46,841
F statistic for weak identification	9.92	10.31	9.87	10.02	9.97	9.72
p value of Anderson-Rubin F statistic	0.005		0.135		0.078	0.053
p value of Hansen J statistic	0.017	0.146	0.216	0.556	0.653	0.638
	(7)	(8)	(9)	(10)	(11)	
Panel B	Self-treatment incidence	Log out-of-pocket self-treatment cost	Dental care incidence	Dentist visits	Log out-of-pocket dentist visits cost	
Schooling years of eldest child	0.038***	0.228***	0.015	0.108**	0.085	
	(0.012)	(0.070)	(0.011)	(0.046)	(0.065)	
Schooling years of eldest child # parent is male	-0.009***	-0.041***	-0.002	-0.010	-0.019	
	(0.003)	(0.015)	(0.003)	(0.012)	(0.016)	
Observations	51,888	51,888	27,267	27,162	27,034	
F statistic for weak identification	10.06	10.06	10.38	10.70	10.49	
p value of Hansen J statistic	0.981	0.989	0.867	0.129	0.554	
	(12)	(13)	(14)	(15)	(16)	
Panel C	Blood pressure examinations	Hypertension management with medicines	Heart management with medicines	Cancer management with medicines	CHE without dental cost	
Schooling years of eldest child	7.015**	0.025*	0.044***	0.005**	0.010	
	(2.734)	(0.014)	(0.011)	(0.002)	(0.013)	
Schooling years of eldest child # parent is male	-0.620	0.007*	-0.001	-0.001	-0.004	
	(0.962)	(0.004)	(0.002)	(0.000)	(0.003)	
Observations	13,511	50,065	49,153	51,668	31,817	
F statistic for weak identification	6.28	10.34	10.02	9.67	7.57	
p value of Anderson-Rubin F statistic	0.017			0.100	0.491	
p value of Hansen J statistic	0.439	0.034	0.069	0.956	0.313	

Notes: The instruments for Schooling years of eldest child and the interaction of schooling years of eldest child and gender of parents include exposure, the interaction of exposure and prelaw, the interaction of exposure and gender of parents, the interaction of exposure, prelaw and gender of parents. All models control for gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects. Standard errors clustered at province-cohorts level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.6 Heterogeneous effects analysis by gender of the eldest child

Variables	(1) IV	(2) IV	(3) IV	(4) IV	(5) IV	(6) IV
Panel A	Outpatient incidence	#Doctor visits	Log out-of-pocket outpatient cost	Inpatient incidence	#Times of inpatient care	Log out-of-pocket inpatient cost
Schooling years of eldest child	-0.012	-0.030	-0.046	0.018**	0.034**	0.087**
	(0.007)	(0.025)	(0.030)	(0.007)	(0.015)	(0.039)
Schooling years of eldest child # eldest child male	-0.009	-0.018	-0.043*	0.010*	0.019*	0.058**
	(0.006)	(0.019)	(0.023)	(0.005)	(0.010)	(0.026)
Observations	51,935	51,371	45,994	51,998	51,981	46,841
F statistic for weak identification	8.21	8.48	8.94	8.21	8.22	8.42
p value of Anderson-Rubin F statistic	0.327	0.386	0.254	0.064	0.141	0.176
p value of Hansen J statistic	0.478	0.297	0.516	0.547	0.695	0.953
	(7)	(8)	(9)	(10)	(11)	
Panel B	Self-treatment incidence	Log out-of-pocket self-treatment cost	Dental care incidence	Dentist visits	Log out-of-pocket dentist visits cost	
Schooling years of eldest child	0.025***	0.157***	0.013	0.097***	0.080	
	(0.010)	(0.053)	(0.009)	(0.037)	(0.049)	
Schooling years of eldest child # eldest child male	0.019***	0.102***	0.004	0.057**	0.017	
	(0.007)	(0.039)	(0.006)	(0.026)	(0.037)	
Observations	51,888	51,888	27,267	27,162	27,034	
F statistic for weak identification	8.16	8.16	8.62	8.93	8.79	
p value of Anderson-Rubin F statistic	0.049	0.017	0.576	0.058	0.303	
p value of Hansen J statistic	0.883	0.978	0.882	0.627	0.858	
	(12)	(13)	(14)	(15)	(16)	
Panel C	Blood pressure examinations	Hypertension management with medicines	Heart management with medicines	Cancer management with medicines	CHE without dental cost	
Schooling years of eldest child	5.311**	0.027**	0.033***	0.003**	0.007	
	(2.143)	(0.011)	(0.009)	(0.002)	(0.010)	
Schooling years of eldest child # eldest child male	4.436**	0.017**	0.020***	0.002*	-0.002	
	(1.853)	(0.008)	(0.006)	(0.001)	(0.007)	
Observations	13,511	50,065	49,153	51,668	31,817	
F statistic for weak identification	5.37	8.35	8.04	8.10	7.29	
p value of Anderson-Rubin F statistic	0.013	0.048	0.000	0.209	0.642	
p value of Hansen J statistic	0.446	0.360	0.052	0.832	0.942	

Notes: The instruments for Schooling years of eldest child and the interaction of schooling years of eldest child and gender of eldest child include exposure, the interaction of exposure and prelaw, the interaction of exposure and gender of eldest child, the interaction of exposure, prelaw and gender of eldest child. All models control for gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects. Standard errors clustered at province-cohorts level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.7 2SLS estimates of effects of children's education on chronic diseases of older parents, by own schooling years

Variables	(1) <=9	(2) >9	(3) <=9	(4) >9	(5) <=9	(6) >9	(7) <=9	(8) >9
Panel A	chronic		hypertension		cancer		heart	
Schooling years of eldest child	0.033**	0.015	0.031*	0.053	0.011**	0.007	0.048***	-0.002
	(0.015)	(0.034)	(0.018)	(0.039)	(0.004)	(0.006)	(0.016)	(0.033)
Observations	46,390	5,536	46,454	5,545	46,456	5,541	46,429	5,538
F statistic for weak identification	12.86	4.57	13.07	4.58	12.92	4.60	12.97	4.40
p value of Anderson-Rubin F statistic		0.804		0.368		0.415		0.994
p value of Hansen J statistic	0.278	0.607	0.694	0.809	0.836	0.599	0.393	0.916
Panel B	(9) <=9	(10) >9	(11) <=9	(12) >9	(13) <=9	(14) >9		
	Dyslipidemia		Kidney		Memory			
Schooling years of eldest child	0.024**	0.013	0.019*	-0.009	0.007	0.020		
	(0.012)	(0.032)	(0.011)	(0.025)	(0.005)	(0.016)		
Observations	46,129	5,525	46,428	5,538	46,433	5,544		
F statistic for weak identification	12.86	4.65	13.25	4.45	13.01	4.56		
p value of Anderson-Rubin F statistic		0.896		0.396		0.301		
p value of Hansen J statistic	0.416	0.815	0.934	0.183		0.262		

Notes: The older parents are divided into two groups based on own schooling years, less or equal to 9 years and above 9 years. All models use 2SLS method and control for the gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects. We report the p value of Anderson-Rubin F statistics which are more reliable when F statistics for weak identification are less than 10. Standard errors clustered at province-cohort level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.8 2SLS estimates of effects of children's education on outpatient of older parents, by own schooling years

Variables	(1) <=9	(2) >9	(3) <=9	(4) >9	(5) <=9	(6) >9
	Outpatient incidence		#Doctor visits		Log out-of-pocket outpatient cost	
Schooling years of eldest child	-0.022*	-0.002	-0.050	0.009	-0.083*	0.034
	(0.011)	(0.023)	(0.038)	(0.068)	(0.045)	(0.115)
Observations	46,401	5,534	45,889	5,482	41,122	4,872
Wave dummies	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohorts FE	Yes	Yes	Yes	Yes	Yes	Yes
F statistic for weak identification	12.72	4.68	13.19	4.63	14.20	4.22
p value of Anderson-Rubin F statistic		0.811		0.987		0.950
p value of Hansen J statistic	0.270	0.517	0.152	0.907	0.309	0.886

Notes: The older parents are divided into two groups based on own schooling years, less or equal to 9 years and above 9 years. All models use 2SLS method and control for the gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects. We report the p value of Anderson-Rubin F statistics which are more reliable when F statistics for weak identification are less than 10. Standard errors clustered at province-cohort level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.9 2SLS estimates of effects of children's education on inpatient care of older parents, by own schooling years

Variables	(1) <=9	(2) >9	(3) <=9	(4) >9	(5) <=9	(6) >9
	Inpatient incidence		#Times of inpatient care		Log out-of-pocket inpatient cost	
Schooling years of eldest child	0.022**	0.019	0.048**	-0.013	0.131**	0.015
	(0.011)	(0.023)	(0.022)	(0.046)	(0.058)	(0.164)
Observations	46,461	5,537	46,446	5,535	41,805	5,036
Wave dummies	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohorts FE	Yes	Yes	Yes	Yes	Yes	Yes
F statistic for weak identification	12.73	4.56	12.75	4.51	13.59	3.26
p value of Anderson-Rubin F statistic		0.653		0.823		0.680
p value of Hansen J statistic	0.717	0.746	0.894	0.601	0.932	0.384

Notes: The older parents are divided into two groups based on own schooling years, less or equal to 9 years and above 9 years. All models use 2SLS method and control for the gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects. We report the p value of Anderson-Rubin F statistics which are more reliable when F statistics for weak identification are less than 10. Standard errors clustered at province-cohort level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.10 2SLS estimates of effects of children's education on self-treatment of older parents, by own schooling years

Variables	(1) <=9	(2) >9	(3) <=9	(4) >9
	Self-treatment incidence		Log out-of-pocket self-treatment cost	
Schooling years of eldest child	0.034**	-0.010	0.206***	0.055
	(0.014)	(0.029)	(0.076)	(0.160)
Observations	46,353	5,535	46,353	5,535
Wave dummies	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Cohorts FE	Yes	Yes	Yes	Yes
F statistic for weak identification	12.64	4.62	12.64	4.62
p value of Anderson-Rubin F statistic		0.923		0.910
p value of Hansen J statistic	0.957	0.834	0.983	0.797

Notes: The older parents are divided to two groups based on own schooling years, less or equal to 9 years and above 9 years. All models use 2SLS method and control for the gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects. We report the p value of Anderson-Rubin F statistics which are more reliable when F statistics for weak identification are less than 10. Standard errors clustered at province-cohort level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.11 2SLS estimates of effects of children's education on dental care use of older parents, by own schooling years

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	<=9	>9	<=9	>9	<=9	>9
	Dental care incidence		#Dentist visits		Log out-of-pocket dentist visits cost	
Schooling years of eldest child	0.015	0.028	0.124**	0.179	0.077	0.177
	(0.013)	(0.030)	(0.055)	(0.146)	(0.073)	(0.174)
Observations	24,372	2,895	24,277	2,885	24,167	2,867
Wave dummies	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohorts FE	Yes	Yes	Yes	Yes	Yes	Yes
F statistic for weak identification	12.95	4.92	13.44	4.79	13.41	4.68
p value of Anderson-Rubin F statistic		0.586		0.223		0.522
p value of Hansen J statistic	0.678	0.646	0.406	0.511	0.433	0.553

Notes: The older parents are divided to two groups based on own schooling years, less or equal to 9 years and above 9 years. All models use 2SLS method and control for the gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects. We report the p value of Anderson-Rubin F statistics which are more reliable when F statistics for weak identification are less than 10. Standard errors clustered at province-cohort level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.12 2SLS estimates of effects of children's education on health management and CHE of older parents, by own schooling years

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	<=9	>9	<=9	>9	<=9	>9
Panel A	Blood pressure examination		Hypertension management with medicines		Heart management with medicines	
Schooling years of eldest child	0.304***	0.398*	0.029*	0.074*	0.043***	0.013
	(0.103)	(0.236)	(0.016)	(0.043)	(0.013)	(0.022)
Observations	45,140	5,409	44,705	5,360	43,956	5,197
F statistic for weak identification	13.11	4.45	13.03	3.90	12.61	4.34
p value of Anderson-Rubin F statistic		0.116		0.141		0.583
p value of Hansen J statistic	0.350	0.479	0.847	0.797	0.009	0.531
Panel B	(7)	(8)	(9)	(10)		
	<=9	>9	<=9	>9		
	Cancer management with medicines		CHE without dental cost			
Schooling years of eldest child	0.005**	0.000	0.007	-0.009		
	(0.002)	(0.004)	(0.014)	(0.050)		
Observations	46,148	5,520	28,223	3,594		
F statistic for weak identification	12.52	4.55	12.49	1.62		
p value of Anderson-Rubin F statistic		0.822		0.935		
p value of Hansen J statistic	0.974	0.530	0.839	0.758		

Notes: The older parents are divided to two groups based on own schooling years, less or equal to 9 years and above 9 years. All models use 2SLS method and control for gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects. We report the p value of Anderson-Rubin F statistics which are more reliable when F statistics for weak identification are less than 10. Standard errors clustered at province-cohort level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.13 Effects of children's education on reasons why forgoing inpatient care

Dependent variable	(1) IV	(2) F statistic for weak identification	(3) p value of Hansen J statistic	(4) Observations
Not enough money	-0.008*			
	(0.005)	14.65	0.011	34,761
Not willing to go to the hospital	0.003			
	(0.003)	14.65	0.874	34,761
hospital quality poor	0.002			
	(0.001)	14.65	0.287	34,761
problem too serious	0.000			
	(0.001)	14.65	0.848	34,761
No ward available	0.000			
	(0.001)	14.65	0.113	34,761
Other	-0.000			
	(0.003)	14.65	0.332	34,761

Notes: All models control for the gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects. Standard errors clustered at province-cohort level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.14 Effects of children's education on parents' labor supply

Variables	(1) Employment	(2) Days of work
Schooling years of eldest child	-0.079***	-22.611***
	(0.020)	(5.781)
Observations	51,560	51,064
Wave dummies	Yes	Yes
Province FE	Yes	Yes
Cohorts FE	Yes	Yes
F statistic for weak identification	15.60	15.47
p value of Hansen J statistic	0.000	0.003

Notes: "Employment" is defined as whether or not the respondent engaged in any work in the past year, including engaging in agricultural work, non-agricultural employed work, non-agricultural self-employed work, or non-agricultural unpaid family business work per their labor force status. "Days of work" is defined as the total days of work of the parents in the past year. We limit the max value of "Days of work" is 365. All models control for gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects. Standard errors clustered at province-cohorts level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.15 Effects of children's education on healthcare use conditional on transfers

Variables	(1) IV	(2) IV	(3) IV	(4) IV	(5) IV	(6) IV
Panel A	Outpatient incidence	#Doctor visits	Log out-of-pocket outpatient cost	Inpatient incidence	#Times of inpatient care	Log out-of-pocket inpatient cost
Schooling years of eldest child	-0.016	-0.036	-0.062	0.021**	0.043**	0.125**
	(0.010)	(0.035)	(0.042)	(0.010)	(0.020)	(0.054)
Observations	50,287	49,739	44,572	50,341	50,325	45,366
F statistic for weak identification	10.24	10.66	11.31	10.24	10.23	10.52
p value of Hansen J statistic	0.361	0.149	0.479	0.984	0.940	0.735
	(7)		(8)	(9)	(10)	(11)
Panel B	Self-treatment incidence		Log out-of-pocket self-treatment cost	Dental care incidence	Dentist visits	Log out-of-pocket dentist visits cost
Schooling years of eldest child	0.035***		0.212***	0.013	0.132**	0.078
	(0.013)		(0.072)	(0.012)	(0.052)	(0.071)
Observations	50,242		50,242	25,735	25,637	25,540
F statistic for weak identification	10.24		10.24	10.16	10.45	10.21
p value of Hansen J statistic	0.679		0.793	0.966	0.870	0.712
	(12)	(13)	(14)	(15)	(16)	
Panel C	Blood pressure examinations	Hypertension management with medicines	Heart management with medicines	Cancer management with medicines	CHE without dental cost	
Schooling years of eldest child	0.293***	0.034**	0.041***	0.005**	0.006	
	(0.095)	(0.015)	(0.011)	(0.002)	(0.013)	
Observations	48,954	48,426	47,517	50,001	31,817	
F statistic for weak identification	10.56	10.39	9.96	10.06	9.65	
p value of Anderson-Rubin F statistic			0.000		0.304	
p value of Hansen J statistic	0.639	0.916	0.014	0.727	0.207	

Notes: IVs for child education include the exposure to CEL and the interaction of exposure and proportion of less than nine-years education of six youngest ineligible cohorts. The amount of net transfer from children is controlled and instrumented by the "average net transfer from children in the reference group (the group with the same province, urban or rural status, and parents' birth year)". All model control for gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects. We report the p value of Anderson-Rubin F statistics which are more reliable when F statistics for weak identification are less than 10. Standard errors clustered at province-cohort level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.16 Effects of children's education on health costs netting out net transfer

Dependent variable	(1) IV	(2) F statistic for weak identification	(3) p value of Hansen J statistic	(4) Observations
Annual total health cost netting out net transfer	1.306*** (0.472)	10.87	0.911	11,192
Annual total health cost netting out net transfer (without dental cost)	0.825*** (0.294)	14.81	0.513	22,579
Household health expenditure netting out net transfer	0.743** (0.310)	12.24	0.955	26,614

Notes: All the independent variables are at the household level and are inverse-hyperbolic sine transformation, that is, $\ln(x + \sqrt{1 + x^2})$. "Annual total health cost netting out net transfer" is calculated as the sum of each household member's annualized total outpatient and self-treatment costs plus inpatient and dental care costs, and minus the net transfer amount received from children. "Household health expenditure netting out net transfer" refers the household health-related expenditures (including the indirect health expenditure) used also in Table 9, minus the net transfer amount. All models control for the gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects. Standard errors clustered at province-cohort level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.17 Robustness check for alternative instruments A

Variables	(1) IV	(2) IV	(3) IV	(4) IV	(5) IV	(6) IV
Panel A	Outpatient incidence	#Doctor visits	Log out-of-pocket outpatient cost	Inpatient incidence	#Times of inpatient care	Log out-of-pocket inpatient cost
Schooling years of eldest child	-0.011	-0.035	-0.050	0.028***	0.051**	0.128**
	(0.011)	(0.036)	(0.042)	(0.011)	(0.022)	(0.054)
Observations	51,935	51,371	45,994	51,998	51,981	46,841
F statistic for weak identification	14.62	15.26	16.38	14.59	14.58	15.41
p value of Hansen J statistic	0.664	0.239	0.653	0.838	0.811	0.719
	(7)		(8)	(9)	(10)	(11)
Panel B	Self-treatment incidence		Log out-of-pocket self-treatment cost	Dental care incidence	Dentist visits	Log out-of-pocket dentist visits cost
Schooling years of eldest child	0.042***		0.264***	0.018	0.104**	0.091
	(0.014)		(0.080)	(0.012)	(0.048)	(0.070)
Observations	51,888		51,888	27,267	27,162	27,034
F statistic for weak identification	14.57		14.57	14.58	15.08	14.84
p value of Hansen J statistic	0.533		0.541	0.691	0.960	0.580
	(12)	(13)	(14)	(15)	(16)	
Panel C	Blood pressure examinations	Hypertension management with medicines	Heart management with medicines	Cancer management with medicines	CHE without dental cost	
Schooling years of eldest child	0.332***	0.039**	0.050***	0.005**	0.018	
	(0.099)	(0.015)	(0.013)	(0.002)	(0.014)	
Observations	50,549	50,065	49,153	51,668	31,817	
F statistic for weak identification	15.06	14.82	14.01	14.36	14.17	
p value of Anderson-Rubin F statistic						
p value of Hansen J statistic	0.457	0.645	0.010	0.772	0.383	

Notes: IVs include the exposure to CEL and the interaction of exposure and proportion of less than nine-years education of six youngest ineligible cohorts. All model control for the gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects. We report the p value of Anderson-Rubin F statistics which are more reliable when F statistics for weak identification are less than 10. Standard errors clustered at province-cohort level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.18 Robustness check for alternative instruments B

Variables	(1) IV	(2) IV	(3) IV	(4) IV	(5) IV	(6) IV
Panel A	Outpatient incidence	#Doctor visits	Log out-of-pocket outpatient cost	Inpatient incidence	#Times of inpatient care	Log out-of-pocket inpatient cost
Schooling years of eldest child	-0.024*	-0.063	-0.116**	0.027**	0.052**	0.121**
	(0.012)	(0.041)	(0.052)	(0.011)	(0.023)	(0.059)
Observations	51,935	51,371	45,994	51,998	51,981	46,841
F statistic for weak identification	12.64	12.97	13.77	12.66	12.66	12.62
p value of Hansen J statistic	0.193	0.069	0.119	0.870	0.781	0.791
	(7)		(8)	(9)	(10)	(11)
Panel B	Self-treatment incidence		Log out-of-pocket self-treatment cost	Dental care incidence	Dentist visits	Log out-of-pocket dentist visits cost
Schooling years of eldest child	0.036**		0.207***	0.019	0.176***	0.115
	(0.015)		(0.080)	(0.014)	(0.064)	(0.081)
Observations	51,888		51,888	27,267	27,162	27,034
F statistic for weak identification	12.60		12.60	12.69	13.15	12.89
p value of Hansen J statistic	0.729		0.937	0.634	0.286	0.389
	(12)	(13)	(14)	(15)	(16)	
Panel C	Blood pressure examinations	Hypertension management with medicines	Heart management with medicines	Cancer management with medicines	CHE without dental cost	
Schooling years of eldest child	0.281**	0.034*	0.034***	0.005*	-0.001	
	(0.111)	(0.017)	(0.011)	(0.002)	(0.014)	
Observations	50,549	50,065	49,153	51,668	31,817	
F statistic for weak identification	12.67	12.74	12.61	12.48	10.86	
p value of Hansen J statistic	0.691	0.820	0.057	0.770	0.927	

Notes: IVs include the exposure to CEL and the interaction of exposure and whether average schooling year of six youngest ineligible cohorts is lower than the national average schooling year. All models control for the gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects. Standard errors clustered at province-cohort level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.19 Robustness check for alternative instruments of exposure dummies

Variables	(1) IV	(2) IV	(3) IV	(4) IV	(5) IV	(6) IV
Panel A	Outpatient incidence	#Doctor visits	Log out-of-pocket outpatient cost	Inpatient incidence	#Times of inpatient care	Log out-of-pocket inpatient cost
Schooling years of eldest child	-0.013	-0.033	-0.066*	0.026***	0.057***	0.124***
	(0.009)	(0.031)	(0.037)	(0.009)	(0.018)	(0.046)
Observations	51,935	51,371	45,994	51,998	51,981	46,841
F statistic for weak identification	5.12	5.23	5.66	5.10	5.10	5.08
p value of Anderson-Rubin F statistic	0.606	0.463	0.495	0.009	0.002	0.016
p value of Hansen J statistic	0.798	0.511	0.773	0.593	0.575	0.696
	(7)	(8)	(9)	(10)	(11)	
Panel B	Self-treatment incidence	Log out-of-pocket self-treatment cost	Dental care incidence	Dentist visits	Log out-of-pocket dentist visits cost	
Schooling years of eldest child	0.036***	0.228***	0.021*	0.133***	0.115*	
	(0.012)	(0.067)	(0.011)	(0.046)	(0.062)	
Observations	51,888	51,888	27,267	27,162	27,034	
F statistic for weak identification	5.08	5.08	5.12	5.09	5.14	
p value of Anderson-Rubin F statistic	0.008	0.001	0.759	0.060	0.836	
p value of Hansen J statistic	0.395	0.523	0.988	0.687	0.999	
	(12)	(13)	(14)	(15)	(16)	
Panel C	Blood pressure examinations	Hypertension management with medicines	Heart management with medicines	Cancer management with medicines	CHE without dental cost	
Schooling years of eldest child	0.319***	0.040***	0.037***	0.004*	0.024**	
	(0.088)	(0.014)	(0.009)	(0.002)	(0.011)	
Observations	50,549	50,065	49,153	51,668	31,817	
F statistic for weak identification	5.31	5.19	5.18	5.00	5.85	
p value of Anderson-Rubin F statistic	0.013	0.103	0.000	0.161	0.001	
p value of Hansen J statistic	1.000	0.971	0.023	0.572	0.033	

Notes: The "exposure" is defined as a set of dummy variables derived from adult children's age when CELs implemented, including the dummy of whether they were younger or equal to 6 years old when the CELs were implemented, the dummy of whether they were older or equal to 16 years old when the CELs were implemented, and the other five dummies measured in 3-year bins between 7 and 15 years (7-9;10-12;13-15). Then we multiply these dummies with the variable "prelaw". All models control for the gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects. Standard errors clustered at province-cohort level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.20 Robustness check with three instruments

Variables	(1) IV	(2) IV	(3) IV	(4) IV	(5) IV	(6) IV
Panel A	Outpatient incidence	#Doctor visits	Log out-of-pocket outpatient cost	Inpatient incidence	#Times of inpatient care	Log out-of-pocket inpatient cost
Schooling years of eldest child	-0.002	-0.008	-0.001	0.011**	0.020**	0.032
	(0.005)	(0.017)	(0.022)	(0.004)	(0.009)	(0.023)
Observations	51,935	51,371	45,994	51,998	51,981	46,841
F statistic for weak identification	35.43	35.43	35.62	35.43	35.50	35.05
p value of Hansen J statistic	0.148	0.209	0.075	0.303	0.298	0.077
	(7)	(8)	(9)	(10)	(11)	
Panel B	Self-treatment incidence	Log out-of-pocket self-treatment cost	Dental care incidence	Dentist visits	Log out-of-pocket dentist visits cost	
Schooling years of eldest child	0.009	0.062*	0.007	0.053**	0.065*	
	(0.006)	(0.033)	(0.006)	(0.026)	(0.033)	
Observations	51,888	51,888	27,267	27,162	27,034	
F statistic for weak identification	35.37	35.37	34.36	35.49	35.12	
p value of Hansen J statistic	0.037	0.020	0.672	0.164	0.777	
	(12)	(13)	(14)	(15)	(16)	
Panel C	Blood pressure examinations	Hypertension management with medicines	Heart management with medicines	Cancer management with medicines	CHE without dental cost	
Schooling years of eldest child	0.111***	0.015**	0.015***	0.001	0.008	
	(0.042)	(0.007)	(0.004)	(0.001)	(0.007)	
Observations	50,549	50,065	49,153	51,668	31,817	
F statistic for weak identification	35.41	34.80	35.72	35.26	26.89	
p value of Hansen J statistic	0.018	0.204	0.000	0.154	0.937	

Notes: The instruments include the "exposure", the "interaction of exposure and prelaw", and an additional IV, the "interaction of exposure and gender of eldest child". All models control for the gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects. Standard errors clustered at province-cohort level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.21 Robustness check for additional provincial characteristics

Variables	(1) IV	(2) IV	(3) IV	(4) IV	(5) IV	(6) IV
Panel A	Outpatient incidence	#Doctor visits	Log out-of-pocket outpatient cost	Inpatient incidence	#Times of inpatient care	Log out-of-pocket inpatient cost
Schooling years of eldest child	-0.021*	-0.057	-0.093**	0.023**	0.042**	0.118**
	(0.011)	(0.037)	(0.045)	(0.010)	(0.021)	(0.055)
Observations	51,935	51,371	45,994	51,998	51,981	46,841
F statistic for weak identification	13.80	14.32	15.21	13.79	13.77	14.30
p value of Hansen J statistic	0.345	0.111	0.264	0.907	0.902	0.945
	(7)		(8)	(9)	(10)	(11)
Panel B	Self-treatment incidence		Log out-of-pocket self-treatment cost	Dental care incidence	Dentist visits	Log out-of-pocket dentist visits cost
Schooling years of eldest child	0.031**		0.194***	0.014	0.136**	0.082
	(0.014)		(0.075)	(0.013)	(0.054)	(0.073)
Observations	51,888		51,888	27,267	27,162	27,034
F statistic for weak identification	13.76		13.76	13.50	13.98	13.68
p value of Hansen J statistic	0.820		0.956	0.771	0.696	0.557
	(12)	(13)	(14)	(15)	(16)	
Panel C	Blood pressure examinations	Hypertension management with medicines	Heart management with medicines	Cancer management with medicines	CHE without dental cost	
Schooling years of eldest child	0.289***	0.035**	0.046***	0.005**	0.001	
	(0.100)	(0.016)	(0.013)	(0.002)	(0.013)	
Observations	50,549	50,065	49,153	51,668	31,817	
F statistic for weak identification	14.02	13.85	13.59	13.61	12.70	
p value of Hansen J statistic	0.570	0.749	0.038	0.762	0.940	

Notes: All models control for the gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects. Besides, we include the province-year characteristics about the log of GDP per capita, number of doctors and hospital beds per 10,000 population and the data from National Bureau of Statistics of China (2009). We also include the sample share of being covered by health insurance within the same province and parental birth cohort to control for the local health insurance development. We report the p value of Anderson-Rubin F statistics which are more reliable when F statistics for weak identification are less than 10. Standard errors clustered at province-cohort level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.22 Robustness check for including linear trend

Variables	(1) IV	(2) IV	(3) IV	(4) IV	(5) IV	(6) IV
Panel A	Outpatient incidence	#Doctor visits	Log out-of-pocket outpatient cost	Inpatient incidence	#Times of inpatient care	Log out-of-pocket inpatient cost
Schooling years of eldest child	-0.021	-0.061	-0.118**	0.022*	0.045*	0.114*
	(0.014)	(0.046)	(0.060)	(0.013)	(0.026)	(0.069)
Observations	51,935	51,371	45,994	51,998	51,981	46,841
F statistic for weak identification	10.17	10.31	10.96	10.20	10.20	10.47
p value of Hansen J statistic	0.304	0.075	0.183	0.951	0.866	0.905
	(7)		(8)	(9)	(10)	(11)
Panel B	Self-treatment incidence		Log out-of-pocket self-treatment cost	Dental care incidence	Dentist visits	Log out-of-pocket dentist visits cost
Schooling years of eldest child	0.035**		0.204**	0.026	0.199***	0.158*
	(0.017)		(0.091)	(0.016)	(0.074)	(0.092)
Observations	51,888		51,888	27,267	27,162	27,034
F statistic for weak identification	10.13		10.13	10.65	11.06	10.87
p value of Hansen J statistic	0.754		0.868	0.389	0.207	0.203
	(12)	(13)	(14)	(15)	(16)	
Panel C	Blood pressure examinati ons	Hypertens ion managem ent with medicines	Heart management with medicines	Cancer manageme nt with medicines	CHE without dental cost	
Schooling years of eldest child	0.289**	0.033*	0.030**	0.005*	-0.009	
	(0.124)	(0.019)	(0.013)	(0.003)	(0.017)	
Observations	50,549	50,065	49,153	51,668	31,817	
F statistic for weak identification	10.11	10.07	9.65	9.91	8.50	
p value of Anderson-Rubin F statistic			0.010	0.170	0.821	
p value of Hansen J statistic	0.578	0.824	0.226	0.902	0.704	

Notes: All models control for the gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects, and the province-specific child birth cohort linear trend. Standard errors clustered at province-cohort level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.23 Robustness check for controlling OCP

Variables	(1) IV	(2) IV	(3) IV	(4) IV	(5) IV	(6) IV
Panel A	Outpatient incidence	#Doctor visits	Log out-of-pocket outpatient cost	Inpatient incidence	#Times of inpatient care	Log out-of-pocket inpatient cost
Schooling years of eldest child	-0.017*	-0.043	-0.072*	0.023**	0.043**	0.119**
	(0.010)	(0.034)	(0.042)	(0.010)	(0.020)	(0.053)
Observations	51,935	51,371	45,994	51,998	51,981	46,841
F statistic for weak identification	15.50	16.12	16.98	15.48	15.47	15.80
p value of Hansen J statistic	0.418	0.186	0.420	0.863	0.957	0.824
	(7)		(8)	(9)	(10)	(11)
Panel B	Self-treatment incidence		Log out-of-pocket self-treatment cost	Dental care incidence	Dentist visits	Log out-of-pocket dentist visits cost
Schooling years of eldest child	0.034***		0.210***	0.016	0.124**	0.091
	(0.013)		(0.071)	(0.012)	(0.049)	(0.068)
Observations	51,888		51,888	27,267	27,162	27,034
F statistic for weak identification	15.45		15.45	15.61	16.10	15.84
p value of Hansen J statistic	0.841		0.923	0.789	0.746	0.587
	(12)	(13)	(14)	(15)	(16)	
Panel C	Blood pressure examinations	Hypertension management with medicines	Heart management with medicines	Cancer management with medicines	CHE without dental cost	
Schooling years of eldest child	0.296***	0.035**	0.044***	0.005**	0.006	
	(0.094)	(0.015)	(0.012)	(0.002)	(0.013)	
Observations	50,549	50,065	49,153	51,668	31,817	
F statistic for weak identification	15.87	15.69	15.11	15.30	13.95	
p value of Hansen J statistic	0.633	0.793	0.021	0.786	0.799	

Notes: All models control for the gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects, and the fines for above-quota births. Standard errors clustered at province-cohort level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.24 Robustness check for child-parent pairs

Variables	(1) IV	(2) IV	(3) IV	(4) IV	(5) IV	(6) IV
Panel A	Outpatient incidence	#Doctor visits	Log out-of-pocket outpatient cost	Inpatient incidence	#Times of inpatient care	Log out-of-pocket inpatient cost
Schooling years of eldest child	-0.015**	-0.039*	-0.058**	0.020***	0.028**	0.080**
	(0.007)	(0.023)	(0.029)	(0.006)	(0.012)	(0.031)
Observations	140,531	138,824	124,112	140,688	140,619	125,602
F statistic for weak identification	32.56	32.87	34.56	32.80	32.78	33.13
p value of Hansen J statistic	0.596	0.248	0.607	0.564	0.872	0.634
	(7)		(8)	(9)	(10)	(11)
Panel B	Self-treatment incidence		Log out-of-pocket self-treatment cost	Dental care incidence	Dentist visits	Log out-of-pocket dentist visits cost
Schooling years of eldest child	0.027***		0.164***	0.021***	0.110***	0.126***
	(0.008)		(0.044)	(0.007)	(0.031)	(0.042)
Observations	140,389		140,389	73,946	73,614	73,273
F statistic for weak identification	32.58		32.58	33.33	33.96	33.52
p value of Hansen J statistic	0.582		0.719	0.601	0.565	0.630
	(12)	(13)	(14)	(15)	(16)	
Panel C	Blood pressure examinations	Hypertension management with medicines	Heart management with medicines	Cancer management with medicines	CHE without dental cost	
Schooling years of eldest child	0.338***	0.034***	0.040***	0.003***	0.007	
	(0.070)	(0.009)	(0.007)	(0.001)	(0.008)	
Observations	136,221	135,089	132,471	139,775	83,394	
F statistic for weak identification	33.20	32.24	32.45	32.69	31.66	
p value of Hansen J statistic	0.848	0.942	0.000	0.300	0.610	

Notes: The regressions are based on a sample including all child-parent pairs. We use the inverse of the number of children in a family as the regression weight. All models control for the gender, age and age squared, schooling years, marital status, number of living child and childhood health condition of parents, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects. Standard errors clustered at province-cohort level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.

Table A.25 Effects of children's education on death attrition of parents

Variables	(1) 2013 wave Die	(2) 2013 and 2015 waves Die
Schooling years of eldest child	-0.003	-0.001
	(0.005)	(0.002)
Observations	13,717	28,314
Wave dummies	Yes	Yes
Province FE	Yes	Yes
Cohorts FE	Yes	Yes
F statistic for weak identification	15.51	18.98
p value of Hansen J statistic	0.557	0.592

Notes: "Die" is defined as the probability of the parent being dead between waves 2011 and 2013. Column 1 only includes sample in 2013 wave and column 2 includes sample in waves 2013 and 2015 (for a larger sample size). All models control for the gender, age and age squared, schooling years, marital status, number of living child, gender of eldest child, type of residence, average education before the law enforcement, wave dummies, province fixed effects, cohort fixed effects. Here we exclude childhood health condition of parents due to too many missing values. Standard errors clustered at province-cohort level in parentheses. ***p<0.01, ** p<0.05, *p<0.1.