Social Indicators Research (2019) 145:257–278
https://doi.org/10.1007/s11205-019-02109-9

ORIGINAL RESEARCH

Adult Children's Education and Later-Life Health of Parents in China: The Intergenerational Effects of Human Capital Investment

Nan Jiang[1]

Accepted: 14 March 2019 / Published online: 19 March 2019

Abstract
Recent research has shown that in high-income countries, investing in children's education could be an effective strategy to improve parental health in older age. However, little is known about whether this pattern exists in China, a rapidly aging context with strong filial piety traditions and a weak public support system for older adults. Using longitudinal data from the China Health and Retirement Longitudinal Study, we used Cox proportional hazards and multinomial logistic regression models to investigate changes in both mortality and subjective health (self-reported health) outcomes. We assessed the association separately by parental gender. Having college-educated children was associated with a 31% decline in the hazard of parental death (adj. *HR* 0.69, $p < .05$). The odds of parents with children who completed secondary education maintaining good health was 1.80 times that of the parents whose children completed primary education or less (*OR* 1.80, $p < .001$). We found no gender difference among parents with respect to the association between children's educational attainment and parental health. Children's education might be a prominent factor in magnifying existing health disparities among Chinese older adults. We urge policymakers to consider the multigenerational advantages of expanding educational opportunities in China for not only college but also secondary education.

Keywords China · Aging · Education · Mortality · Self-rated health

1 Introduction

Education of individuals appears to be protective regarding the health of their family members. Recently, studies in developed countries found that offspring's level of education is positively associated with parental longevity (Friedman and Mare 2014; Sabater and Graham 2016; Torssander 2013, 2014; Zimmer et al. 2007, 2016). An emerging body of research also has documented how the educational resources of adult children may shape older parents' short- and long-term health outcomes, such as functional limitation,

✉ Nan Jiang
nj2246@columbia.edu

[1] School of Social Work, Columbia University, New York, NY 10027, USA

depressive symptoms, cognitive impairment, and physiological dysregulation (Lee 2018a, b; Lee et al. 2017; Yahirun et al. 2017).

However, only a few available studies focused on whether this pattern exists in low- and middle-income countries (De Neve and Harling 2017; De Neve and Kawachi 2017; Yahirun et al. 2016, 2017; Yang et al. 2016). In contrast to evidence from high-income countries, recent literature from Asia (Cai et al. 2006; Giles et al. 2010; Knodel et al. 2000), Latin America (Giles et al. 2010), and Africa (De Neve and Harling 2017) suggests that many individuals aged 60 or older in low- and middle-income countries still depend on support provided by their children. Without a reliable public support system, older parents in developing countries rely heavily on close family ties. Given the strong empirical association between education and socioeconomic status, investing in children's human capital might be one of the most effective strategies for parents to secure their living conditions in old age (De Neve and Harling 2017; Friedman and Mare 2014; Lundborg and Majlesi 2015; Torssander 2014; Zimmer et al. 2016). This is particularly important in policy settings where the public welfare system provides limited resources to older adults and adult children play a more prominent role in supporting older generations.

This study extended previous research by testing whether the educational attainment of adult children influences objective and subjective health outcomes among older parents in China. China is a developing country where educational expansion has occurred rapidly since the late 1990s. It is also still characterized by the cultural tradition of filial piety. This paper examines changes in both objective (mortality) and subjective (self-reported health) health outcomes in China. Most previous research assessed long-term outcomes and parents' current health status, but few studies discussed changes over time. We addressed this question by studying objective and subjective health changes to better understand the dynamics of older parents' health associated with children's education.

2 Literature Review

2.1 Adult Children's Education and Parental Health

To study intergenerational human capital transmission, researchers have generally followed human capital theory, which is based on the seminal work of Becker and Tomes (1976). Human capital refers to the stock of habits and social and personality attributes, including creativity, embodied in the ability to perform labor so as to produce economic value (Becker and Tomes 1976, 1986). The human capital model not only accounts for genetic or biological transmission across generations, but also assumes that socioeconomic factors—such as parents' investment in their own education, occupational skills, income, and assets—play a significant role. It describes intergenerational human capital transmission in two ways. First, health and ability are transmitted from parents to children biologically and genetically. Second, better-educated parents invest more or more efficiently in their children's human capital (e.g., skills and knowledge; Becker and Tomes 1986; Kaushal 2014; Solon 1999).

Human capital theory thus explains intergenerational transmission from parents to children. However, differential investment in children's education may be a key driver of social and health disparities among parents in older age (Berkman et al. 2000; De Neve and Kawachi 2017; Kawachi and Berkman 2000). The impact of children's human capital on parental health is likely to be protective for three reasons. First, children could function as

a substitute for tax-supported institutions (e.g., public health insurance and social security) or market institutions (e.g., employer-provided pensions and private health insurance) in less-developed settings (Stephens and Yang 2014). Children could compensate with monetary support to their parents for human capital investment in their childhood related to their education. Second, children with better education might be more able to provide care to parents due to better knowledge of preventive care, the health insurance system, long-term care arrangements, and health technology. Well-educated children might also indirectly influence their parents to engage in a healthier lifestyle by simply exposing parents to their own lifestyles (DiMaggio et al. 2001; Friedman and Mare 2014). Finally, social support and social control may be common means by which adult children affect older parents' health. Parental relationships with their adult children represent a major element of their social networks and source of household support. Well-educated children are likely to develop empathy and build self-confidence, attributes that increase the likelihood of helping family members and promoting family integration (Oliker 2000; Roschelle 1997).

A growing share of correlational research has examined the benefits of human capital among children for parents. In developed settings, both cross-sectional (Sabater and Graham 2016; Yahirun et al. 2016; Zimmer et al. 2002) and longitudinal (Friedman and Mare 2014; Lee 2018a; Lee et al. 2017; Torssander 2013, 2014; Zimmer et al. 2007) studies found a universally protective association between children's education and parental health. In Swedish studies, for instance, Torssander (2013, 2014) used sibling fixed-effects and found that having tertiary-educated children was associated with a 20% increase in the hazard of parental survival compared to parents whose children only completed compulsory schooling. In the United States, Friedman and Mare (2014) found that having children with a college degree was associated with a 6.3% increase in the hazard of parental survival compared to parents of children with less than a high school education, and this effect was more pronounced in terms of mortality, with ties to behavioral risks (e.g., lung cancer and chronic lower respiratory diseases).

In developing countries with limited public support in old age and stronger expectations of obligations to care for older parents, only a handful of available studies have found a similar positive association between children's education and parental health. Although the spillover effect of children's education on parents might differ based on the epidemiological profile, cultural factors, and institutional settings under study (De Neve and Fink 2018), this marginal impact in lower-resources settings was generally larger than the impact in a high-resource setting. Yahirun et al. (2017) found that adult children's education was not associated with changes in parents' physical functioning, but having college-educated children was associated with a 40% decline in parental mortality risk. Another study using data from South Africa found that a 1-year increase in children's schooling attainment was associated with a 5% decline in the hazard of maternal death and 6% decline in the hazard of paternal death (De Neve and Harling 2017). Finally, Yang et al. (2016) found in China the adjusted hazard of parental death for children who received 10 or more years of education was 17% lower than that of children who received 6 years of education or less. This Chinese population-based study, however, is difficult to interpret because it did not control for likely child-level confounders such as number of children, sex composition, and income level, thereby potentially introducing bias into the estimates.

Although the bulk of correlational studies is growing rapidly, identifying a causal relationship is difficult given the endogeneity of children's education and omitted variable bias, such as unobserved genetic or environmental factors that might have determined children's educational attainment and parental health status. Limited research has exploited large educational reforms as "nature experiments" to estimate the causal effects of education on

parental health. Lundborg and Majlesi (2018) used changes in years of compulsory schooling as the instrumental variable, but this study found no causal effect of children's education on parental mortality risk. In low-resource settings, the marginal impact of children's education is more prominent. De Neve and Fink (2018) exploited the 1974 Tanzania Universal Primary Education policy reform as their instrumental variable and found that each additional year of primary schooling among children led to a 3.7% reduction in maternal death and 0.8% reduction in paternal death. Ma (2017) used the exposure of adult children to compulsory education reform around 1986 in China and its interaction with enforcement intensity as an instrument variable for children's years of schooling, and found increasing years of adult children's education led to higher level of cognitive functions and a longer expected survival of older parents.

2.2 Distinctions in Associations Between Children's Education and Mothers' and Fathers' Health

The effect of children's education on parents' health likely differs by gender. A growing number of studies confirm that children's education affects women and men distinctly, but the evidence is mixed. On the one hand, Yahirun et al. (2017) and Smith-Greenaway et al. (2018) investigated the association between children's education and parental mortality and found mother's survival is more sensitive to children's education than fathers. Women may depend more on the support of their children because they have far fewer financial resources given their loose attachment to the labor market. In addition, women are more likely to serve as caregivers in the family. They continue to provide unpaid care to children and grandchildren. These roles place mothers in close physical proximity to children and potentially open up additional pathways through which mothers and children support mutually (Gomes 2007). Yang et al. (2016), on the other hand, found that men whose children had high education had a lower risk of death in China. Men are more likely to engage in unhealthy behaviors, such as excessive tobacco and alcohol use (Li et al. 2015). Thus, children might have more opportunities to positively influence father's health. Due to patriarchal culture and the father-child relationship it fosters, children may be more aware of their aging fathers' needs (De Neve and Kawachi 2017). This variance in findings across countries is partly due to differences in family cultures and institutional settings, but makes the generalizations difficult.

2.3 Chinese Education System

Like other developing countries, China underwent a rapid expansion in educational attainment throughout the latter half of the twentieth century. Alongside economic reforms and opening of China, the Chinese government began the first structural implementation of 9-year compulsory education in 1986, including 6 years of primary education and 3 years of secondary education (Tsang 1991). Enrollment at both levels of compulsory schooling increased rapidly, reaching approximately 104% and 95% for primary and secondary school gross enrollment, respectively (UNESCO 2018). In 1999, higher education expansion started, which resulted in a sharp increase in college graduates (Li et al. 2014; Xing et al. 2017). In contrast to older generations, younger generations grew up with higher educational opportunities. The number of children receiving higher education has boomed from 1 million in 1998 to 6.3 million in 2009 (Yeung 2013). The large generational gap

in higher education may raise the possibility that children's human capital contributes to parental health in China.

2.4 Chinese Context: Old-Age Support and the Role of Children

Due to increases in longevity and a strict one-child policy for 30 years, China is confronting rapid population aging at a relatively early stage of development. China's elderly support ratio, defined as the number of prime-aged adults (25–64 years old) divided by the number of adults aged 64 or older, is estimated to decrease from 7.3 in 2014 to only 2.1 by 2050 (National Bureau of Statistics of China 2015). Family support for older people is still taken seriously in both urban and rural China, but its significance among rural older adults is substantially greater (Cai et al. 2012). Currently, family remains the main source of support for rural older adults in China (Cai and Wang 2006). Old-age support provided through the extended family network is not only a deep-rooted tradition in China, but also mandated and promoted by a family support law (Chan and Chui 2011). The extent of these forms of support is evidenced by indicators such as shared living arrangements and household income (Pei and Tang 2012; Li and Jiang 2017).

In China, social insurance retirement benefits play a major role in the total income of older adults, but this support often varies greatly by residential registration. Most urban residents enjoy pensions through employment. Select groups (e.g., public sector employees) have pension arrangements, whereas other groups do not. Occupational pensions are present but are more limited and industry-specific. In rural China, residents aged 60 or older have received a minimum monthly income of 55 RMB (about $8 USD) under the New Rural Pension Scheme since 2008. Although designed as an insurance scheme, this basic minimum is guaranteed by the state, with contributions from both central and local governments. However, the program's adequacy has been widely doubted due to the low rate of the benefit (Guo 2014; Pei and Tang 2012; Shen and Williamson 2010). The weak public support system drives poverty that affects almost a quarter of Chinese individuals aged 60 or older (Castañeda et al. 2016).

Understanding the broader returns of investing in children's human capital is particularly important in China's rapidly aging society for three reasons. First, in Chinese culture, children's educational achievement is highly valued as a symbolic asset and perceived social standing among aging parents. The educational attainment of children is regarded as an essential factor of successful aging and supportive ties with children (Hsu and Wu 2016). Parents begin going to great lengths to ensure their children's, and by extension their families 'success. Second, a college education is costly and becoming more expensive in China, and parents bear much of the financial burden of high tuition costs. In China, many parents pay for their children's college expenses. In fact, research has indicated that more than half of Chinese parents spend more than 10,000 RMB ($1453 USD) per year on children's college tuition (Yeung 2013). Previous findings estimated that tuition costs are approximately 37% of the average gross national income per person in China (Brandenburg and Zhu 2007). Many parents deplete their life savings to pay for a good education for their children. In a context featuring high lifetime health care costs, parents are confronted with a tradeoff between investing in their children's higher education and holding on to their wealth for future expenses. Finally, China is facing significant challenges in its effort to provide adequate support to the older population in the coming years. Due to the one-child policy, older adults in the future will have fewer children to provide caregiving (Jiang et al. 2018; Zhang

et al. 2012). Large-scale migration and urbanization also are undermining traditional filial piety, and the public pension program remains immature and unequal in urban areas (Fowler et al. 2010). Therefore, the current study has important implications for research and policy by assessing whether investment in increased education in China may bring benefits in terms of improved health for older generations, beyond those arising more directly from children's improved well-being.

2.5 Hypotheses

Hypothesis 1 The association between adult children's education and parents' mortality rate will be negative over time, even after adjusting for parents' socioeconomic status.

Hypothesis 2 Adult children's higher education will be positively associated with mitigated self-rated health deterioration and later onset of health decline.

Hypothesis 3 The strength of the association between adult children's education and parental health outcomes will vary by parental gender. We posit the association will be stronger for mothers compared to fathers due to women's weaker attachment to the labor market and their roles as family caregivers, which may result in closer relationships with adult children in later life compared to fathers.

3 Methods

3.1 Data

This study is based on data from the China Health and Retirement Longitudinal Study (CHARLS), a biannual panel survey of residents aged 45 years or older living in households in China. It is modeled after the U.S. Health and Retirement Study, including detailed information on health, socioeconomic status, health status, and children (Zhao et al. 2014). The baseline sample was conducted in 2013 and included 18,605 individuals in approximately 11,000 households. The response rate was 80.51% across 28 provinces. Two follow-up interviews were conducted in 2013 and 2015. We restricted the sample to individuals aged 50 or over who had at least one child in 2011. Given that most children have finished their highest level of education by age 25, this study excluded respondents if all their children were younger than 25 at baseline. This left us with an analytic sample of 7340 parents.

The analytic samples of this study differed for mortality and self-rated health analyses. The mortality analysis, used to assess changes in long-term health, drew on the three waves of data from 2011 to 2015. We excluded parents who were assumed dead but whose year of death could not be identified. Of the 7340 individuals included in the baseline sample, 565 died by 2015. For self-reported health analysis, we also used three waves of data. We excluded participants who were lost to follow-up, died, or did not report self-reported health at any of the waves. The self-reported health sample consisted of 4794 parents who rated their health as fair or poor in 2011 and 1343 parents who rated their health as good, very good, or excellent in 2011.

3.2 Outcome Variables

We examined older parents' timing of death by leveraging 5 years of mortality data. Decedents' year of death was recorded in an exit interview section. For self-reported health, respondents were asked to rate their health as excellent, very good, good, fair, or poor in the past 12 months. At each wave, the answer was recoded as a binary variable (0 = *poor or fair*, 1 = *good, very good, or excellent*). Our outcome variable was the change in self-reported health status: deteriorating, maintaining poor health, improving, and maintaining good health.

3.3 Explanatory Variables

The main explanatory variable was adult children's education, measured by the highest educational attainment of children for each parent at baseline, following earlier studies by De Neve and Harling (2017) and Ma (2017). Educational attainment was defined as a categorical variable as follows: (a) primary school or lower level of schooling, (b) secondary school, and (c) college or higher level of education. We compared parents whose children finished primary or lower schooling to parents whose children had completed secondary school or college education or above. These comparisons are likely to be policy relevant in China, where much of the public attention is focused on equality of access to college education and beyond.

3.4 Control Variables

To account for possible confounding, we controlled for a set of parental characteristics, including parents' age in years using both linear and quadratic terms, based on the finding of a nonlinear relationship between age and parental health trajectories. In our sample, a large proportion of parents received little formal education. Thus, we recoded parents' education as less than primary education, completed primary education, finished secondary education, and at least some college education. We also adjusted for parents' gender, marital status (currently married or unmarried), residence registration (urban or rural), number of living children, personal income, and household wealth. We followed previous research in using tertiles of income and wealth (Yahirun et al. 2017).

To examine how adult children's education influences parental health, we also included a series of measures of children's characteristics, including the highest income among children, average age, gender composition, marital status, employment, average number of children, living arrangement, and financial support to parents. Gender composition was measured by the proportion of sons for each parent. The highest income of children was based on parents' reports (tertiles). For living arrangement, we accounted for the proportion of children who lived with parents, in another neighborhood of the same town, and in another city or province, suggesting the importance of coresiding children in caregiving for aging parents. Financial support to parents was measured by asking whether participants received any transfers from children in the last 12 months (Lee 2018b; Yahirun et al. 2016, 2017). These variables were based on baseline measurement and time-invariant.

3.5 Statistical Analyses

Our unit of analysis was the parent. To investigate the association between changes in parental health and adult children's education, we conducted two sets of analyses. First, we used Cox proportional hazard models to estimate the timing of parents' death. Parents entered the study at the baseline interview in 2011 and were followed until the last interview date or death. Additionally, we also assessed whether interacting children's education with parents' gender affected the significance of our main variables. When testing the proportionality, we found slight violations of the proportionality assumption at the youngest ages. Therefore, we tested nonproportionality in two ways. We interacted adult children's education with parents' age and found no effect on our main variable. Another approach was to examine the interaction between adult children's education with a dichotomous variable for parents younger than 80. We found similar results—children's education remained significantly associated with parental mortality.

Our second analyses used multinomial logistic regression models to examine maintenance, decline, and improvement in parents' self-reported health between 2011 and 2015. Models of self-reported health change included respondents who reported their health at all three waves. We used multinomial logistic regression to predict the odds of maintaining good or poor health, experiencing health deterioration, or experiencing improved health. The progressive adjustment strategy was as follows: Model 1 consisted of parents' characteristics, including parents' educational attainment. Model 2 added children's highest education, the main variable in our study. In Model 3, we adjusted for other characteristics of children's life (e.g., highest income among children, average age, gender composition, marital status, employment, number of children, and living arrangement) (Yahirun et al. 2017). Model 4 examined whether interacting parents' gender with children's education affected the significance of our main predictor variable.

All analyses models were weighted based on recent research methods (Friedman and Mare 2014; Lee 2018b). The analyses were conducted in Stata 15. Finally, the covariate with the most missing data was the indicator measuring children's income, with less than 5% of missing values. Missing data on independent variables was handled with the Stata multiple imputation suite (StataCorp 2013).

3.6 Sensitivity Analyses

In supplemental analyses, we also tested alternative specifications of children's education, such as mean or median years of education, but the results remained similar. In addition, we examined the proportion of children (a) with primary school education or less, (b) who completed secondary school, and (c) with college-level education using methods from Friedman and Mare (2014). The three proportions summed to 1 for each parent. We found that the highest educational attainment among adult children differentiated parental health.

4 Results

Table 1 presents baseline parents' characteristics for the two samples used in our analyses. Mean age at the 2011 baseline survey was 63 for parents. Rural residents made up the majority of parents in the sample. At the baseline, the parents' sample consisted of

Table 1 Weighted descriptive statistics, parents aged 50+. *Source*: CHARLS, 2011–2015

	Mortality sample Proportion/mean (SE)	Self-rated health sample Proportion/mean (SE)
Parents' demographic characteristics		
Gender		
Female	50.10%	48.03%
Male	49.90%	51.97%
Age	63.07 (8.98)	62.30 (8.27)
Educational attainment		
No education	30.74%	29.20%
Primary education	42.36%	43.98%
Secondary education	25.33%	25.43%
College and above	1.58%	1.39%
Marital status		
Not married	24.76%	21.84%
Married	75.24%	78.16%
Hukou status		
Rural	76.33%	78.38%
Urban	23.67%	21.62%
Income		
No income record	17.10%	16.08%
First tercile	32.80%	33.10%
Second tercile	26.47%	27.00%
Third tercile	23.63%	23.81%
Household wealth		
No wealth record	30.53%	29.41%
First tercile	25.75%	26.02%
Second tercile	22.63%	23.70%
Third tercile	21.08%	20.87%
Number of children	2.99 (1.50)	2.97 (1.46)
Children's characteristics		
Children's highest education		
Primary education	20.49%	20.80%
Secondary education	58.71%	58.47%
College and above	20.80%	20.72%
Average age	35.75 (8.22)	36.85 (7.92)
% of sons	0.34 (0.35)	0.35 (0.34)
% of married	0.83 (0.31)	0.85 (0.28)
No. of grandchildren	1.26 (0.76)	1.33 (0.74)
Children's highest income		
First tercile	8.40%	8.56%
Second tercile	36.65%	36.60%
Third tercile	54.95%	54.84%
% of employed	0.86 (0.29)	0.86 (0.27)
Proximity		
% of co-resident children	0.23 (0.32)	0.25 (0.32)

Table 1 (continued)

	Mortality sample Proportion/mean (SE)	Self-rated health sample Proportion/mean (SE)
% of children in the same town	0.26 (0.32)	0.27 (0.32)
% of children in another city	0.21 (0.33)	0.21 (0.32)
% of children provide financial support	0.42 (0.49)	0.44 (0.50)
N	7340	6137

predominantly married persons with respondents reporting an average of three children. More than 70% of the parents across the samples had a primary school education or less. Table 1 also provides descriptive statistics of children's characteristics at baseline in 2011. The percentage of parents whose children have college education or above was approximately 20% compared to parents with college and above was only 1.58%. Median highest educational level among adult children was secondary education, substantially greater than the educational attainment of their parents. A substantial share of children were daughters, employed, and married at the baseline. Adult children reported an average of 1–2 children. Less than 50% of the parents reported receiving financial support from children. On average, 25% of children chose to live with parents, while 27% reported living in another neighborhood in the same town and 21% in another city. Descriptive statistics for the full children sample are provided in Appendix Table 4.

Table 2 displays the hazard ratios (HR) derived from Cox proportional hazard models of mortality. Model goodness-of-fit was evaluated using a Gronnesby and Borgan test based on the predicted risk score (Gronnesby and Borgan 1996). Across the four survival regression models, we do not find statistically significant evidence of a poor fit ($p > .05$). The Akaike information criterion (AIC) was used to evaluate and compare the goodness-of-fit between the four models; a smaller AIC score indicated a better model (Akaike 1974). Model 1 indicates that parents' educational attainment was not associated with mortality risk. Model 2 provides support for the hypothesis that parents with children who attended college have a lower hazard of death than parents who have no children with a college education (*HR* 0.63, $p < .01$). Model 3 added the remainder of children's characteristics, with the strength of the association between children's highest education and timing of parental death slightly increasing (*HR* 0.66, $p < .05$). In contrast, secondary education was not associated with parental mortality in adjusted models, suggesting a nonlinear relationship in the analyses. In the final model, the interaction between children's highest education and parents' gender was not significant, and thus gender differences were not apparent in our analyses.

Table 3 presents the multinomial logistic regression results in the form of odds ratios (OR) from the self-rated health change models. The likelihood ratio Chi square tests for the four models were significant ($p < 0.001$). The pseudo R^2 (Nagelkerke) for the model was between .25 and .33, indicating these models fit the data well. The AIC test was also performed for the multinomial logistic regressions for model comparison. In Model 1, parents with college education were not associated with maintaining poor health, health improvement, or maintaining good health. Model 2 shows that the association between children's college education and parental health change was nonsignificant ($p > .05$). The odds of parents with children who completed secondary education maintaining good health was 1.96 times that of the parents whose children completed primary education or less (*OR* 1.96,

Table 2 Cox proportional hazard models predicting mortality among parents aged 50 in CHARLS 2011–2015. *Source*: CHARLS, 2011–2015

	M1	M2	M3	M4
Parent's characteristics				
Male	1.505*** (0.149)	1.482*** (0.147)	1.491*** (0.149)	1.397* (0.229)
Educational attainment (ref. less than primary education)				
Primary education	1.015 (0.106)	1.045 (0.110)	1.045 (0.110)	1.044 (0.110)
Secondary education	0.819 (0.131)	0.895 (0.146)	0.905 (0.148)	0.900 (0.147)
Some college	0.408 (0.243)	0.494 (0.297)	0.500 (0.301)	0.500 (0.301)
Urban Hukou	0.887 (0.111)	0.959 (0.122)	0.958 (0.124)	0.956 (0.124)
Children's characteristics				
Children highest education (ref. primary education)				
Secondary education		0.874 (0.086)	0.891 (0.089)	0.843 (0.117)
College and above		0.628** (0.106)	0.688* (0.121)	0.685* (0.122)
Children's highest income (ref: first tercile)				
Second tercile			1.174 (0.188)	1.176 (0.188)
Third tercile			1.085 (0.178)	1.085 (0.178)
% of children employed			1.276 (0.233)	1.279 (0.177)
Sex composition/% of sons			1.085 (0.194)	1.085 (0.194)
Average age of children			1.012 (0.009)	1.013 (0.009)
% of children married			0.523*** (0.103)	0.523*** (0.102)
% of children live with parents			0.919 (0.220)	0.915 (0.187)
% of children live in another neighborhood in the same town			0.843 (0.190)	0.837 (0.189)
% of children live in another city			0.571 (0.144)	0.569 (0.143)
Average no. of grandchildren			1.101 (0.072)	1.101 (0.072)
Children provide financial support			1.000 (0.096)	0.999 (0.096)
Parent's gender × children's education				
Father × secondary education				1.111 (0.212)
Father × college and above				1.014 (0.316)
AIC	9465	9461	8394	8395
Likelihood ratio test (Groennesby and Borgan)				
LR chi2	24.64	17.99	16.29	16.30
Prob > chi2	0.34	0.35	0.40	0.41
N	7340	7340	7340	7340

Parents' characteristics, including age, age square, marital status, income level, wealth level, and number of children, are controlled for in all models

$p < .001$). When children's other characteristics were added to Model 3, the association between adult children's secondary education and parental self-rated health maintenance only slightly attenuated the odds ratio, and the correlation remained significant (*OR* 1.80, $p < .001$). Model 4 shows no gender difference with respect to the association between children's highest educational attainment and self-rated health change of parents.

Table 3 Multinomial logistic regression models predicting self-reported health changes among parents aged 50 in CHARLS 2011–2015. *Source*: CHARLS 2011–2015

	Health deteriorating versus maintain poor health				Health deteriorating versus health improving				Health deteriorating versus maintain good health			
	M1	M2	M3	M4	M1	M2	M3	M4	M1	M2	M3	M4
Parent's characteristics												
Male	0.662* (0.106)	0.664* (0.107)	0.645** (0.106)	0.364*** (0.111)	0.738 (0.116)	0.745 (0.118)	0.727* (0.117)	0.423*** (0.124)	1.208 (0.199)	1.242 (0.205)	1.270 (0.214)	0.589 (0.187)
Educational attainment (ref. less than primary education)												
Primary education	0.973 (0.172)	0.954 (0.170)	0.961 (0.173)	0.982 (0.176)	1.160 (0.201)	1.122 (0.197)	1.112 (0.197)	1.137 (0.201)	1.020 (0.187)	0.951 (0.176)	0.919 (0.172)	0.959 (0.187)
Secondary education	1.054 (0.253)	1.069 (0.264)	1.093 (0.273)	1.092 (0.271)	1.400 (0.328)	1.376 (0.332)	1.390 (0.339)	1.387 (0.336)	1.389 (0.338)	1.268 (0.318)	1.243 (0.314)	1.125 (0.314)
Some college	0.541 (0.377)	0.604 (0.426)	0.671 (0.475)	0.664 (0.471)	1.089 (0.704)	1.167 (0.762)	1.218 (0.799)	1.201 (0.779)	1.305 (0.859)	1.288 (0.857)	1.273 (0.850)	1.241 (0.827)
Urban Hukou	1.355 (0.296)	1.389 (0.312)	1.507 (0.321)	1.527 (0.359)	1.594* (0.339)	1.599* (0.349)	1.715* (0.389)	1.723* (0.394)	1.342 (0.296)	1.285 (0.291)	1.301 (0.306)	1.312 (0.301)
Children's characteristics												
Children highest education (ref. primary education)												
Secondary education		1.301 (0.223)	1.310 (0.228)	0.804 (0.214)		1.429 (0.241)	1.375 (0.235)	0.870 (0.230)		1.961*** (0.355)	1.799*** (0.259)	0.963 (0.273)
College and above		0.882 (0.206)	0.853 (0.212)	0.606 (0.215)		1.019 (0.232)	0.896 (0.217)	0.630 (0.220)		1.461 (0.352)	1.120 (0.306)	0.780 (0.289)
Children's highest income (ref: first tercile)												
Second tercile			0.644 (0.197)	0.638 (0.196)			0.710 (0.216)	0.706 (0.215)			0.799 (0.260)	0.798 (0.260)
Third tercile			0.664 (0.207)	0.644 (0.202)			0.791 (0.245)	0.775 (0.241)			0.989 (0.328)	0.979 (0.326)
% of children employed			0.863 (0.255)	0.854 (0.252)			1.003 (0.216)	1.003 (0.216)			1.044 (0.316)	1.042 (0.315)
Sex composition/ % of sons			1.020 (0.284)	1.025 (0.285)			1.102 (0.298)	1.102 (0.298)			1.213 (0.341)	1.220 (0.343)

Table 3 (continued)

	Health deteriorating versus maintain poor health				Health deteriorating versus health improving				Health deteriorating versus maintain good health			
	M1	M2	M3	M4	M1	M2	M3	M4	M1	M2	M3	M4
Average age of children			1.008 (0.018)	1.008 (0.018)			1.007 (0.017)	1.007 (0.017)			1.022 (0.018)	1.022 (0.018)
% of children married			1.170 (0.385)	1.190 (0.391)			1.605 (0.517)	1.632 (0.525)			2.026* (0.682)	2.070* (0.696)
% of children live with parents			0.481* (0.175)	0.466* (0.169)			0.524 (0.186)	0.515 (0.182)			0.604 (0.223)	0.600 (0.221)
% of children live in another neighborhood in the same town			0.396** (0.128)	0.373** (0.121)			0.566 (0.177)	0.546 (0.172)			0.716 (0.234)	0.703 (0.230)
% of children live in another city			1.363 (0.515)	1.274 (0.487)			1.636 (0.606)	1.574 (0.590)			1.304 (0.506)	1.291 (0.502)
Average no. of grandchildren			1.054 (0.138)	1.040 (0.136)			0.974 (0.125)	0.964 (0.124)			0.839 (0.114)	0.831 (0.112)
Children provide financial support			1.162 (0.182)	1.146 (0.180)			1.076 (0.165)	1.063 (0.163)			1.133 (0.182)	1.116 (0.179)
Parent's gender × children's education												
Father × secondary education				2.375 (0.817)				2.228 (0.754)				3.000 (1.090)
Father × college and above				1.772 (0.766)				1.819 (0.765)				2.106 (0.939)

Table 3 (continued)

	Health deteriorating versus maintain poor health				Health deteriorating versus health improving				Health deteriorating versus maintain good health			
	M1	M2	M3	M4	M1	M2	M3	M4	M1	M2	M3	M4
N	6137	6137	6137	6137	6137	6137	6137	6137	6137	6137	6137	6137
Pseudo R^2	.25	.26	.31	.33								
AIC	13,996	13,981	11,958	11,958								

Parents' characteristics, including age, age square, marital status, income level, wealth level, and number of children, are controlled for in all models

Standard errors in parentheses. Dependent variable: change in self-rated health. Omitted category = health deteriorating

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

Children's marital status living arrangement could be considered serious confounders in our analysis. We carried out Pearson's correlation among children's variables in the current analysis in Appendix Table 5. To address the multicollinearity problems, we conducted Sobel–Goodman test to examine what the share of association between children's educational attainment and parental mortality and self-rated health change could be explained by these confounders (Sobel 1982, 1986; Preacher and Hayes 2004). We found that approximately 25% of children's education on parental mortality and 41% of children's education on self-rated health change was confounded by marital status ($p < .001$), whereas a smaller proportion (15–18% for mortality, 24–28% for self-rated health change) of the total effect was confounded by living arrangement ($p < .001$). However, controlling for these variables, as well as parents' age, marital status, income level, wealth level, and the number of children, did not make the association between children's education and parental mortality and self-rated health change non-significant. Model 3 includes all children's characteristics as mediators and controls. However, the substantive results remain the same as before.

5 Discussion

This study used data from the China Health and Retirement Longitudinal Study to examine whether adult children's education is associated with aging parents' objective and subjective health changes between 2011 and 2015. In the case of China, adult children's college education appeared to drive survival benefits for older parents. This association remained robust even after adjusting adult children's income level and financial transfer to parents, pointing to behavioral norms or knowledge support as more plausible explanations than access to material resources. Adult children affect the well-being of their older parents through a multitude of channels: the acquirement of health knowledge (e.g., dietary habits or preventive medicine), higher earnings in the labor market, and decisional capacity of life choices such as career path, marriage, and fertility. Going to college is a sanctioned move toward independence and development of coping and problem-solving abilities, which may increase the likelihood of helping family members and promoting family integration (Oliker 2000; Roschelle 1997). These results suggest that the years of college education may be a critical period of investment in the human capital of children that can promote parental health.

These results are consistent with recent findings that adult children's education is significantly associated with increased parental survival in the United States (Friedman and Mare 2014), Sweden (Torssander 2013, 2014), Taiwan (Zimmer et al. 2007), Mexico (Yahirun et al. 2017), and South Africa (De Neve and Harling 2017). Interestingly, the magnitude of the hazard ratio in our study was higher than that in higher-resource countries (e.g., the United States and Sweden) but lower than some lower-resource settings (e.g., South Africa). This finding supports the prediction that the role of children's education in low- and middle-income countries with limited social welfare is more likely to be important because a larger proportion of older parents needs to rely on children for care and support (De Neve and Fink 2018; De Neve and Harling 2017; De Neve and Kawachi 2017; Solon 1999). The current result emphasizes the significance of adult children's educational resources for parental survival in societies that have a weak public support system and emphasize strong filial obligations (Lee 2018a; Zimmer et al. 2007).

Furthermore, we also assessed the association between adult children's education and change in parental self-reported health. The strong association between children's

secondary education and higher maintenance of good self-reported health is of particular interest. One possible explanation for this finding might be that highly educated children with higher family expectations found themselves working hard in a hypercompetitive environment. In contrast, less-educated children might take responsibility for providing support and housework assistance. Compared to their counterparts with primary school education, children with secondary education likely have more resources and more flexible jobs, both of which would enable them to provide direct care. But they may not have greater access to health knowledge and familiarity with doctors. This could be a potential reason for the minimal statistical association between children's education and short-term parental health deterioration or improvement. In supplementary analyses, we explored whether children's education leads to different caregiving processes by testing whether co-residence of parents and children was differently correlated with children's education. The result shows that children's education was a significant predictor of a lower likelihood of co-residence. Even if we could not directly examine other factors, such as instrumental support provided from children, due to data limitations, this result offers some evidence that children with secondary education are more likely to provide direct care to their parents, whereas this tendency was not found among college-educated children. Although further investigation is necessary, we speculate that direct care and closer relationships appear to play a crucial role in the maintenance of good subjective health among parents in China. This finding in the Chinese context is relevant to other East Asian cultures that emphasize direct caregiving responsibility in intergenerational relationships.

In addition, we found no significant difference in the effects of children's education on objective and subjective health outcomes across mothers and fathers. Although further work is needed to understand the reason behind these effects, we suspect that the cultural norm of filial piety in Chinese culture may engender a balanced relationship between parents and their children. In the patrilineal context, children are expected to care for their fathers and pay back fathers' investment in their education. Mothers, who are often regarded as caregivers and provide care to grandchildren, are more likely to formulate closer relationships.

Although this study added evidence of the significance of children's education for parents' health, we note several limitations. First, we controlled for a wide range of comprehensive measures of parents and children's socioeconomic status available in the dataset, but the design of our study did not allow for causal inference. Given the scarcity of empirical evidence on the role of human capital in children and parental health, the aim of this study was to extend the current associational literature to low-resource settings with high expectations of filial obligations and to provide a comprehensive baseline analysis for subsequent research. There might be a reverse causality, as healthier and wealthier parents are more likely to invest in their children's education and in their own health. Different methodological approaches, such as natural experiments, are necessary to address the causality between children's education and parental health. Future research could exploit education reforms in China as a natural experiment to address the endogeneity issue more thoroughly (De Neve and Fink 2018; De Neve and Kawachi 2017; Lundborg and Majlesi 2018; Ma 2017; Torssander 2013).

Second, due to data limitations, this paper did not investigate other mechanisms beyond financial transfers and coresidence through which adult children's education might affect parents' health and mortality. It is possible that other behavioral factors, such as caregiving, care monitoring, and future planning, mediate the relationship between children's education and parental health (Friedman and Mare 2014; Torssander 2014; Yahirun et al. 2016, 2017). Third, the underlying mechanisms depend on the settings under study. The current

study examined samples of parents that were much older and had high fertility. In contrast, the educational resources of the one-child policy generation may be less important for parents, who spent their life relatively advantaged. Younger parents tend to be better educated and have a higher chance of building better pensions and receiving more generous social welfare support. Future research should focus on this special cohort to test this relationship in China as it experiences modernization and rapid social changes.

6 Conclusion

This study provides an expanded understanding of whether children's education is associated with parents' objective and subjective health outcomes. In the case of China, children's human capital appears to be important for increasing parental longevity rather than improving self-reported health, suggesting the effect of educational resources may be the strongest on aging parents at the most extreme end of the health continuum. The effect of children's educational resources on parental health may be more related to earlier life exposures. This study has policy implications for reducing health disparities in the aging process through intergenerational ties. In a society in which older adults are the most vulnerable population, welfare policies should support older adults who are at risk of mortality due to exposure to the heavy family burden. Parents who rely most on resources from their children are least likely to have college-educated children. A holistic understanding of the pathway by which children's education protects parental health is critical not only for suggesting how intergenerational human capital transmission shapes individual well-being, but also for developing policies to strengthen family support of aging populations. Therefore, policymakers need to pay attention to reforming the education system to increase educational opportunities for younger generations in a country with rapid population aging and in which families remain important institutions wherein human capital is shared across generations.

Acknowledgement The author would like to thank Professor Neeraj Kaushal, Professor Ada C. Mui, Professor Qin Gao at Columbia University on their mentorship in research design and discussion.

Compliance with Ethical Standards

Conflict of interest The author reports no conflicts of interest.

Appendix

See Tables 4 and 5.

Table 4 Weighted descriptive statistics, adult children aged 25+. *Source*: CHARLS, 2011–2015

	Mortality sample Proportion/mean (SE)	Self-rated health sample Proportion/mean (SE)
Educational attainment		
Primary school and below	42.86%	44.26%
Secondary school	47.07%	46.27%
College and above	10.08%	9.48%
Gender		
Female	53.59%	53.53%
Male	46.41%	46.47%
Age (range: 25–80)	38.87 (8.87)	38.85 (8.87)
Marital status		
Not married	7.04%	11.83%
Married	92.96%	88.17%
Proximity		
Live with parents	36.22%	36.20%
Live in another village/neighborhood in the same town	37.87%	37.88%
Live in another city/province away from parents	25.91%	25.92%
No. of children (range: 0–8)	1.49 (0.93)	1.49 (0.93)
Employed		
No	13.16%	13.53%
Yes	86.84%	86.47%
Income level		
First tercile	23.72%	23.78%
Second tercile	36.30%	36.26%
Third tercile	39.98%	39.96%
Provided financial support to parents		
No	47.30%	47.20%
Yes	52.70%	52.80%
N	21,094	19,301

Table 5 Pearson's correlation of children's characteristics

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Primary education	1												
2. Secondary education	−0.5994*	1											
3. College and above	−0.2608*	−0.6164*	1										
4. Income first tercile	0.0962*	−0.0285*	−0.0598*	1									
5. Income second tercile	0.1249*	0.0728*	−0.2097*	−0.2521*	1								
6. Income third tercile	−0.1768*	−0.0542*	0.2381*	−0.3445*	−0.8216*	1							
7. % of sons	−0.0103	0.0192	−0.013	−0.0813*	−0.0483*	0.0947*	1						
8. % of co-resident children	0.0731*	0.0653*	−0.1507*	−0.0038	0.0254*	−0.0224	0.3651*	1					
9. % of children in the same town	−0.0155	0.0141	−0.0018	−0.0815*	−0.0154	0.0630*	−0.0078	−0.2456*	1				
10. % of children in another city	−0.0248*	−0.0645*	0.1022*	−0.0900*	−0.0848*	0.1353*	0.2543*	−0.2989*	−0.2961*	1			
11. Average age	0.1107*	0.0241*	−0.1372*	−0.0092	−0.0673*	0.0706*	0.2067*	0.2597*	0.1262*	−0.0776*	1		
12. No. of grandchildren	0.2050*	0.0956*	−0.3170*	−0.0528*	0.0433*	−0.0109	0.1058*	0.2411*	0.1231*	−0.0434*	0.4831*	1	
13. % of employed	0.0084	−0.0458*	0.0470*	−0.2346*	0.004	0.1343*	0.1396*	0.0302*	−0.0306*	0.0906*	−0.0218*	0.0987*	1
14. % of children provide financial support	0.0549*	0.0046	−0.0595*	−0.1059*	−0.0662*	0.1267*	0.1754*	0.0895*	0.1300*	0.1614*	0.2445*	0.2469*	0.0831*

References

Akaike, H. (1974). A new look at the statistical model identification. *IEEE Transactions on Automatic Control, 19*(6), 716–723.

Becker, G. S., & Tomes, N. (1976). Child endowments and the quantity and quality of children. *Journal of Political Economics, 84*(1), 143–162. https://doi.org/10.1086/260536.

Becker, G. S., & Tomes, N. (1986). Human capital and the rise and fall of families. *Journal of Labor Economics, 4*(2), 1–39. https://doi.org/10.1086/298118.

Berkman, L. F., Glass, T., Brissette, I., & Seeman, T. E. (2000). From social integration to health: Durkheim in the new millennium. *Social Science and Medicine, 51*(4), 843–857. https://doi.org/10.1016/S0277-9536(00)00065-4.

Brandenburg, U., & Zhu, J. (2007). Higher education in China in the light of massification and demographic change. In *Lessons to be Learned for German*. CHE.

Cai, F., Giles, J., & Meng, X. (2006). How well do children insure parents against low retirement income? An analysis using survey data from urban China. *Journal of Public Economics, 90*(6), 2229–2255. https://doi.org/10.1016/j.jpubeco.2006.03.004.

Cai, F., Giles, J., O'Keefe, P., & Wang, D. (2012). *The elderly and old age support in rural China: Challenges and prospects*. Washington, DC: World Bank.

Cai, F., & Wang, M. (2006). Challenge facing China's economic growth in its aging but not affluent era. *China World Economics, 14*(5), 20–31. https://doi.org/10.1111/j.1749-124X.2006.00035.x.

Castañeda, A., Doan, D., Newhouse, D., Nguyen, M. C., Uematsu, H., & Azevedo, J. P. (2016). *Who are the poor in the developing world?*. Washington, DC: World Bank.

Chan, C. L. F., & Chui, E. W. T. (2011). Association between cultural factors and the caregiving burden for Chinese spousal caregivers of frail elderly in Hong Kong. *Aging and Mental Health, 15*(1), 500–509. https://doi.org/10.1080/13607863.2010.536139.

De Neve, J. W., & Fink, G. (2018). Children's education and parental old age survival–quasi-experimental evidence on the intergenerational effects of human capital investment. *Journal of Health Economics, 58*(3), 76–89. https://doi.org/10.1016/j.jhealeco.2018.01.008.

De Neve, J. W., & Harling, G. (2017). Offspring schooling associated with increased parental survival in rural KwaZulu-Natal, South Africa. *Social Science and Medicine, 176*(1), 149–157. https://doi.org/10.1016/j.socscimed.2017.01.015.

De Neve, J. W., & Kawachi, I. (2017). Spillovers between siblings and from offspring to parents are understudied: A review and future directions for research. *Social Science & Medicine, 183*, 56–61. https://doi.org/10.1016/j.socscimed.2017.04.010.

DiMaggio, P., Hargittai, E., Neuman, W. R., & Robinson, J. P. (2001). Social implications of the internet. *Annual Review of Sociology, 27*(2), 307–336. https://doi.org/10.1146/annurev.soc.27.1.307.

Fowler, A. R., Gao, J., & Carlson, L. (2010). Public policy and the changing Chinese family in contemporary China: The past and present as prologue for the future. *Journal of Macromarketing, 30*(1), 342–353. https://doi.org/10.1177/0276146710377095.

Friedman, E. M., & Mare, R. D. (2014). The schooling of offspring and the survival of parents. *Demography, 51*(3), 1271–1293. https://doi.org/10.1007/s13524-014-0303-z.

Giles, J., Wang, D., & Zhao, C. (2010). Can China's rural elderly count on support from adult children? Implications of rural-to-urban migration. *Journal of Population Ageing, 3*(1), 183–204. https://doi.org/10.1007/s12062-011-9036-6.

Gomes, C. (2007). Intergenerational exchanges in Mexico: Types and intensity of support. *Current Sociology, 55*(4), 545–560. https://doi.org/10.1177/0011392107077638.

Gronnesby, J. K., & Borgan, O. (1996). A method for checking regression models in survival analysis based on the risk score. *Lifetime Data Annals, 2*(4), 315–328.

Guo, Y. (2014). Pension policy reforms in China from 2009 to 2012. *China Journal of Social Work, 7*(2), 237–246. https://doi.org/10.1080/17525098.2014.962756.

Hsu, S., & Wu, Y. Y. (Eds.). (2016). *Education as cultivation in Chinese culture*. New York: Springer.

Jiang, N., Lou, V. W., & Lu, N. (2018). Does social capital influence preferences for aging in place? Evidence from urban China. *Aging and Mental Health, 22*(3), 405–411. https://doi.org/10.1080/13607863.2016.1249455.

Kaushal, N. (2014). Intergenerational payoffs of education. *Future of Children, 24*(1), 61–78. https://doi.org/10.1353/foc.2014.0005.

Kawachi, I., & Berkman, L. F. (2000). Social cohesion, social capital, and health. In L. F. Berkman, L. Kawachi, & M. M. Glymour (Eds.), *Social epidemiology* (2nd ed., pp. 290–319). New York: Oxford University Press.

Knodel, J., Friedman, J., Si Anh, T., & Cuong, B. T. (2000). Intergenerational exchanges in Vietnam: Family size, sex composition, and the location of children. *Population Study, 54*(4), 89–104. https://doi.org/10.1080/713779067.

Lee, C. (2018a). Adult children's education and physiological dysregulation among older parents. *Journal of Gerontology: B Psychology and Social Sciences, 73*(5), 1143–1154. https://doi.org/10.1093/geronb/gbx044.

Lee, Y. (2018b). Adult children's educational attainment and the cognitive trajectories of older parents in South Korea. *Social Science and Medicine, 209*(3), 76–85. https://doi.org/10.1016/j.socscimed.2018.05.026.

Lee, C., Glei, D. A., Goldman, N., & Weinstein, M. (2017). Children's education and parents' trajectories of depressive symptoms. *Journal of Health and Social Behavior, 58*(1), 86–101. https://doi.org/10.1177/0022146517690200.

Li, Y., & Jiang, Q. (2017). The intergenerational effect and second childbirth: Survey findings from the Shaanxi Province of China. *Social Indicators Research, 133*(2), 669–691. https://doi.org/10.1007/s11205-016-1386-2.

Li, S., Whalley, J., & Xing, C. (2014). China's higher education expansion and unemployment of college graduates. *China Economic Review, 30*(3), 567–582. https://doi.org/10.1016/j.chieco.2013.08.002.

Li, Z., Yao, Y., Han, W., Yu, Y., Liu, Y., Tao, Y., et al. (2015). Smoking prevalence and associated factors as well as attitudes and perceptions towards tobacco control in Northeast China. *International Journal of Environmental Research and Public Health, 12*(7), 8606–8618. https://doi.org/10.3390/ijerph120708606.

Lundborg, P., & Majlesi, K. (2015). *Intergenerational transmission of human capital: Is it one-way street?*. Bonn: Institute for the Study of Labor.

Lundborg, P., & Majlesi, K. (2018). Intergenerational transmission of human capital: Is it a one-way street? *Journal of Health Economics, 57*(3), 206–220. https://doi.org/10.1016/j.jhealeco.2017.12.001.

Ma, M. (2017). *Does children's education matter for parents' health and cognition in old age? Evidence from China*. Los Angeles: University of Southern California.

National Bureau of Statistics of China. (2015). *China's elderly support ratio, 2014*. http://data.stats.gov.cn/easyquery.htm?cn=C01&zb=A030707&sj=2014. Accessed August 8, 2018.

Oliker, S. J. (2000). Examining care at welfare's end. In M. H. Meyer (Ed.), *Care work: Gender, labor and the welfare state* (pp. 167–185). New York: Routledge.

Pei, X., & Tang, Y. (2012). Rural old age support in transitional China: efforts between family and state. In S. Chen & J. L. Powell (Eds.), *Aging in China: Implications to social policy of a changing economic state* (pp. 61–81). New York: Springer.

Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers, 36*(4), 717–731.

Roschelle, A. R. (1997). *No more kin: Exploring race, class, and gender in family networks*. Thousand Oaks: Sage.

Sabater, A., & Graham, E. (2016). *Intergenerational exchanges, children's education and parents' longevity in Europe*. Southampton: ESRC Centre for Population Change.

Shen, C., & Williamson, J. B. (2010). China's new rural pension scheme: Can it be improved? *International Journal of Sociology and Social Policy, 30*(4), 239–250. https://doi.org/10.1108/01443331011054217.

Smith-Greenaway, E., Brauner-Otto, S., & Axinn, W. (2018). Offspring education and parental mortality: Evidence from South Asia. *Social Science Research*, *76*, 157–168.

Sobel, M. E. (1982). Asymptotic confidence intervals for indirect effects in structural equation models. *Sociological Methodology, 13,* 290–312.

Sobel, M. E. (1986). Some new results on indirect effects and their standard errors in covariance structure models. *Sociological Methodology, 16,* 159–186.

Solon, G. (1999). Intergenerational mobility in the labor market. In O. C. Ashenfelter & D. Card (Eds.), *Handbook of labor economics* (Vol. 3, pp. 1761–1800). Amsterdam: Elsevier.

StataCorp. (2013). *Stata multilevel mixed-effects reference manual*. College Station: StataCorp.

Stephens, M., Jr., & Yang, D. Y. (2014). Compulsory education and the benefits of schooling. *American Economic Review, 104*(4), 1777–1792. https://doi.org/10.1257/aer.104.6.1777.

Torssander, J. (2013). From child to parent? The significance of children's education for their parents' longevity. *Demography, 50*(1), 637–659. https://doi.org/10.1007/s13524-012-0155-3.

Torssander, J. (2014). Adult children's socioeconomic positions and their parents' mortality: A comparison of education, occupational class, and income. *Social Science and Medicine, 122*(2), 148–156. https://doi.org/10.1016/j.socscimed.2014.10.043.

Tsang, M. C. (1991). The structural reform of secondary education in China. *Journal of Education Administration, 29*(1), 29. https://doi.org/10.1108/EUM0000000002475.

UNESCO. (2018). *China: Education and literacy, 2014*. http://uis.unesco.org/country/CN. Accessed August 8, 2018.

Xing, C., Yang, P., & Li, Z. (2017). The medium-run effect of China's higher education expansion on the unemployment of college graduates. *China Economic Review*. https://doi.org/10.1016/j.chieco.2017.05.005.
Yahirun, J. J., Sheehan, C. M., & Hayward, M. D. (2016). Adult children's education and parents' functional limitations in Mexico. *Research on Aging, 38*(2), 322–345. https://doi.org/10.1177/0164027515620240.
Yahirun, J. J., Sheehan, C. M., & Hayward, M. D. (2017). Adult children's education and changes to parents' physical health in Mexico. *Social Science and Medicine, 181*(3), 93–101. https://doi.org/10.1016/j.socscimed.2017.03.034.
Yang, L., Martikainen, P., & Silventoinen, K. (2016). Effects of individual, spousal, and offspring socioeconomic status on mortality among elderly people in China. *Journal of Epidemiology, 26*(2), 602–609. https://doi.org/10.2188/jea.JE20150252.
Yeung, W. J. J. (2013). Higher education expansion and social stratification in China. *Chinese Sociological Review, 45*(2), 54–80. https://doi.org/10.2753/CSA2162-0555450403.
Zhang, N. J., Guo, M., & Zheng, X. (2012). China: awakening giant developing solutions to population aging. *The Gerontologist, 52*(2), 589–596. https://doi.org/10.1093/geront/gns105.
Zhao, Y., Smith, J. P., & Strauss, J. (2014). Can China age healthily? *Lancet, 384,* 723–724. https://doi.org/10.1016/S0140-6736(14)61292-7.
Zimmer, Z., Hanson, H. A., & Smith, K. R. (2016). Offspring socioeconomic status and parent mortality within a historical population. *Demography, 53*(1), 1583–1603. https://doi.org/10.1007/s13524-016-0502-x.
Zimmer, Z., Hermalin, A. I., & Lin, H. S. (2002). Whose education counts? the added impact of adult-child education on physical functioning of older Taiwanese. *Journal of Gerontology : B Psychology and Social Science, 57*(3), 23–32. https://doi.org/10.1093/geronb/57.1.S23.
Zimmer, Z., Martin, L. G., Ofstedal, M. B., & Chuang, Y. L. (2007). Education of adult children and mortality of their elderly parents in Taiwan. *Demography, 44*(1), 289–305. https://doi.org/10.1353/dem.2007.0020.