Applied Spatial Analysis and Policy
https://doi.org/10.1007/s12061-022-09489-5

Childhood Socioeconomic Status and Late-Adulthood Health Outcomes in China: A Life-Course Perspective

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Received: 24 March 2022 / Accepted: 15 October 2022

Abstract

The relationship between socioeconomic status and health has been studied widely across many western countries but the relationship is relatively underexplored in China. Using a life-course perspective, this paper examines the associations between six indicators of childhood socioeconomic status with classic late-adulthood health outcomes. The analysis uses logistic and Ordinary Least Square (OLS) regression models with data on life history and data from the most recent wave of CHARLS – a nationally representative survey of people aged 45 and older. The models demonstrate that unfavourable socioeconomic status in childhood is, in general, correlated with poorer health outcomes later in life, whereas a more socioeconomically advantaged childhood is associated with better health outcomes in middle and older age. However, for those individuals who were overweight in childhood, the advantaged socioeconomic status effect appears to increase the probability of remaining overweight when older. Furthermore, the indicators of current socioeconomic status as well as the interaction terms between childhood socioeconomic status and adulthood socioeconomic status were introduced, as most existing research in the world, including China, tends to only focus on the mediation effect of current socioeconomic status. The findings show that, among all the health outcomes in this research, only the associations between disability-related health variables and adulthood socioeconomic status are moderated by childhood socioeconomic status. These results indicate both homogeneity and heterogeneity in the impacts of childhood socioeconomic status on different health outcomes and also inform public policies in China with regard to population health.

Keywords Childhood · Socioeconomic status · Health · Life course · Public policies · China

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Published online: 24 November 2022

Introduction

The relationship between socioeconomic status and health is one of the most sustained and stable associations in the field of social sciences (Mackenbach, 1994), with a large body of evidence showing that socioeconomic disadvantage is detrimental to health (Burkert et al., 2013; Chen, 2016; Mackenbach, 2006; Quon & McGrath, 2015). From the 1980s onwards, a growing number of studies often using British, American or European data, have found that inequalities in health have risen (Harper & Lynch, 2007; Mackenbach et al., 2009; Smith et al., 1990), as have socioeconomic inequalities (Kunst et al., 2005; Mackenbach, 1994). The evidence from these studies confirm that socioeconomic status plays an important role in the persistence of unequal health outcomes. Link and Phelan (1995) regard socioeconomic status as the root cause of health inequalities because they reflect access to a series of critical social and economic resources, including wealth, knowledge, prestige, power and social capital that, if possessed in sufficient quantities, can help protect an individual's health from potential risk factors, thereby providing health benefits relative to the less socioeconomically advantaged.

Having established the links between socioeconomic status and health outcomes, more recent, longitudinal, research has turned to a life course and cohort perspective. This has an emphasis on how different social, cultural and economic contexts, such as those at birth, alter the expected impacts of socioeconomic status on health outcomes by age and birth cohort (Chen et al., 2010). In particular, attention has been paid to the associations of childhood socioeconomic status with later life health outcomes. However, much of this research has focused on what are conventionally described as 'developed countries' and the extent to which the findings can be generalised to less developed countries (across a wide array of health measures) is less well-known (Angelini et al., 2019; Pudrovska & Anikputa, 2014; Vable et al., 2019; Wang & Kang, 2019).

For China, which is undergoing significant socioeconomic change, exploring the relationships between childhood socioeconomic status and health later in life is important to improve overall health outcomes in the population and reduce health inequalities. Given the social and economic transformation that China has experienced since the Second World War, a period including the Chinese Communist Revolution (1945 – 1949), the Great Chinese Famine (1959 – 1961), the Cultural Revolution (1966 – 1976) and the post-Mao Reform and Opening-up (1978 – present) (Chen et al., 2010) makes this an especially important issue. Prior to the Reform and Opening-up, China was an underdeveloped nation where poverty and malnutrition were highly prevalent. Post 1978, with the economic reform introducing increasing elements of capitalism and market economies, the quality of life improved significantly among Chinese people (Shen & Zeng, 2014; Wen & Gu, 2011). Those born between 1945 and 1978, who were exposed to the disadvantaged socioeconomic surroundings in early life, were likely to have higher living standards in late-adulthood, which appears to have beneficially influenced their health later in life (Wei et al., 2020). However, this achievement

has not benefitted everyone, and concern for the fair distribution of health benefits of economic progress has mounted (Tang et al., 2008). Therefore, to achieve greater understanding of the link between Childhood socioeconomic status and health in China, this study examines the associations between childhood socioeconomic status and various late-adulthood health outcomes in China by extending previous work (see for example Cheng & Elo, 2009; Cui et al., 2020; Liu et al., 2019; Wang & Kang, 2019; Wen & Gu, 2011).

Literature Review

Considerable evidence, mainly in developed countries, acknowledges the significant associations between socioeconomic conditions in childhood and various late-life health outcomes (Angelini et al., 2019; Loucks et al., 2010; Marmot et al., 2012). Despite the heterogeneous influences on health across gender, ethnicity, region and measures of socioeconomic position (Cui et al., 2020; Lawlor et al., 2004; Ward et al., 2004), studies have shown that childhood socioeconomic status has long-lasting impacts connecting early, middle, and late life (Guralnik et al., 2006; Maharani, 2019; Straatmann et al., 2020).To better understand the mechanisms behind these impacts, four major conceptual models regarding life course have been formulated: the critical period model (or latent model), the pathway model, the socioeconomic mobility model, and the accumulation of risk model (Niedzwiedz et al., 2012; Pudrovska & Anikputa, 2014).

The critical model indicates that adverse early-life socioeconomic status has a long-term negative impact on health, independent of current socioeconomic status, and that this impact is irreversible and permanent (Ben-Shlomo & Kuh, 2002; Niedzwiedz et al., 2012; Tsenkova et al., 2014). By contrast, the pathway model suggests the effects are not fixed and that adulthood socioeconomic status plays an important, mediating, role in the relationship between childhood conditions and health (Niedzwiedz et al., 2012). In Europe, for instance, Angelini et al. (2019) detected that less privileged childhood socioeconomic status is positively associated with poorer mental health, independent of contemporaneous socioeconomic status. However, this effect abated after allowing for contemporaneous socioeconomic status, which is related to pathway models. Overall, researchers agree that disadvantaged childhood conditions are likely to result in adverse health consequences but differ in how rigid these associations are after adjusting for late-adulthood conditions.

Socioeconomic mobility models can be sub-classified into two categories: intergenerational and intra-generational. Inter-generational mobility represents the differences in socioeconomic status between generations, captured by comparing parental socioeconomic status in childhood and the child's socioeconomic status in adulthood. Intra-generational mobility suggests the downward or upward movement of an individual's own socioeconomic status during their life course (Ferraro & Shippee, 2009; Niedzwiedz et al., 2012). Most research into the relationship between childhood socioeconomic position and health status has focused on the effect of intra-generational mobility (Wen & Gu, 2011) However, there is little consensus about how socioeconomic mobility affects health status. It has been argued that people

who are upwardly mobile appear to be healthier than those who are downwardly mobile or maintain the same status (Ferraro & Shippee, 2009; Wang & Kang, 2019). In contrast, Syme et al. (1965) identified a negative effect of upward socioeconomic mobility on the onset of coronary heart disease. They speculated that the relationship was probably due to increased stress suffered by people having lower original socioeconomic status who then achieve higher status later in life via long-term hard work.

Finally, the accumulation model refers to how "exposure to socioeconomic disadvantage (or advantage) over multiple periods exerts a stronger influence on later health than an individual episode of socioeconomic disadvantage (or advantage)" (Walsemann et al., 2016). It proposes that health disparities by childhood social status become more pronounced with age because advantages or disadvantages linked with certain social status have cumulative effects on health (Dannefer, 2003; Kendig et al., 2015; Wang & Kang, 2019) For example, using data from a US longitudinal national study, Lee and Park (2020), found that the gap in body mass index between low and high childhood socioeconomic positions widens from midlife to retirement age. However, there is another potential explanation for how the relationship between health and childhood socioeconomic status varies over the life course — the age-as-leveller hypothesis — which conflicts with the accumulation model. The age-as-leveller hypothesis suggests that health inequalities would decline with age in older populations although increasing with age in younger populations (Dupre, 2007; House et al., 1994) because being elderly is associated with declining health. House et al. (1994) believe that biological ageing plays a much more important part in predicting health outcomes than socioeconomic status when an individual is becoming old. Dupre (2007), explored the relationship between education and health risks, and explained the inconsistency between the accumulation model and the age-as-leveller hypothesis by differentiating individual-level changes from aggregate-level changes. At the aggregate level, the educational inequality in disease prevalence reaches its highest level at mid-life and then decrease, whereas at the individual level, disease incidence rises with age at a higher rate for less-educated individuals compared with those well-educated.

There is a substantial body of research assessing whether or not the relationships between childhood socioeconomic status and health consequences vary across age or birth cohorts (Haas, 2008; Kasen et al., 2011; Moody-Ayers et al., 2007; Zaninotto et al., 2018) Regardless of the conceptual model adopted, the importance of cohort effects cannot be ignored –age patterns in the associations between childhood socioeconomic status and health trajectories for one cohort are not necessarily present in others. For instance, using data from the US Kasen et al. (2011), detected decreases in depression with age in more recent cohorts but rises with age in earlier cohorts.

Thus far, we have focused on research conducted in 'Western' countries. Turning to studies using Chinese data, it has been argued that low childhood socioeconomic status is linked with a variety of adverse health outcomes such as difficultly with activities of daily living (ADLs), cognitive impairment, poor self-rated health, and mortality (Cheng & Elo, 2009; Cui et al., 2020; Wang & Kang, 2019; Wen & Gu, 2011). Among them, however, the role of late-adulthood socioeconomic status

is divided: Wang and Kang (2019) argue that the relationships between childhood socioeconomic status and later health are mediated by current socioeconomic status in China, whereas Wen and Gu (2011) find that the protective effects of high childhood socioeconomic status on functional limitations, cognitive impairment, self-rated health, and mortality are independent of adult conditions. These contrasting results suggest that the effects of socioeconomic mobility on health outcomes have a similarly complex pattern. Research has also investigated how early-life exposure to famine affects health later in life. For example, dividing study participants into those who were nonexposed, fetal-exposed or infant-exposed, Liu et al. (2019) find that exposure to famine during early life was linked with a higher probability of obesity in adulthood. Fan and Qian (2015) categorise participants into three groups: a famine cohort born during the Great Chinese Famine, a pre-famine cohort and a post-famine cohort. Their results demonstrate more negative effects for the famine cohort on health later in life when born into a family where both parents were not members of the Communist Party compared to those born to a family with at least one Party member. Although little is known about whether the links between childhood socioeconomic status and health consequences vary across age or/and birth cohorts in China, there are a few China-based studies using longitudinal data analysis to assess the dynamic feature of health inequalities. For example, Sha et al. (2018) find that childhood socioeconomic status is positively related to mid-life and late-life baseline cognition, but not related to cognition decline in both groups. Using longitudinal data between 1989 and 2011 from the China Health and Nutrition Survey, Yang et al. (2017) find that the trajectories of all chronic non-communicable diseases (but systolic blood pressure) increased to a peak and then declined across the lifespan.

Methods

Data Source and Sample

This study uses the longitudinal data from the China Health and Retirement Longitudinal Study (CHARLS). This survey includes four waves (2011, 2013, 2015 and 2018) plus a life history wave (2014) (Zhao et al, 2020). This dataset represents a Chinese version of the US Health and Retirement Study (HRS) and the UK English Longitudinal Study of Ageing (ELSA). It includes a nationally representative sample of individuals aged 45 years and older across all the 28 provinces and province-level cities in China, excluding Tibet. It reports on a wide range of attributes including demographic background, socioeconomic position, health status, household information, community information and information about their children (where applicable). For the life history survey, sampling all living individuals in the first two waves, information includes childhood backgrounds and experiences. The age threshold is taken as a moment beyond which individuals are middle-aged or elderly, in line with other East Asian longitudinal studies of ageing (Wang & Kang, 2019). 'Late-adulthood' is used as a synonym for this group. Following the example of the HRS, non-blood biomarkers were collected for every wave of the CHARLS, whereas

blood biomarkers, with diagnostic information such as diabetes and hypertension, were collected in the baseline survey and every other wave (Zhao et al, 2020).

In this study, we do not use the panel feature of CHARLS, focusing on the data from CHARLS 2018 (wave 4) and the life history wave. We use wave 4 as it is the latest wave (released in September 2020). Wave 4 participants were selected by a stratified multi-stage random sampling strategy (Zhao et al, 2020). Initially, 150 county-level units were randomly chosen from a sampling framework by probability proportional to population size (PPS). Within each county-level unit, three primary sampling units (villages or urban communities) were randomly selected by PPS. In each sampled village or urban community, 24 households with members aged 45 and above were chosen randomly. Within the household, members aged 45 or older and their spouses were interviewed. The response rate was 86%. A total of 19,816 individuals were interviewed and measured in CHARLS 2018 and 94.6% of them (18,754) were included in the 2014 life history survey.

Variable Selection

To comprehensively measure health outcomes beyond those in previous China-based studies, we include a wide variety of objective health measures including people's physical health, mental health and cognitive function.

Health Outcomes Later in Life

The physical health variables include being overweight (including obesity), multimorbidity, difficulty with ADLs (activities of daily living, such as eating, dressing, and bathing), and difficulty with IADLs (Instrumental activities of daily living; for example, cooking, shopping, and taking medication). Multimorbidity is defined as having two or more of 12 listed chronic diseases in the CHARLS questionnaire (Boyd & Fortin, 2010; Fortin et al., 2012). Examples of these diseases are hypertension, dyslipidemia, diabetes or high blood sugar, chronic lung diseases, heart disease, and asthma. Respondents' mental health later in life was captured by the CESD-10 depression score that is a commonly used psychometric scale of depression (Andresen et al., 1994). For cognitive ability, three items were picked to measure mental intactness: a serial-7 number subtraction (calculate 100 – 7, 5 times in a row), time orientation (naming today's date – the day of the week, day, month, year, and season), and picture drawing. The scores for these cognitive tests range from 0–5, 0–5, and 0–1 respectively so respondents can gain a maximum overall score of 11. To measure episodic memory, the immediate and delayed word recall tests were employed. Individuals were required to recall 10 words right after they heard these words (immediate recall) and also recall them 4 min later (delayed recall) (Zhang et al., 2021). Scores for both the immediate recall test and the delayed word recall test vary from 0 to 10. Following Cui et al. (2020), the mean of scores in the immediate and delayed word recall tests is used to measure episodic memory. For analysis we used the variables either as continuous (depression score, mental intactness, and episodic memory) or binary (overweight, multimorbidity, difficulty with ADLs, and

difficulty with IADLs). We consider each of these later-life health outcomes separately in regard to their associations with childhood socioeconomic status.

Indicators of Childhood Socioeconomic Status

The key independent variables in the analysis are childhood socioeconomic status. Following (Malaty & Graham, 1994; Wang & Kang, 2019), six indicators of childhood socioeconomic status were constructed from the 2014 life history wave to capture conditions or experiences before the age of 17: father's educational attainment, mother's educational attainment, father's employment status, mother's employment status, whether or not experiencing starvation, and the financial situation within their family. Parental educational attainment was classified into three levels: illiterate, primary school, and secondary school or above. Parental employment status was divided into three types: unemployed throughout childhood, employed for a part of childhood, and employed throughout childhood. For the experience of starvation, if the participant had never experienced starvation, this variable was coded as 1, otherwise it was 0. Participants were interviewed to describe their household financial status before the age of 17 as one of the three categories: better than other people, worse than other people, and same as other people. Both the experience of starvation as well as household financial status are relative and perceptual measures.

Demographic Variables

All models were adjusted for participants' age and gender (reference group: male). Age was centred as the grand mean to eliminate the issue of multicollinearity between the independent variables.

Statistical Strategy

Logistic regression was performed to evaluate the relationships between the six indicators of childhood socioeconomic status and the physical health outcomes. Odds ratios and 95% confidence intervals are reported, since all the physical outcomes are binary variables. Next, ordinary least squares regression models was used to estimate the associations between the six indicators of childhood socioeconomic status and continuous health variables with coefficients and 95% confidence intervals reported. The continuous variables report mental health and cognitive ability.

Furthermore, as a robustness check, the indicators of current socioeconomic status as well as the interaction terms between childhood socioeconomic status and current socioeconomic status were introduced. Current socioeconomic status is measured by education attainment (illiterate, less than elementary school, elementary school, and middle school or above), household expenditure, and employment (unemployed or retired, agricultural work, or non- agricultural work). Including the interaction terms allows for examination of whether higher childhood SES may be protective against detrimental effects of lower adult SES. Similar research has been conducted in Britain (Nettle & Bateson, 2017) whereas most existing research in the

world, including China, tends to only focus on the mediation effect of current socioeconomic status and omit the moderation effect of childhood socioeconomic status.

Summary of the Model Variables

Table 1 provides a summary of all the variables in this study: The average age of the sample is 62 years old and 53% are female. For health outcomes, 41% of participants were overweight (but not obese) and 5% of participants were obese. Overweight is a BMI greater than or equal to 25.0 kg/m^2, and obesity is a BMI greater than or equal to 30.0 kg/m^2 according to the World Health Organization criterion (World Health Organization, 2000). Z-scores of BMI were calculated to identify and

Table 1 Descriptive statistics, CHARLS data 2014 (life history) and 2018 (wave 4)

Variable	Mean	SD	Minimum	Maximum
Demographic Background				
Age	62.00	10.12	45.00	118.00
Female	0.53	_____	0.00	1.00
Physical Health				
Overweight	0.41	_____	0.00	1.00
Multimorbidity	0.17	_____	0.00	1.00
Difficulty with ADLs	0.27	_____	0.00	1.00
Difficulty with IADLs	0.33	_____	0.00	1.00
Mental Health				
Depression score	9.58	5.50	0.00	30.00
Cognitive abilities				
Mental Intactness (0–11)	5.85	3.49	0.00	11.00
Episodic Memory (0–10)	3.16	2.02	0.00	10.00
Father's educational attainment (reference: illiterate)				
Primary school	0.35	_____	0.00	1.00
secondary school or above	0.09	_____	0.00	1.00
Mother's educational attainment (reference: illiterate)				
Primary school	0.11	_____	0.00	1.00
secondary school or above	0.02	_____	0.00	1.00
Father's employment (reference: unemployed throughout the childhood)				
Employed for a part of childhood	0.05	_____	0.00	1.00
Employed throughout the childhood	0.85	_____	0.00	1.00
Mother's employment (reference: unemployed throughout the childhood)				
Employed for a part of childhood	0.02	_____	0.00	1.00
Employed throughout the childhood	0.97	_____	0.00	1.00
Experienced starvation before age 17	0.82	_____	0.00	1.00
Household Financial situation before age 17				
Same as others	0.52	_____	0.00	1.00
Better than others	0.10	_____	0.00	1.00

remove outliers ($Z < -3.29$ or $Z > 3.29$). This excludes 57 individuals from the analysis (0.35% of the total). The percentage overweight is higher than that in the study using CHARLS wave 1 in China (37.6%) (Chen et al., 2021) but consistent with studies using ELSA (41.4%) (Jackson et al., 2015, 2017) and HRS (40.7%) with a broadly similarly-aged cohort of people (Feinglass et al., 2007). However, the proportion of obesity (6%) is much lower than those using data from ELSA and HRS (31% and 21.9%, respectively) (Feinglass et al., 2007; Jackson et al., 2015, 2017). Amongst the sample, 17% of participants reported multimorbidity, 27% had difficulty with ADLs and 33% had difficulty with IADLs. The average scores for depression, mental intactness, and episodic memory were 9.58, 5.85 and 3.16, respectively. Regarding their childhood circumstances, most of parents were illiterate (father 58% and mother 87%) but most of their parents were employed throughout their childhood (father 85% and mother 82%). More than four-fifths of the sample had experienced starvation and only 10% believed that the household financial situation before their age of 17 is better than other people.

Results

Starting with childhood socioeconomic status and physical health (Table 2), age is significantly associated with all the health outcomes. In model 1, females are more likely to report an ADL disability by 31.7% than males (OR: 1.317 95% CI: 1.182–1.467). Compared to individuals with illiterate parents, individuals with parents of higher educational attainment are less likely to report difficulty with ADLs: Father's education: elementary school or below group OR and 95% CI: 0.896 (0.794–1.011); middle school or higher group: 0.697 (0.543–0.895). Mother's education: the elementary school or below: 0.765 (0.613–0.955); Middle school or higher: 0.394 (0.213—0.728). Neither father's employment status nor mother's employment status are significantly correlated with difficulty with ADLs. Individuals who had experienced starvation increased the likelihood of difficulty with ADLs by 19.6% (OR: 1.196 95% CI: 1.032—1.386). Compared to those with a financial situation perceived to be worse than others before the age of 17, those with the same financial situation as others and those with better are less likely to report difficulty with ADLs by 21.0% and 32.2% respectively (OR: 0.790 95% CI: 0.707–0.882 and OR: 0.678 95% CI: 0.552–0.833).

In model 2, compared to individuals with illiterate fathers, individuals with fathers of higher educational attainment are less likely to report difficulty with IADLs: the elementary school and below group OR and 95% CI: 0.848 (0.765—0.977); Middle school and above group, 0.699 (0.615—0.993). In addition, individuals whose mothers had educational attainment of elementary school or below are less likely to report difficulty with IADLs by 26.1% (OR: 0.739 95% CI: 0.641—0.987). Individuals with mothers employed for a part of their childhood are also more likely to have an IADL disability (OR: 1.421 95% CI: 1.121—4.821) when compared to those with mothers unemployed throughout the individual's childhood. Experience of starvation increases the likelihood of difficulty with IADLs by 29.3% (OR: 1.293 95% CI: 1.097—1.492). Having the same or better perceived financial situation than

Table 2 Association between the indicators of childhood socioeconomic status and physical health using logistic models

Variables	Model 1 Difficulty with ADLs (95% CI)	Model 2 Difficulty with IADLs (95% CI)	Model 3 Overweight and obesity (95% CI)	Model 4 Multimorbidity (95% CI)
Father's education (reference: illiterate)				
Elementary school and below	0.896* (0.794 – 1.011)	0.848*** (0.765—0.977)	1.102** (1.013—1.198)	0.994 (0.800—1.236)
Middle school and above	0.697*** (0.543—0.895)	0.699*** (0.615—0.993)	0.976 (0.842—1.131)	1.320 (0.948—1.838)
Mother's education (reference: illiterate)				
Elementary school and below	0.765** (0.613—0.955)	0.739*** (0.641—0.987)	1.053 (0.923—1.201)	0.844 (0.625—1.141)
Middle school and above	0.394*** (0.213—0.728)	0.786 (0.462—1.206)	1.250 (0.949—1.648)	0.880 (0.491—1.576)
Father's employment status before age 17 (reference: unemployed throughout the childhood)				
Employed for a part of childhood	0.808 (0.606—1.077)	0.909 (0.655—1.190)	0.950 (0.775—1.165)	0.476** (0.254—0.892)
Employed throughout the childhood	1.018 (0.873—1.187)	1.067 (0.893—1.270)	0.953 (0.848—1.072)	0.835 (0.615—1.134)
Mother's employment status before age 17 (reference: unemployed throughout the childhood)				
Employed for a part of childhood	1.493 (0.969—2.300)	1.421* (1.121—4.821)	0.891 (0.663—1.199)	0.719 (0.181—2.854)
Employed throughout the childhood	1.043 (0.832—1.308)	1.132 (0.735—2.488)	1.037 (0.879—1.225)	1.240 (0.448—3.435)
Experienced starvation before age 17	1.196** (1.032—1.386)	1.293*** (1.097—1.492)	1.012 (0.917—1.117)	1.164 (0.904—1.499)
Household financial situation before age 17				
Same as others	0.790*** (0.707—0.882)	0.683*** (0.649—0.818)	1.089** (1.007—1.179)	0.802** (0.653—0.985)
Better than others	0.678*** (0.552—0.833)	0.591*** (0.552—0.834)	1.247*** (1.087—1.431)	0.798 (0.566—1.125)

Table 2 (continued)

Variables	Model 1 Difficulty with ADLs (95% CI)	Model 2 Difficulty with IADLs (95% CI)	Model 3 Overweight and obesity (95% CI)	Model 4 Multimorbidity (95% CI)
Demographic background				
Female	1.317*** (1.182—1.467)	1.978*** (1.387—1.738)	1.458*** (1.354—1.569)	0.939 (0.776—1.136)
Age	1.049*** (1.043—1.055)	1.067*** (1.046—1.059)	0.975*** (0.971—0.979)	1.027*** (1.017—1.-037)

Statistical significance: * indicating 90% level, ** 95% level and *** 99% level of statistical significance

others, in childhood, is correlated to difficulty with IADLs later in life, decreasing the likelihood of difficulty with IADLs by 31.7% and 40.9% respectively (OR: 0.683 95% CI: 0.649—0.818 and OR: 0.591 95% CI: 0.552—0.834) compared to those with worse financial situations. In contrast, in model 3, same financial situations or better financial situations in childhood increases the likelihood of difficulty with IADLs by 8.9% and 24.7% (OR: 1.089 95% CI: 1.007—1.179 and OR: 1.247 95% CI: 1.087—1.431) compared to worse financial situations. In model 4, individuals with fathers employed for a part of childhood are 52% with 95% confidence (0.254 to 0.892) less likely to report multimorbidity compared to those with fathers unemployed throughout the childhood, and individuals having the same household financial situation as others were 20% with 95% confidence (0.653 to 0.985) less likely to report multimorbidity compared to those having worse household financial situation.

Table 3 shows the impacts of the six indicators from childhood socioeconomic status on depression, mental intactness and episodic memory respectively. As the health outcomes change from binary to continuous, Ordinary Least Squares regression has been employed in Table 3. Age and gender are both significantly associated with these three health consequences whereas the effects of the mother's employment status before the age of 17 are not significant across all the three models. Model 5 indicates that the depression scores of individuals with fathers of educational attainment of elementary school or below are 0.208 (95% CI: -0.452—0.036 lower than those whose father was illiterate. Individuals who experienced starvation before age 17 report higher depression scores by 0.609 (95% CI: 0.319 – 0.899). Financial situations among individuals labelled as same or better during childhood are 0.887 (95% CI: -1.121—-0.652) and 1.129 (95% CI: -1.522—-0.736) lower than that among worse situations during childhood respectively. In model 6 and model 7, the results for mental intactness and episodic memory are consistent with each other regarding the level of statistical significance and the direction of the effects. Greater educational attainment is positively associated with higher levels of both mental intactness and episodic memory, and having a father in the longest period of employment is associated with lower levels of mental intactness and of episodic memory compared to having a father without employment. Though starvation during childhood is associated with increased risks of difficulty with ADLs, difficulty with IADLs, and depression, it appears to enhance cognitive abilities. To be specific, the experience of starvation is significantly positively contributed with mental intactness by 0.400 (95% CI: 0.234 – 0.565) and episodic memory by 0.182 (95% CI: 0.075 – 0.289) respectively compared to those without such experience. Regarding financial situations, in model 6 and model 7, and compared to those with worse perceived childhood situations than others, individuals with the same financial situations or better report higher mental intactness by 0.408 (95% CI: 0.273 – 0.542) and 0.911 (95% CI: 0.685 – 1.137) respectively, and higher episodic memory by 0.191 (95% CI: 0.104 – 0.277) and 0.534 (95% CI: 0.390 – 0.678) respectively.

To assess the robustness of the result to the model specification, the indicators of current socioeconomic status are added in Table 4 (physical health) and Table 5 (mental health and cognitive ability). In Table 4, Model 8 and Model 9 shows that, for difficulty with ADLs and difficulty with ADLs, the effects of childhood socioeconomic status which are statistically significant in the original models remain

Table 3 Association between the indicators of childhood socioeconomic status and mental health/cognitive ability using Ordinary Least Squares models

Variables	Model 5 Depression score (95% CI)	Model 6 Mental intactness (95% CI)	Model 7 Episodic memory (95% CI)
Father's education (reference: illiterate)			
Elementary school and below	-0.208* (-0.452—0.036)	0.668*** (0.527 – 0.808)	0.354*** (0.264 – 0.444)
Middle school and above	-0.247 (-o.661—0.168)	0.739*** (0.500 – 0.979)	0.405*** (0.255 – 0.556)
Mother's education (reference: illiterate)			
Elementary school and below	-0.161 (-0.518—0.197)	0.420*** (0.213 – 0.627)	0.443*** (0.313 – 0.572)
Middle school and above	-0.366 (-1.096—0.364)	0.799*** (0.375 – 1.223)	0.451*** (0.189 – 0.712)
Father's employment status before age 17 (reference: unemployed throughout the childhood)			
Employed for part of childhood	-0.238 (-0.842—0.366)	0.104 (-0.243 – 0.452)	0.021 (-0.199 – 0.242)
Employed throughout the childhood	-0.235 (-0.138—0.609)	-0.492*** (-0.706—-0.279)	-0.270*** (-0.407—-0.134)
Mother's employment status before age 17 (reference: unemployed throughout the childhood)			
Employed for part of childhood	-0.112 (-1.639—1.415)	0.123 (-0.733 – 0.980)	-0.331 (-0.891 – 0.228)
Employed throughout the childhood	-0.115 (-1.395—1.165)	0.335 (-0.373 – 1.044)	-0.098 (-0.565 – 0.369)
Experienced starvation before age 17	0.609*** (0.319—0.899)	0.400*** (0.234 – 0.565)	0.182*** (0.075 – 0.289)
Household financial situation before age 17			
Same as others	-0.887*** (-1.121—-0.652)	0.408*** (0.273 – 0.542)	0.191*** (0.104 – 0.277)
Better than others	-1.129*** (-1.522—-0.736)	0.911*** (0.685 – 1.137)	0.534*** (0.390 – 0.678)
Demographic background			
Female	1.886*** (1.669—2.103)	-1.337*** (-1.462—-1.212)	-0.211*** (-0.291—-0.131)
Age	-0.026*** (-0.038—-0.014)	1.053*** (-0.094—-0.081)	0.975*** (-0.070—-0.061)

Statistical significance: * indicating 90% level, ** 95% level and *** 99% level of statistical significance

significant, but the sizes generally become smaller. Model 10 indicates that all the indicators in childhood socioeconomic status are no longer related to overweight. In Table 5, the effects of childhood starvation on mental health and cognitive abilities persist After adjusting for socioeconomic status in middle and older age, for both mental intactness and episodic memory, the impacts of father's education, mother's education, father's employment before the individual's age of 17 continues although the effects sizes decrease. However, for both of them, the relationships between childhood household financial situation and later health are not significant.

Table 4 Robustness test for associations between the indicators of childhood socioeconomic status and physical health by allowing for current socioeconomic status using logistic models

Variables	Model 8 Difficulty with ADLs (95% CI)	Model 9 Difficulty with IADLs (95% CI)	Model 10 Overweight (95% CI)	Model 11 Multimorbidity (95% CI)
Childhood SES				
Father's education (reference: illiterate)				
Elementary school and below	0.961 (0.840—1.101)	0.914 (0.809—1.033)	1.029 (0.930—1.138)	0.870 (0.669—1.132)
Middle school and above	0.768* (0.581—1.014)	0.811* (0.639—1.030)	0.933 (0.773—1.127)	1.279 (0.849—1.927)
Mother's education (reference: illiterate)				
Elementary school and below	0.747** (0.579—0.962)	0.830* (0.668—1.031)	1.014 (0.855—1.202)	0.919 (0.631—1.339)
Middle school and above	0.394** (0.192—0.809)	0.886 (0.541—1.453)	1.032 (0.713—1.494)	0.637 (0.252—1.613)
Father's employment status before age 17 (reference: unemployed throughout the childhood)				
Employed for a part of childhood	0.870 (0.637—1.188)	0.894 (0.675—1.186)	0.967 (0.758—1.232)	0.554* (0.283—1.086)
Employed throughout the childhood	1.027 (0.868—1.215)	1.033 (0.886—1.205)	0.978 (0.854—1.120)	0.850 (0.621—1.163)
Mother's employment status before age 17 (reference: unemployed throughout the childhood)				
Employed for a part of childhood	1.486 (0.923—2.391)	1.520* (0.991—2.332)	0.845 (0.596—1.198)	1.191 (0.460—3.086)
Employed throughout the childhood	1.035 (0.812—1.318)	1.124 (0.901—1.403)	1.001 (0.830—1.207)	1.412 (0.839—2.376)
Experienced starvation before age 17	1.182** (1.005—1.392)	1.278*** (1.104—1.479)	1.019 (0.906—1.147)	1.227 (0.913—1.651)
Household financial situation before age 17				
Same as others	0.811*** (0.717—0.918)	0.725*** (0.649—0.810)	1.029 (0.937—1.131)	0.665*** (0.525- 0.843)

Table 4 (continued)

Variables	Model 8 Difficulty with ADLs (95% CI)	Model 9 Difficulty with IADLs (95% CI)	Model 10 Overweight (95% CI)	Model 11 Multimorbidity (95% CI)
Better than others	0.717*** (0.571—0.902)	0.706*** (0.576—0.865)	1.092 (0.925—1.290)	0.625** (0.412—0.948)
Current SES				
Education (reference: illiterate)				
less than elementary school	0.879 (0.747—1.035)	0.728*** (0.628—0.843)	1.125* (0.992—1.277)	0.973 (0.690—1.372)
Elementary school	0.679*** (0.569—0.810)	0.546*** (0.467—0.639)	1.195*** (1.046—1.366)	1.068 (0.757—1.506)
Middle school and above	0.614*** (0.508—0.741)	0.347*** (0.293—0.410)	1.264*** (1.100—1.453)	1.005 (0.710—1.421)
Household expenditure (log)	0.902*** (0.846—0.961)	0.896*** (0.846—0.949)	1.160*** (1.104 -1.219)	1.139** (1.003—1.295)
Employment (reference: unemployed or retired)				
Agricultural work	0.611*** (0.536—0.695)	0.480*** (0.427—0.539)	0.743*** (0.675—0.819)	0.509*** (0.398—0.650)
Non-agricultural work	0.748 (0.386—1.448)	0.449*** (0.245—0.822)	0.962 (0.659—1.403)	0.631 (0.278—1.430)
Demographic background				
Female	1.005 (0.881—1.147)	1.240*** (1.102—1.396)	1.655*** (1.500—1.825)	0.972 (0.764—1.236)
Age	1.026*** (1.019—1.033)	1.031*** (1.024 -1.037)	0.973*** (0.968—0.978)	1.013** (1.000—1.025)

Statistical significance: * indicating 90% level, ** 95% level and *** 99% level of statistical significance

Table 5 Robustness test for associations between the indicators of childhood socioeconomic status and mental health/cognitive ability by allowing for current socioeconomic status using Ordinary Least Squares models

Variables	Model 12 Depression score (95% CI)	Model 13 Mental intactness (95% CI)	Model 14 Episodic memory (95% CI)
Childhood SES			
Father's education (reference: illiterate)			
Elementary school and below	-0.117 (-0.408—0.173)	0.317*** (0.174—0.460)	0.115** (0.019—0.210)
Middle school and above	0.114 (-0.412—0.641)	0.296** (0.035—0.557)	0.181** (0.009—0.353)
Mother's education (reference: illiterate)			
Elementary school and below	-0.080 (-0.541—0.381)	0.207* (-0.022—0.436)	0.274*** (0.125—0.423)
Middle school and above	-0.655 (-1.679—0.368)	0.433 (-0.083—0.949)	0.071 (-0.259—0.402)
Father's employment status before age 17 (reference: unemployed throughout the childhood)			
Employed for part of childhood	-0.555 (-1.229—0.119)	0.327* (-0.007—0.660)	0.130 (-0.093—0.353)
Employed throughout the childhood	0.065 (-0.317—0.446)	-0.138 (-0.325—0.049)	-0.113* (-0.240—0.013)
Mother's employment status before age 17 (reference: unemployed throughout the childhood)			
Employed for part of childhood	-0.314 (-1.395—0.767)	0.036 (-0.497—0.570)	-0.223 (-0.588—0.141)
Employed throughout the childhood	-0.119 (-0.684—0.447)	0.134 (-0.139—0.407)	-0.090 (-0.280—0.100)
Experienced starvation before age 17	0.678*** (0.337—1.018)	0.464*** (0.298—0.630)	0.225*** (0.112—0.338)
Household financial situation before age 17			
Same as others	-1.047*** (-1.319—-0.775)	0.058 (-0.076—0.192)	0.062 (-0.028—0.152)
Better than others	-1.368*** (-1.843—-0.893)	0.158 (-0.075—0.392)	0.072 (-0.084—0.228)
Current SES			
Education (reference: illiterate)			
Less than elementary school	-0.183 (-0.566—0.201)	2.108*** (1.922—2.295)	1.047*** (0.916—1.178)
Elementary school	-0.554*** (-0.951—-0.157)	3.488*** (3.295—3.682)	1.694*** (1.561—1.827)
Middle school and above	-0.846*** (-1.248—-0.443)	4.131*** (3.934—4.328)	2.187*** (2.052—2.321)
Household expenditure (log)	-0.115 (-0.258—0.028)	0.252*** (0.183—0.322)	0.167*** (0.120—0.215)
Employment (reference: unemployed or retired)			
Agricultural work	-0.229 (-0.508—0.049)	0.135* (-0.002—0.272)	0.009 (-0.083—0.101)
Non-agricultural work	-0.425 (-1.350—0.501)	0.428* (-0.035—0.892)	0.091 (-0.203—0.385)

Table 5 (continued)

Variables	Model 12 Depression score (95% CI)	Model 13 Mental intactness (95% CI)	Model 14 Episodic memory (95% CI)
Demographic background			
Female	1.375*** (1.092—1.657)	-0.306*** (-0.445—-0.168)	0.353*** (0.260—0.446)
Age	-0.053*** (-0.069—-0.038)	-0.039*** (-0.046—-0.031)	-0.042*** (-0.047—-0.037)

Statistical significance: * indicating 90% level, ** 95% level and *** 99% level of statistical significance

Furthermore, significant terms from the above robustness check are interacted between childhood socioeconomic status and current socioeconomic status. For overweight and depression score, as either childhood socioeconomic status or current socioeconomic status is insignificant, there is no interaction available for them. For multimorbidity, mental health, and episodic memory, all the interactions terms are not significant. Therefore, in this study, childhood socioeconomic status only has moderation effects on difficulty with ADLs and on difficulty with IADLs as Table 6 presents. For the simplicity of the table, only statistically significant terms are shown in the table. In Model 15, amongst individuals whose father was middle school and above, the difference in the possibility of difficulty with ADLs between illiterate individuals and individuals with elementary school is 68.2% (OR: 1.682 95% CI: 0.932 – 3.037) higher compared with those with an illiterate father. By contrast, amongst individuals whose mother was elementary school and below, the gap in the possibility of difficulty with ADLs between illiterate individuals and individuals with middle school and above is 35.5 (OR: 0.645 95% CI: 0.394 – 1.057) lower compared with those with an illiterate mother. The results of difficulty with IADLs are consistent with the above results.

Discussion and Conclusions

Using data from the 2018 wave of the China Health and Retirement Longitudinal Study (CHARLS), for individuals over 45, we have analysed the associations between childhood socioeconomic status and various health outcomes later in life. We add to what is otherwise a relative paucity of literature about how a range of different health indicators relate to childhood socioeconomic status in China. Methodologically, the major difference between this and other studies is that this study used six dimensions of childhood socioeconomic status (father's educational attainment, mother's educational attainment, father's employment status, mother's employment status, the experience of starvation, and household financial situation before age 17), whereas some Western studies aggregated those types of indicators to synthesise a uni-dimensional indicator of socioeconomic status, such as a single index created by principal component analysis. This might be an effective method to measure

socioeconomic status, but loss of information appears to be an inevitable issue (Gracia et al., 2014).

The substantive findings show that, in general, unfavourable socioeconomic conditions during childhood are correlated with poor health outcomes later in life. However, there are exceptions. One exception is being overweight – here advantaged childhood socioeconomic status increases the probability of becoming overweight. The reason might be that most Chinese children living in high socioeconomic status have an affluent and urban background. In these types of areas, they can afford more food, and more fattening food intake is recorded. Sedentary lifestyles are also more popular. These conditions are more likely to cause weight gain than in deprived and rural areas (Chen et al., 2011; Kivimäki et al., 2017). This finding is generally consistent with western studies in this field (Bowen & González, 2010; Malaty & Graham, 1994; van der Linden et al., 2020). Secondly, the prolonged influences of starvation during childhood depend on which health outcomes are considered. It is found that individuals with early-life starvation have higher odds of ADL (activities of daily living) and IADL (instrumental activities of daily living) disability, even allowing for current socioeconomic status. Nevertheless, in contrast to the general conclusion of this study, they may also have better cognitive abilities with higher scores on mental intactness and episodic memory. This might be attributed to certain biochemical mechanisms inside the body when hunger is triggered (Coghlan, 2006).

How reliable life history data is for being used to determine later-life health should also be discussed.. The study by (Jivraj et al., 2020) has provided some reassurance to utilise variables from retrospective surveys to explore life course relationships with later health. It may not be easy for individuals to recall their parents' educational attainment in detail, but the categories in this study (illiterate/elementary school and below/middle school and above) are sufficiently general, which is more likely to be recalled correctly. However, the starvation experience during childhood is found to be overestimated (Jivraj et al., 2020). As China has experienced two major famines (the Henan Famine (1942–1943) and the Great Chinese Famine (1959–1961)) and most participants in this sample had some starvation experience during childhood, starvation was still taken into account in this study. Household financial situation might also not be remembered accurately, but there might be an overestimation of other childhood socioeconomic statuses if we do not consider it (Jivraj et al., 2020). Therefore, the household financial situation was also included.

The results of this study also point to areas for further investigation. Given the features of observational research, we can only clarify associations instead of causations. Furthermore, social survey schemes in China started much later than in major Western countries. For example, the China Health and Retirement Longitudinal Study started in 2011 and only has data about later life attributes and retrospective childhood data. The data between early life and later life is not recorded, but sensitive periods significantly associated with later health may be also in between (Jivraj et al., 2019). Therefore, there is scope for further surveys to collect life history data between childhood and late adulthood, providing more detailed longitudinal studies.

In spite of the above limitations, this paper can still help to inform public policies in China. In terms of education, the intergenerational health effects of educational

Table 6 Robustness test by including the interaction terms between childhood SES and current SES using logistic models

Variables	Model 15 Difficulty with ADLs (95% CI)	Model 16 Difficulty with IADLs (95% CI)
Childhood SES		
Father's education (reference: illiterate)		
Elementary school and below	0.910 (0.805—1.028)	0.910 (0.805—1.028)
Middle school and above	0.705* (0.488—1.019)	0.643 (0.362—1.144)
Mother's education (reference: illiterate)		
Elementary school and below	1.065 (0.736—1.540)	1.326** (0.703—2.502)
Middle school and above	0.829 (0.331—2.077)	0.889 (0.539—1.466)
Father's employment status before age 17 (reference: unemployed throughout the childhood)		
Employed for a part of childhood	0.895 (0.675—1.187)	0.896 (0.675—1.189)
Employed throughout the childhood	1.034 (0.886—1.205)	1.033 (0.885—1.204)
Mother's employment status before age 17 (reference: unemployed throughout the childhood)		
Employed for a part of childhood	1.508* (0.982—2.314)	1.745 (1.042—2.922)
Employed throughout the childhood	1.119 (0.897—1.397)	1.117 (0.895—1.394)
Experienced starvation before age 17	1.280*** (1.106—1.482)	1.278*** (1.104—1.479)
Household financial situation before age 17		
Same as others	0.726*** (0.649—0.812)	0.726*** (0.649—0.811)

Table 6 (continued)

Variables	Model 15 Difficulty with ADLs (95% CI)	Model 16 Difficulty with IADLs (95% CI)
Better than others	0.710*** (0.579—0.870)	0.711*** (0.580—0.871)
Current SES		
Education (reference: illiterate)		
less than elementary school	0.724*** (0.625—0.839)	0.729*** (0.626—0.849)
Elementary school	0.531*** (0.451—0.625)	0.535*** (0.454—0.630)
Middle school and above	0.360*** (0.302—0.429)	0.359*** (0.301—0.428)
Household expenditure (log)	0.897*** (0.847—0.951)	0.898*** (0.847—0.951)
Employment (reference: unemployed or retired)		
Agricultural work	0.479*** (0.426—0.538)	0.483*** (0.430—0.544)
Non-agricultural work	0.451** (0.246—0.827)	0.453** (0.247—0.829)
Demographic background		
Female	1.237*** (1.099—1.392)	1.236*** (1.098—1.391)
Age	1.031*** (1.024—1.037)	1.031*** (1.024—1.037)

Table 6 (continued)

Variables	Model 15 Difficulty with ADLs (95% CI)	Model 16 Difficulty with IADLs (95% CI)
Interaction terms		
'Father's edu.: Middle school and above' * 'elementary school'	1.682* (0.932—3.037)	1.921* (0.922—4.005)
'Mother's edu.: Elementary school and below' * 'Middle school and above'	0.645* (0.394—1.057)	0.526* (0.258—1.074)

Statistical significance: * indicating 90% level, ** 95% level and *** 99% level of statistical significance

attainment shown in this study indicate that attention must be paid to tackling educational inequalities, which would be not only beneficial to the individuals themselves but also to future generations. It should also be noted that China has implemented a household registration system called the hukou system. Based on the hukou system, the nearby enrolment policy is employed in almost all regions in China. Nearby enrolment policy only allows children to attend school within the subdistrict where their hukou is. As good educational resources are concentrated in urban districts, this policy has widened educational inequalities (Xiang et al., 2018) and thus may exacerbate health inequalities (Beckfield et al., 2013; Zajacova & Lawrence, 2018). In addition, due to this policy, there were 6.97 million children remaining in rural areas whereas their parents left to make a living in urban areas in 2018 (Ministry of Civil Affairs of the People's Republic of China, 2018). Since 2020, the zero-Covid policy in China has also made online learning more frequent than before and some children in rural areas have limited access to the Internet and devices. Taking into account the above facts, the government should not only distribute more educational resources to rural areas but also should consider allowing some schools in urban areas to enrol in-migrant children from the rural hukou. Furthermore, policies should continue focusing on reducing the gap between rich and poor to mitigate health inequalities caused by adverse household financial situations. For example, the government could reduce healthcare fees for deprived families, especially for people moving to urban areas but still keeping the rural hukou, because they cannot access the same healthcare benefits as those with the urban hukou. Overall, what the paper shows is the importance of trying to reach equality in childhood socioeconomic status as a policy goal.

Declarations

Conflict of Interest The authors declare that they have no conflict of interest.

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