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Direct and indirect effects of childhood conditions on survival and health among male and female elderly in China

Ke Shen [a, *], Yi Zeng [b, c]

[a] Institute of Population Research, School of Social Development and Public Policy, Fudan University, Shanghai, 200433, China
[b] Center for the Study of Aging and Human Development and Geriatric Division of Medical School, Duke University, Durham, NC 27710, USA
[c] Center for Healthy Aging and Development Studies, National School of Development, Peking University, Beijing, 100871, China

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ABSTRACT

This paper investigates whether childhood conditions affect survival and health, both directly and indirectly through the mediating variable of adulthood socioeconomic status, among Chinese elderly. Using data from the 2008–2009 and 2011–2012 waves of the Chinese Longitudinal Healthy Longevity Survey, we apply structural equation models to estimate these effects. We find that favorable childhood conditions exert a negative direct impact on survival probability at senior ages, possibly resulting from mortality selection. Our results also support the pathways model, which indicates that advantageous childhood conditions improve socioeconomic status in adulthood and thus indirectly promote longevity and health at advanced ages. Combining the direct and indirect effects, the total effects of childhood advantages on survival and health are positive. We further demonstrate that direct and indirect effects of childhood conditions are stronger for women than they are for men. Our findings suggest that public policies that target childhood wellbeing may have far-reaching protective impacts on health among seniors.

1. Introduction

Socioeconomic disparities in morbidity and mortality have long been an important topic in inequality research, especially in rapidly developing economies with growing income inequality. Recent studies in the life course context have expanded to investigate linkages between childhood conditions and a range of health outcomes among the elderly. For example, children born into impoverished families tend to experience increased morbidity, disability, and mortality when they are older adults (Bengtsson and Brostrom, 2009; Elo and Preston, 1992; Galobardes et al., 2008; Hayward and Gorman, 2004; Huang and Elo, 2009; O'Rand and Hamil-Luker, 2005). However, there are disputes on how early-life circumstances persist to affect late-life health and longevity.

Three hypotheses attempt to answer this question. The *fetal origins hypothesis* affirms the positive direct effect of advantageous childhood conditions on health at old ages. It argues that certain adversities and diseases acquired in childhood may permanently impair survivors and thus increase death rates at subsequent ages (Barker et al., 1989; Gluckman et al., 2008). Ozanne and Hales' (2004) experimental work on mice has confirmed that mice with restricted fetal growth who were well fed after birth exhibited rapid catch-up growth, but they died significantly earlier than did mice who were well fed in utero. Empirical studies on human populations have supported this finding. For example, low birth weight or growth retardation in childhood elevated the risk of death from chronic diseases, especially cardiovascular diseases and diabetes, in later ages (Barker and Martyn, 1992).

In contrast with the fetal origins hypothesis, the *mortality selection* hypothesis suggests a direct and inverse association between advantages in early life and good health in late life. Specifically, an individual who survives harsh and poor environments in childhood has genetic or congenital traits that enhance survival and health across the life cycle (Preston et al., 1998). For instance, Mu and Zhang (2011) compared health outcomes in adulthood between famine survivors who were born during China's Great Famine (1959–1961) and a control cohort who were born after the famine (1963–1965). They found that male famine survivors, who experienced extreme adversities in childhood, were much less likely to be disabled in 1990, compared to the male control cohort, who did not experience similar childhood adversities.

* Corresponding author. Room 1137, Wen Ke Building, Fudan University, No. 220 Handan Road, Shanghai, 200433, China.
E-mail address: shenke@fudan.edu.cn (K. Shen).

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The third hypothesis is the *pathways model*, which indicates that the impact of early-life circumstances on late-life health is mostly indirect through the mediator of adulthood socioeconomic status (SES). In other words, childhood circumstances set individuals on diverse social and economic trajectories in adulthood that, in turn, affect their health at old ages (Marmot et al., 2001). For instance, Hayward and Gorman (2004) and Zeng et al. (2007) found that the associations between childhood conditions and mortality risk at old ages were substantially attenuated or even disappeared when adulthood factors were incorporated into the models in the United States and China, respectively. In a study of New England residents, Turner and Butler (2003) applied path analyses and showed that most of the association between childhood adversities and late-life depression was mediated by adulthood adversities. Using a Finnish sample, Laaksonen et al. (2007) applied structural equation modeling to find that childhood circumstances were not directly associated with physical or mental functioning, but they found indirect effects resulting through adult SES.

In addition to exploring the impacts of childhood circumstances on late-life health among the general population, researchers have further documented gender differences in the contributions of early-life circumstances, but findings have been inconsistent. For example, Hamil-Luker and O'Rand (2007) found that women who grew up without a father and under adverse economic conditions were more likely to experience elevated heart attack risk in adulthood, while childhood SES had no impact on heart attack risk among men. Using a nationally representative cohort born in March 1945 in Great Britain, Kuh et al. (2002) also found that childhood SES more strongly predicted adult mortality among women than among men. However, Zeng et al. (2007) showed that a father's occupation in childhood played a more important role in predicting mortality among male oldest-old aged over 80, compared to female counterparts.

Our study contributes to this growing body of knowledge about the link between childhood circumstances and elderly survival and health in several ways. First, we quantify the magnitude of direct, indirect, and total effects of childhood conditions on survival and health among the elderly using structural equation models (SEMs). This task cannot be achieved with the conventional regression methods used in previous research (Hayward and Gorman, 2004). Second, we pay special attention to gender differences in the contributions of childhood conditions. Hayward and Gorman (2004) restricted their sample to older men in the United States, and Preston et al. (1998) included gender only as a control variable in their estimation. Third, we sample from an elderly population in China, whereas previous studies have targeted developed countries (Hayward and Gorman, 2004; Laaksonen et al., 2007). The contributions of early-life conditions in developed countries might differ from developing countries, where social inequalities of origin are more serious and recent economic transformations are more radical. An exception is the study by Zeng et al. (2007), which investigated data from 1998 to 2002 for the oldest-old (i.e., aged above 80) in China, but it excluded the young-old (i.e., aged between 65 and 79).

The paper is organized as follows. Section 2 describes the data, estimation method, and measurement. Section 3 presents the direct, indirect, and total effects of childhood conditions on survival and health by using full samples and male and female sub-samples. Section 4 discusses the results and concludes the paper.

2. Data, method, and measurement

2.1. Data source

Our study uses data from the Chinese Longitudinal Healthy Longevity Survey (CLHLS), which is the largest longitudinal survey of centenarians, nonagenarians, and octogenarians ever conducted. The CLHLS randomly selected half of the counties in 22 out of 31 Chinese provinces, whose populations together constitute about 85% of the total population in China. The CLHLS was conducted in 1998, 2000, 2002, 2005, 2008–2009 (late 2008 and early 2009), and 2011–2012 (late 2011 and early 2012). The 1998 and 2000 waves targeted the oldest-old (i.e., aged above 80). The young-old group (i.e., aged between 65 and 79) was added since the 2002 wave. These surveys provide rich information on retrospective history in childhood and adulthood, as well as current health of the elderly.

This paper is based on the panel data from the latest 2008–2009 and 2011–2012 waves of the CLHLS. Excluding those who were lost to follow-up in the 2011–2012 wave, the longitudinal data includes 12,258 elderly aged above 65 who were interviewed in 2008–2009. Of those, 7341 elderly survived until the 2011–2012 survey, and 4917 elderly died before the follow-up. Table 1 presents the 2008–2009 sample distribution by gender and age groups. Extensive evaluations, including assessments of non-response rate, sample attrition, reliability and validity of health measures, and the rates of logically inconsistent answers have shown that data quality is acceptably good, compared to other surveys of the elderly.

2.2. Method

We apply the structural equation model (SEM) in our study. As previously noted, a complex relationship exists between childhood conditions and survival and health at advanced ages. For example, childhood conditions may influence late-life health, both directly and indirectly through the mediator of adulthood SES. Consequently, adulthood SES is the dependent variable in one set of relationships and an explanatory variable of late-life health. Unlike conventional regression methods, an SEM enables us to deal with such complex relationships and to estimate the direct and indirect effects of the variables of interest.

In addition, traditional multivariate regressions are based on observed measurements only, whereas SEM incorporates both unobserved (i.e., latent) variables, which are represented by circles in Fig. 1, and their observed indicators, which are represented by boxes (Byrne, 1998). In this study, constructs such as childhood conditions, adulthood SES, and health cannot be observed directly and are thus operationally measured by several observed indicators. SEM comprises both a measurement model and a structural model. The measurement model depicts the linkages between latent variables and their observed measures (denoted as $\lambda_1 \ldots \lambda_4$, $\gamma_1 \ldots \gamma_8$), and the structural model depicts the links among latent variables themselves (denoted as $a, b \ldots f, g$).

As shown in Fig. 1, we construct a hypothesized conceptual model. We quantitatively estimate "*a*", which is the direct effect of childhood conditions on adulthood SES; "*b*", which is the direct effect of adulthood SES on current health; and "*c*", which is the direct effect of childhood conditions on current health. Following the statistical methodology in previous studies (Ames et al., 2005;

Table 1
Sample distributions of the 2008–2009 wave of the Chinese Longitudinal Healthy Longevity Survey.

Age group	Male	Female	Total
65–69	539	509	1048
70–79	1162	1070	2232
80–89	1633	1601	3234
90–99	1442	1956	3398
100+	471	1875	2346
Total	5247	7011	12,258