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Access to healthcare services makes a difference in healthy longevity among older Chinese adults☆

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ABSTRACT

The positive impact of access to healthcare on health and survival among older adults is well-documented in Western societies. However, whether the pattern still holds in developing countries where healthcare coverage is more limited is largely unknown. China, a developing country with the largest population in the world, has been transforming its antiquated healthcare system during the past few decades in response to rapid population aging. Yet, in recent years the lack of access to healthcare has been identified as the top concern by most citizens in China. We used the Chinese Longitudinal Healthy Longevity Survey and the community-level data sources from the National Bureau of Statistics of China to examine the impact of current as well as childhood access to healthcare services on subsequent three-year survival and healthy survival at old ages from 2002 to 2005 under a multilevel context. Healthy survival was measured by a cumulative deficit index calculated from thirty-nine variables pertaining to various dimensions of health. Our analyses showed that access to healthcare at present and during childhood improved the odds of subsequent three-year survivorship by 13–19% and 10%, respectively, controlling for various confounders. But the effect of access to healthcare at present was no longer statistically significant once baseline health status in 2002 was controlled for. Access to healthcare at present increased odds of healthy survival by 22–68%, while access to healthcare in childhood increased odds of healthy survival by 18%. All patterns held true for both men and women, for urban and rural areas, across ages, as well as across socioeconomic statuses. Our findings suggested that positive inputs such as access to healthcare services over the life course make a substantial difference in healthy longevity, which has implications for the establishment of the universal healthcare system.

Introduction

With the transformation of China's healthcare system from a government-managed system that provided affordable basic healthcare to all citizens to a market-oriented system, Chinese people have witnessed a universal and substantial decline in access to healthcare in spite of China's rapid economic growth since the late 1970s (Bloom & Gu, 1997; Blumenthal & Hsiao, 2005; Yip & Hsiao, 2008). In addition, according to the Chinese government, there is severe inequality in healthcare services between cities and rural areas, with 80 percent of health resources (e.g., hospitals and healthcare practitioners) allocated to the cities. Coastal regions have also enjoyed more health resources than inland regions (Lee, 2004). Due to lack of adequate public funding, many rural clinics have become privatized for-profit institutions, and rural residents have witnessed a greater decline in access to healthcare than urban people (Lee, 2004; Yip & Hsiao, 2008). In short, skyrocketing medical costs are prohibiting people with low socioeconomic status and older people from getting basic healthcare services in both rural and urban areas (Gu & Vlosky, 2008; Liu, Zhao, Cai, Yamada, & Yamada, 2002; Liu, Zhang, Lu, Kwon, & Quan, 2007). For the first time since the economic reform, healthcare replaced employment as the most important concern in 2002 among urban residents (Dong, 2003).

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The steady decline in access to healthcare could have a negative impact on the health and well-being of Chinese people. The purpose of this study is to provide solid empirical evidence on whether access to healthcare can enhance healthy longevity at old ages. Before the second half of this century, China will have the largest number of the elderly in the world, at a time when its healthcare system will undergo major transformation. The investigation of the relationship between access to healthcare and health outcomes helps us better understand the role of access to healthcare as a positive input on the stock of health capital at old ages (Grossman, 1972), and provides important information to policy makers as they try to revamp the country's healthcare system.

Literature review

Numerous studies in Western societies showed that access to healthcare yielded positive effects on health and mortality. One study from a population-based elderly sample in Spain showed that lack of access to adequate medical service increased five-year mortality by 80% among those who had reported two or more chronic conditions, and increased mortality by 155% among those who were disabled in instrumental activities of daily living (IADL) (Alonso, Orfila, Ruigomez, Ferrer, & Anto, 1997). Studies in the North America revealed that access to healthcare made the most difference in slowing down functional decline and reducing the risk of death among those elders with no functional limitations at baseline (Porell & Miltiades, 2001).

In the United States, access to healthcare is largely determined by health insurance, and there is substantial evidence that lack of health insurance negatively impacted health and survival. For example, lack of insurance was associated with poorer self-rated health, more functioning problems, a greater number of chronic conditions, and a greater perceived need for services among older Americans (Goin, Hays, Landerman, & Hobbs, 2001; Hadley, 2007; Okoro, Young, Strine, Balluz, & Mokdad, 2005). Researchers also found that lack of insurance was associated with higher mortality risk among adults (Frank, Clancy, & Gold, 1993) and the near-elderly even after adjusting for possible confounders, especially among persons with low income or with specific chronic disease conditions (McWilliams, Zaslavsy, Meara, & Ayanian, 2004). Such differentials in health outcomes might be explained in part by early detection and diagnosis of health problems due to a higher frequency of physician visits and checkups (Aday, 1993; Card, Dobkin, & Maestas, 2004).

In addition, prior research indicated that timely access to healthcare when in need mattered when it came to survival. One study reported that wait times for healthcare were also positively associated with mortality risk (Prentice & Pizer, 2007), possibly because delayed access to healthcare could cause delays in diagnoses and treatments (Kenagy, Berwick, & Shore, 1999). Bunker, Fraizer, and Mosteller (1994) reported that almost half of the increase in life expectancy in the last 25 years may be attributed to medical care.

One shortcoming of the extant literature is the lack of research using data from non-Western countries. It is unclear to what extent the protective effect of access to healthcare on health and mortality found in developed countries will still hold in newly developed or developing societies where the healthcare system is either largely underdeveloped or under reform. One study in Taiwan (Chen et al., 2007) reported that improvements in access to healthcare services did not yield significant protective effects on self-rated health and one-year mortality risk, although there appeared to be significant increases in the utilization of both outpatient and inpatient care among the elderly after the implementation of a new universal health insurance program in 1995. Authors attributed this finding to the short-term follow-up that prohibited them from detecting the significant protective effect of access to healthcare on health, given that health is a lifetime investment and other factors such as the environment, lifestyle, and health behavior play significant roles in improving population health (Chen et al., 2007). More research is needed in developing countries on the association between access to healthcare and health outcomes as more and more developing countries (including China) are revamping their healthcare systems.

Another limitation is that prior studies in gerontology and geriatrics usually examined the association between access to healthcare and a specific health condition. As pointed out by some researchers, the benefit of access to healthcare for one health condition may not be translated into a benefit for another health condition or coexisting conditions (Alonso et al., 1997). Thus, most studies in this area were unable to capture the associations between access to healthcare and broader or more holistic health outcomes.

Third, there is a paucity of research that examines the association between access to healthcare resources and health or mortality at very advanced ages due to lack of data. Most previous studies did not have enough cases to examine access to healthcare and well-being for the oldest-old, the fastest growing segment of the elderly population. Fourth, a growing body of research demonstrated that earlier life conditions improved health status in later life (e.g., Finch & Crimmins, 2004; Preston, Hill, & Drevenstedt, 1998). However, most studies did not fully examine the long-term impact of access to healthcare at early life stages on health and mortality in old age. Further, an increasing number of recent research indicated that community/neighborhood characteristics had significant influences on late life health and mortality (e.g., Kawachi & Berkman, 2003), suggesting that these factors were the potential confounders in the associations between access to healthcare and health. Yet, few studies in this area integrated community/neighborhood factors into the framework.

Using the 2002 wave of the Chinese Longitudinal Healthy Longevity Survey (CLHLS) and its follow-up interview in 2005, this study examines the associations between access to healthcare services, at present as well as in childhood, and people's stock of health capital in terms of survival and healthy survival after accounting for various individual and neighborhood/community factors among the Chinese elderly aged 65–109. Below we start by providing some background on the healthcare system in China.

Healthcare system in China

The current Chinese healthcare system with an urban/rural health disparity can be traced back to the early 1950s, a couple of years after the establishment of the People's Republic of China. In urban areas, health insurance consisted of the Government Insurance Scheme and the Labor Insurance Scheme; together they covered 100% of treatment and prescription drug expenses for almost all urban employees and 50% of the costs for all dependents of beneficiaries before the urban system was reformed in the middle of the 1980s (Dong, 2003). This system is normally called *the free public medical care system*, also known as the employment-based healthcare system since it was only available to urban employees. The cost of healthcare services was affordable and accessible even for the poor and uninsured due to government ownership, strictly government-controlled drug prices, and substantial subsidies to hospitals (Yip & Hsiao, 2008). After the healthcare system reform in the middle of the 1980s, the government decentralized its responsibility for running hospitals and the urban system shifted to a cost-sharing and then to an urban-based social health insurance scheme that only covered urban employees/retirees, excluding rural-urban migrant workers (Shi, 1993; Yip & Hsiao, 2008). The program combined individual medical savings accounts and catastrophic insurance, and was financed by the employers and the employees. The latest estimates showed that

healthcare coverage dropped down to 57% for all urban residents in 2003 (National Bureau of Statistics of China, 2004). Such a significant reduction in healthcare coverage seemed universal with the largest reduction found among the poor (Yip & Hsiao, 2008).

In rural areas, before the economic reform that introduced the Household Responsibility System in 1979, residents were covered by the Cooperative Medical Scheme (CMS) system, which was financed by the welfare funds of local communes (collective farming) and operated through a three-tier system. Under this system, preventive and primary care was provided by the part-time barefoot doctors at the first tier; outpatient clinic service or inpatient service was provided by commune health centers staffed by junior doctors at the second tier; and service regarding more serious illnesses was provided by county hospitals staffed with senior doctors at the third tier (Chow, 2002). Rural residents saw doctors free of charge and were partly reimbursed for drugs and hospitalization (Yip & Hsiao, 2008). After the economic reform in 1979, the CMS collapsed due to the disappearance of communes, and the barefoot doctor system was abolished; the CMS system shifted to a fee-for-service system, which required a greater number of rural people to shoulder their own healthcare costs (Shi, 1993). Although private health insurance is an option, the premiums for extensive coverage are not affordable to the majority of the rural populations (Liu et al., 2007). In response, the number of village health officials decreased by 18–33% and the number of hospitals and healthcare centers in towns and villages decreased significantly from the 1970s through the 1990s (Lok, 1995). Consequently, all individuals in rural areas experienced greatly reduced access to medical care and the proportion of rural residents covered by the CMS dropped from over 85% in 1975 to less than 10% in 1997 with the poor witnessing the greatest reduction (Tomlinson, 1997; Wang, Yip, Zhang, Wang, & Hsiao, 2005; Yip & Hsiao, 2008). In 2002, the Chinese government started to re-establish the CMS system for rural residents, and some pilot projects were being launched (Liu et al., 2007). However, the benefits of this new scheme may be very limited because it mainly covers several rare and severe diseases, not generic, chronic diseases (Wang, Gu, & Dupre, 2008).

At the time when the healthcare system was being established for community-residing elders in the 1950s, China established an institutional care system for elders with no relative, no income, and no physical ability to work (so-called "Three-No" elders) in each urban residential neighborhood block through funding and in-kind contributions from local residential committees and governmental units as a social welfare system (Chen, 1996). The cost of services for food, healthcare, clothing, accommodation, and funeral for "Three-No" elders is free. "Three-No" elders residing in rural areas were generally cared for by the local village, and either continued to live alone or with a local family. However, in contemporary China the "Three-No" population is very small, accounting for only 1–2% of the elderly population according to the 2000 census (Gu, Dupre, & Liu, 2007).

In summary, the Chinese people, rural residents and the poor in particular, have experienced a large and universal reduction in access to healthcare after economic reform in the late 1970s (Tomlinson, 1997; Yip & Hsiao, 2008). Although China today has adopted flexible approaches with both public and private resources to improve its citizens' access to the healthcare system, the majority of elder's medical care expenses are paid by their family members (Gu & Vlosky, 2008; Yip & Hsiao, 2008).

Data and methods

Data

This study used data from the 2002 and 2005 waves of the CLHLS. The CLHLS is the first nation-wide longitudinal survey with the largest sample of oldest-old ever conducted in a developing country. The CLHLS began in 1998 to conduct interviews in half of the counties/cities in 22 provinces randomly selected in China with an attempt to interview all centenarians in the sampled counties/cities with informed consent. For each centenarian with a pre-designated random code, one nearby octogenarian and one nonagenarian were randomly interviewed with pre-designated age and sex. The term 'nearby' refers to the same village or street, or the same town, county or city, when applicable. This sampling strategy was designed to ensure comparable numbers of randomly selected male and female octogenarians and nonagenarians at each age from 80 to 99. The second wave was conducted in 2000. The CLHLS has started to include young elders aged 65–79 in the sample since the third wave in 2002. The 2002 wave interviewed 4845 young elders and 11,127 oldest-old aged 80–109 (4238 octogenarians, 3747 nonagenarians, and 3142 centenarians). Of the total 15,972 interviewees in the 2002 wave, 8113 (50.8%) were re-interviewed in the 2005 wave, 5832 (36.5%) died before the 2005 wave, and 2027 (12.7%) were lost to follow-up (i.e., the respondents were unable to be located due to incorrect address, migration, or governmental resettlement). These total 15,972 respondents were from 867 communities (i.e., counties/city districts) with different population sizes. According to the 2000 census, the average population size of these 867 communities was around 520,000 with the smallest around 90,000 and the largest nearly 1.5 million.

The CLHLS collected information on whether the respondent could have access to adequate healthcare service when in need at present. Health capital or stock was collected in terms of self-reported health, self-reported life satisfaction, lower and upper extremities performance, instrumental activities of daily living (IADL), activities of daily living (ADL), cognitive functioning, and chronic diseases. Other data covering demographic characteristics, family and household characteristics, lifestyle, diet, psychological characteristics, economic resources, and family support were collected as well. All information was obtained through in-home interviews. The dates of death for deceased respondents were collected from various sources including death certificates, next-of-kin, and neighborhood committees. All dates at death were validated and the dates reported on death certificates were ultimately used when available, otherwise the next-of-kin's report was used, followed by neighborhood registries. Systematic assessments of the CLHLS regarding the accuracy of age reporting, as well as the reliability, validity, and consistency of numerous measures, and the randomness of attrition showed that the data quality in the CLHLS was quite good (Gu, 2008; Gu & Dupre, 2008).

Dependent variables

We used two outcome variables, survival status and overall health condition in the 2005 follow-up wave, to measure healthy longevity. The response categories for survival status in 2005 were *died* (code = 0) versus *alive* (code = 1). The overall health condition in 2005 was measured in terms of cumulative deficit index (DI) (Kulminski et al., 2008; Yashin et al., 2007). The DI captures the cumulative health deficits of an individual (also called frailty index, FI, see Mitnitski et al., 2005). The DI is constructed by summing all deficits and then dividing by the number of total possible deficits. The validity of the DI as a proxy for biological age and as a robust predictor of risks of death and health change in various populations has been well-documented (Kulminski et al., 2008; Mitnitski et al., 2005; Yashin et al., 2007).

Following the previous studies (Kulminski et al., 2008; Yashin et al., 2007), we constructed a DI based on 39 variables. The detailed distribution of sample over these variables is listed in Table 1. Each item is dichotomized and coded one when the deficit is present (otherwise 0). We assigned a score of two if the sampled person had

Table 1
Percentage distribution of 39 variables used to calculate cumulative deficit index (DI).

Variables	Measured at the 2002 baseline			Measured at the 2005 follow-up
	Full sample	Survival sample	Healthy-survival sample	
Total # of respondents	15,972	13,945	8113	8113
(1) Needs assistance bathing	27.3	26.9	14.3	21.4
(2) Needs assistance dressing	12.8	12.4	4.3	11.2
(3) Needs assistance toileting	13.8	13.4	4.8	11.5
(4) Needs assistance in indoor transferring	11.1	10.8	3.8	9.9
(5) Incontinence	7.2	6.9	3.1	5.5
(6) Needs assistance eating	8.1	7.8	2.8	6.6
(7) Unable to visit neighbors by oneself	26.7	26.5	13.2	23.7
(8) Unable to shop by oneself if necessary	42.1	42.3	25.2	36.3
(9) Unable to cook meals by oneself if necessary	41.7	41.7	24.2	37.1
(10) Unable to wash clothing by oneself	42.1	42.1	25.9	38.1
(11) Unable to walk continuously for 1 kilometer	50.2	50.4	33.7	45.8
(12) Unable to lift a weight of 5 kg (such as a heavy bag of groceries)	49.5	49.5	34.2	44.8
(13) Unable to continuously crouch and stand up three times	54.5	54.7	39.3	51.8
(14) Unable to use public transportation	57.8	58.2	41.6	53.4
(15) Poor self-rated health	23.6	23.6	16.4	24.3
(16) Health worsened in the past year	45.6	45.6	37.9	46.1
(17) Poor interviewer-rated health	17.3	17.2	9.6	18.3
(18) Unable to put hand behind neck	12.6	12.4	8.1	12.0
(19) Unable to put hand behind lower back	12.7	12.7	8.3	13.7
(20) Unable to raise arm upright	12.0	11.8	7.7	12.1
(21) Unable to stand up from sitting in a chair	33.9	33.9	21.0	30.9
(22) Unable to pick up a book from the floor	34.5	34.4	20.0	32.3
(23) Abnormal heart rhythm	9.1	9.0	7.9	10.2
(24) Hearing loss	31.6	32.1	19.2	27.9
(25) Vision loss	33.3	33.2	22.1	38.0
(26) Having one serious illnesses in the past two years	12.2	11.9	10.9	15.8
(26-1) Having 2+ serious illnesses in the past two years	6.3	6.3	4.7	7.2
(27) Suffering from hypertension	15.2	14.9	16.0	19.3
(28) Suffering from diabetes	2.3	2.0	1.9	2.7
(29) Suffering from heart disease	8.8	8.4	9.0	9.8
(30) Suffering from stroke/cerebrovascular disease	5.3	5.2	4.6	6.2
(31) Suffering from bronchitis, emphysema, asthma, or pneumonia	13.0	12.9	12.5	12.9
(32) Suffering from tuberculosis	0.8	0.7	0.8	0.8
(33) Suffering from cancer	0.4	0.4	0.3	0.6
(34) Suffering from gastric or duodenal ulcers	5.1	5.0	5.6	5.3
(35) Suffering from Parkinson's disease	0.6	0.5	0.4	0.5
(36) Suffering from bedsores	0.9	0.9	0.6	0.8
(37) Suffering from arthritis	17.2	16.9	18.2	18.2
(38) Symptom of psychological distress (based on loneliness, usefulness, and fearfulness)	27.2	26.9	25.8	28.6
(39) Cognitively impaired (based on the Mini-Mental State Examination)	40.9	41.3	26.1	43.7

Note: Percentages in the table are unweighted.

a serious illness two or more times that caused him/her to be hospitalized or bedridden as did by others (Goggins, Woo, Sham, & Ho, 2005). We then classified those respondents who survived to the 2005 follow-up wave into healthy survivors and non-healthy survivors based on the quartile of their DI in 2005. We also tried the quintile of DI as the criterion of healthy and non-healthy survival and the patterns were the same (not shown). Those with the lowest quartile of DI were considered as healthy survivors. Otherwise, they were regarded as non-healthy survivors.

Explanatory variables

Access to healthcare service is the key explanatory variable in our models. One widely cited definition of access to healthcare was proposed by Penchansky and Thomas (1981) who defined it as a concept of access to healthcare consisting of availability, accessibility, accommodation, affordability, and acceptability. However, there is no gold standard in measuring access to healthcare. New approaches are constantly being developed, attempting to capture changes in the delivery of care, and there is increasing interest in outcome-based measures of access (Goin et al., 2001). One common measure was whether the respondent ever visited a physician or was hospitalized in a given time (Aday, 1993; Andersen, 1995; Porell & Miltiades, 2001). In other words, most studies regarded the actual use of healthcare as an indicator of access to healthcare services. Although this measure correctly reflected the access to healthcare for those in need, it overlooked those who were not in need but could have access to healthcare when in need. In our study, access to healthcare services at present was measured by a single question in the CLHLS: "Could you get adequate medical service at present when it is necessary?" The answers were yes (code = 1) and no (code = 0). Access to healthcare services in childhood was measured by a single question "Could you get adequate medical service in childhood when it was necessary?" The answers were yes (code = 1) and no (code = 0). For those respondents who were first interviewed in 1998 (about 16% of the total sample), there are three answers: yes, no, and was not ill in childhood. We coded "was not ill in childhood" (comprising 8% of the total sample) as missing values and then imputed them using multiple imputation given equal conditions in demographics, SES, family/social support, health practice and the baseline health in 2002 (Allison, 2002).

Controls

Previous research has shown that social environment (i.e., social network, individual's socioeconomic status, and community-level socioeconomic characteristics) is strongly associated with health

(Seeman & Crimmins, 2001). Although access to healthcare is related to an individual's social environment, substantial empirical evidence in epidemiology, social and behavioral science, as well as medicine has shown that access to healthcare is independently associated with health/mortality, after controlling for various socioeconomic factors (Andersen, 1995; Frank, Clancy, & Gold, 1993; Hadley, 2007). In health economics literature, socioeconomic status, family/social support, and health practice, parallel to access to healthcare, are all considered as inputs, and thus directly influence the stock of health capital (Grossman, 1972; Guimaraes, 2007). In the social model of health, access to healthcare is often considered as an intermediate factor of the effects of other socioeconomic variables on health (e.g., Adams, Hurd, McFadden, Merrill, & Ribeiro, 2003). In the behavioral model, individual socioeconomic status and family/social support are considered as enabling factors in determining the access to healthcare that directly affects health (Andersen, 1995). Furthermore, in both ecological and social models of health, the level of a community's development and its other environmental factors are further considered as critical determinants of health (Kawachi & Berkman, 2003). Therefore, it is important that we control for individual socioeconomic status, family/social support, health practice, and community-level characteristics in analyzing the effects of access to healthcare on health/survival.

Following these guidelines and findings in the extant literature (e.g., Andersen et al., 2002; Ferrucci et al., 2003; Liang, Bennett, Sugisawa, Kobayashi, & Fukaya, 2003; Preston et al., 1998), we controlled for numerous factors that were associated with healthy longevity. Specifically, control variables at the individual level (i.e., level-one variables) included demographic characteristics, socioeconomic status (SES) in childhood and at present, family care resources, and health practices. Demographic variables included age, sex, ethnicity (Han vs. Non-Han), and current residence (urban vs. rural). Childhood SES was measured by father's occupation (white-collar vs. others) and whether the respondent went to bed hungry. Current SES consisted of economic independence (yes vs. no), education (1+ years of schooling vs. 0), and occupation (white-collar occupation vs. others). Family caregiving resources included marital status (married vs. unmarried), proximity to children in terms of whether the respondent had one or more children living nearby or coresiding (yes vs. no), and the number of living children. Health practices were measured by "whether the respondent smokes at present (yes vs. no)", "drinks any alcohol at present (yes vs. no)", and "regularly does exercise at present (yes vs. no)".

At the community level (a county/district of a city), we first attempted to include per capita GDP, average years of schooling, number of hospital beds per 1000 persons, percent of urban population, the total population dependency ratio and air pollution index to control for important environmental factors for health (Andersen et al., 2002; Sandström, Frew, Svartengren, & Viegi 2003). These community-level variables (i.e., level-two variables) reflected different dimensions of area socioeconomic development and were obtained from the National Bureau of Statistics of China (2003) and the Chinese Natural Resources database. However, to simplify the analyses, we only kept per capita GDP and the total population dependency ratio in our final models after dropping the insignificant factors in the regressions. The two significant community-level variables were coded by quartile to capture their possible non-linear correlations with survival and healthy survival.

Methods

We conducted two different sets of analyses with different samples. First, multilevel logistic regression was employed to examine how access to healthcare service is associated with subsequent survival. In these analyses (referred to here as survival models), those who were lost to follow-up in 2005 ($n = 2027$) were dropped since we do not know whether they were alive or dead at the time of the 2005 survey, leaving a total sample of 13,945 respondents (7976 women and 5969 men) consisting of 8113 survivors and 5832 decedents.

According to the CLHLS technical report (Gu, 2007), loss to follow-up in the 2005 wave was not completely at random. Therefore, exclusion of those lost to follow-up in analyses may introduce some bias. However, such bias was small. In additional analyses (results not shown), we used multiple imputation to impute the survival status of those who were lost to follow-up in the 2005 survey with all covariates mentioned in this study except for community-level factors. This multiple imputation approach assumed that the structural pattern of missing values depended only upon a combination of random change that could be predicted from all observed factors in the model. This approach was an alternative estimation approach in the correction of loss to follow-up in social science research (Singer & Willett, 2003). The results from the multiple imputation approach were very close to those obtained from excluding those who were lost to follow-up.

Sequential models were designed to investigate how the impact of access to healthcare on survival and healthy survival was mediated by each set of different covariates. This strategy is a common practice in aging research (e.g., Hayward & Pienta, 1997; Liang et al., 2003; Preston et al., 1998). Model I included access to healthcare in childhood and at present, demographic factors, and childhood and adulthood SES. We did not present the results based on models controlling for demographic factors only and models controlling for demographic factors and SES at childhood only, since we found that the odds ratios for access to healthcare were almost the same as those in Model I. Model II added family caregiving resources and health practices into Model I. Although Model I and Model II did not include community-level factors, a random effect term at Level Two was included in both models to account for variation across counties. This approach is widely applied in multilevel analysis (Raudenbush, Bryk, Cheong, & Congdon, 2004). Model III added the initial health capital in terms of the DI in 2002 into Model II. Finally, Model IV further controls for the community-level factors. Please note that there are 24% and 15% of respondents in the sample who used a proxy to answer questions for access to healthcare at present and in childhood, respectively. We added this information as two indicator variables into all regression models to adjust for possible biases and found similar results to those without controlling for proxy responses. Therefore, we presented the results without two proxy indicator variables.

The second set of analyses investigated the association between access to healthcare and healthy survival (abbreviated as healthy-survival model). Only survivors (8113 respondents) were included in this set of analyses. Multilevel logistic regression and the above-mentioned sequential modeling strategy were employed to fulfill the goal.

Given that the sampling weight variable in the publicly released CLHLS dataset was calculated based on the age–sex–urban–rural residence-specific distribution of the population and did not capture other important compositional variables (e.g., marital status, economic status), the weight was not applied in the current study. Research showed that including variables related to sample selection produces unbiased coefficients without weights (Winship & Radbill, 1994), and weighted regression results were likely to enlarge the standard errors (see http://www.sociology.ohio-state.edu/people/ptv/faq/weights.htm, Access on July 18, 2007). In addition, our preliminary analyses showed that the general patterns and conclusions were similar between weighted and unweighted data. All analyses were performed using the -xtmelogit- command in Stata version 10.0 (StataCorp, 2007).

Results

Table 2 presents the percentage distribution of variables for the two samples used in the study. The results show that the composition of the full sample is very close to that of the sample for survival analysis, suggesting that excluding those who were lost to follow-up would not introduce a significant bias for survival analysis. As expected, the sample used for healthy survival analysis is relatively younger and healthier than the other two. According to unweighted data of our samples, the proportion of the Chinese elders having access to healthcare services at present is around 89% (The weighted number is around 91%. The weighted number captures the entire elderly population in sampled provinces.). In other words, around 10% of elders could not currently have access to adequate healthcare.

Table 3 reveals that those elders who could get access to healthcare services at present when in need were 19% more likely to survive in a three-year interval than those who could not, controlling for demographic characteristics, access to healthcare in childhood, and both childhood and adulthood SES (Model I). Such a protective effect was moderately reduced but it was still marginally significant ($p < 0.1$) even after we additionally controlled for family caregiving resources and health practice (Model II). However, once baseline health (i.e., DI) in 2002 was controlled, the protective effect of access to healthcare at present was diminished (Model III). This indicates that baseline health condition played a substantial role in determining subsequent survival. Additionally controlling for community-level factors did not further change the odd ratios of currently having access to healthcare on survival (Model IV). The protective effect of access to healthcare in childhood on survival was about 10% and consistent across models, suggesting that the effects of access to healthcare in childhood on late age mortality risk was independent not only from demographic characteristics, SES, family caregiving resources, health behavior, baseline health, and community-level factors, but from current access to healthcare as well. These results also indicate that access to healthcare in childhood had pronounced long-term protective effects on survival at old ages.

Table 4 shows that current access to healthcare services could improve the odds of healthy survival by 68% in the presence of individual demographic factors, both childhood and adulthood SES, and access to healthcare in childhood (Model I). The effects were only slightly modified to 58% when family caregiving resources and health practice were further controlled for (Model II). Even in the presence of baseline health condition in 2002, the protective effect of current access to healthcare was still marginally significant although it was reduced down to 22% (Model III). Community-level factors almost had no mediated effect on the association between currently having access to healthcare and healthy survival. Access to healthcare in childhood improved the odds of healthy survival by 17–19%, and the protective effect was statistically significant and changed little across all the models.

Our additional analyses also reveal that the protective effects of access to healthcare on survival and healthy survival were similar for urban and rural areas, for men and women, for young elders and the oldest-old, and for different SES categories as well (not shown). It is clear that access to healthcare have pronounced short-term and long-term protective effects on survival and healthy survival, and access to healthcare across the life course makes a difference in healthy longevity in China.

We conducted additional analyses to examine the effects of access to healthcare at present or in childhood on healthy survival measured by major components of the DI including IADL, ADL, cognitive function, chronic diseases, and self-rated health (results not shown). Here healthy survival was defined as IADL active, ADL active, cognitively unimpaired, not suffering from any chronic disease, or self-rated good health, respectively. We found that except for ADL and chronic disease, the positive effects of current access to healthcare on healthy survival were all statistically significant if we did not additionally control for baseline health. Specifically, improved odds of survival for those with current access to healthcare were 20–25% for active IADL, 30–45% for unimpaired cognition, and 60–73% for self-rated good health. The corresponding figures for access to healthcare in childhood were 14–17% for active IADL, 12–21% for unimpaired cognition, and 13–17% for self-rated good health. Such effects were reduced when baseline health was considered, but most of them were still statistically significant.

We further compared the life expectancy and various health expectancies between elders who currently could have access to healthcare and those who could not. Health expectancies could be measured by disability free life expectancy (active life expectancy) based on IADL or ADL, cognitively unimpaired life expectancy, healthy life expectancies based on self-rated good health, and disease free life expectancy (see Robine, Jagger, Mathers, Crimmins, & Suzman, 2003). These health expectancies were estimated using the Sullivan method according to the estimated probability distribution of each health capital variable by sex and urban–rural

Table 2
Sample description in the 2002 CLHLS.

Variables	Full sample[a]	Survival sample[a]	Healthy-survival sample[a]
Individual level variables			
Number of individuals	15,972	13,945	8113
% Able to get access to healthcare services at present	88.7	88.5	90.2
% Able to get access to healthcare services in childhood	–	42.4	43.4
Demographics			
Age (mean)	86.3	86.5	81.8
% Male	42.8	42.8	45.2
% Living in urban	46.1	43.4	43.9
% Han ethnicity	94.3	93.8	93.5
Socioeconomic status			
% Father had a white-collar job	4.0	3.8	3.9
% Went to bed hungry in childhood	62.5	63.4	63.4
% Economically independence	26.0	24.6	32.3
% Received 1+ years of schooling	38.6	37.9	42.6
% White-collar occupation of the respondent	8.6	8.0	10.0
Family caregiving resources			
% Married	31.4	31.2	41.8
% High proximity with children	52.8	53.5	49.4
Number of living children (mean)	3.2	3.3	3.5
Health practice			
% Smoking at present	18.4	18.6	21.2
% Drinking Alcohol at present	20.4	21.1	23.2
% Regular exercise at present	31.6	31.2	37.3
Cumulative deficit index in 2002, DI (mean)	0.23	0.23	0.18
% Survivors in 2005	–	41.8	–
% Healthy survivors in 2005	–	–	27.8
Community-level variables			
Number of communities	867	845	775
Per capita GDP (×1000 *Yuan*)[b]	6.4	6.4	6.4
% Population dependency ratio[b]	43.6	43.5	43.6

Note: percentages and means in the table are unweighted.
–, Variables are not used in the analysis.
[a] The survival sample dropped those who were lost to follow-up in 2005. The healthy-survival sample included those who survived to the 2005 wave only. The full sample included all persons in the 2002 survey.
[b] Calculated at county level.

Table 3
Odds ratios and 95% CI of access to healthcare at present and in childhood on survival among the Chinese elderly, CLHLS 2002–2005.

	Model I	Model II	Model III	Model IV
Having access to healthcare in childhood (no)	1.11 (1.02, 1.21)*	1.11 (1.02, 1.21)*	1.09 (1.01, 1.19)*	1.09 (1.00, 1.19)*
Having access to healthcare at present (no)	1.19 (1.05, 1.3 4)**	1.13 (0.99, 1.27)+	0.91 (0.80, 1.04)	0.91 (0.80, 1.04)
Individual level covariates				
Age	0.90 (0.90, 0.91)***	0.90 (0.90, 0.91)***	0.92 (0.91, 0.92)***	0.92 (0.91, 0.92)***
Men (women)	0.72 (0.66, 0.80)***	0.62 (0.56, 0.69)***	0.58 (0.53, 0.65)***	0.58 (0.52, 0.65)***
Urban (rural)	0.99 (0.91, 1.08)	0.96 (0.88, 1.05)	1.01 (0.92, 1.11)	1.03 (0.93, 1.12)
Han ethnicity (no-Han)	0.94 (0.78, 1.15)	0.93 (0.76, 1.13)	0.95 (0.77, 1.15)	0.92 (0.75, 1.13)
Father had a white-collar job (no)	0.96 (0.77, 1.19)	0.96 (0.78, 1.21)	0.91 (0.73, 1.13)	0.91 (0.73, 1.13)
Went to bed hungry in childhood (no)	1.07 (0.98, 1.16)	1.06 (0.98, 1.16)	1.06 (0.97, 1.16)	1.06 (0.97, 1.16)
Economic independent (dependent)	1.52 (1.34, 1.71)***	1.39 (1.23, 1.57)***	1.40 (1.24, 1.59)***	1.40 (1.24, 1.59)***
1+ years schooling (no)	0.97 (0.88, 1.07)	0.95 (0.86, 1.05)	0.95 (0.86, 1.06)	0.95 (0.86, 1.06)
White-collar job (no)	1.07 (0.90, 1.28)	1.01 (0.85, 1.22)	1.08 (0.90, 1.29)	1.08 (0.90, 1.29)
Current married (no)		1.29 (1.15, 1.43)***	1.30 (1.16, 1.45)***	1.29 (1.16, 1.45)***
High proximity to children (no)		0.89 (0.82, 0.97)**	0.91 (0.84, 0.99)*	0.92 (0.84, 1.00)*
# Of living children		1.02 (1.01, 1.05)*	1.02 (1.00, 1.05)*	1.03 (1.00, 1.05)*
Currently smoking (no)		1.00 (0.89, 1.12)	0.94 (0.84, 1.06)	0.95 (0.84, 1.06)
Currently drinking alcohol (no)		1.25 (1.13, 1.39)***	1.14 (1.02, 1.27)*	1.14 (1.03, 1.27)*
Do regular exercise (no)		1.58 (1.44, 1.74)***	1.22 (1.12.1.36)***	1.24 (1.13.1.37)***
DI in 2002 2nd quarter (1st quarter)			0.65 (0.58, 0.73)***	0.65 (0.58, 0.73)***
DI in 2002 3rd quarter (1st quarter)			0.45 (0.40, 0.51)***	0.45 (0.41, 0.51)***
DI in 2002 4th quarter (1st quarter)			0.24 (0.21, 0.28)***	0.24 (0.21, 0.28)***
Community-level covariates				
Per capita GDP 2nd quartile (1st quartile)				1.01 (0.88, 1.17)
Per capita GDP 3rd quartile (1st quartile)				1.07 (0.92, 1.24)
Per capita GDP 4th quartile (1st quartile)				1.31 (1.11, 1.55)*
Dependency ratio 2nd quartile (1st quartile)				1.02 (0.88, 1.18)
Dependency ratio 3rd quartile (1st quartile)				1.33 (1.13, 1.56)***
Dependency ratio 4th quartile (1st quartile)				1.27 (1.08, 1.50)**
-LL	7618.3***	7540.0***	7281.9***	7270.1***
rho	0.03***	0.03***	0.03***	0.03***
Improvement as compared to the previous model (LR chi square)	–	156.5***	516.3***	23.5***

Note: DI: cumulative deficit index.
Category in the parentheses of each variable is the reference.
+, $p < 0.1$; *, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$.

residence. We found that access to healthcare services at present could increase life expectancy by around 1.0 year at age 65 and 0.6 year at age 80 (relative percentages to e_{65} and e_{80} are 5% and 7%, respectively). Having access to healthcare services at present further improved health expectancies. Compared to those without access to healthcare, those who had access to adequate healthcare had a longer active life expectancy by 0.8 year at age 65 and by 0.5 year at age 80. The corresponding figures for cognitively unimpaired life expectancy at ages 65 and 80 were 1.8 and 1.5 years; and the figures for healthy life expectancy at ages 65 and 80 were 3.5 and 2.1 years, respectively. All these improved life expectancy and health expectancies were almost the same between two sexes and between urban and rural residents.

Discussion

Access to healthcare services is an important resource to protect oneself from disease onset and to hasten recovery from diseases and impairments. However, there have been few investigations of the association between access to healthcare services and health condition at the oldest-old ages and even fewer in developing countries, mainly due to unavailability of data. Drawing from the world's largest aging population, we used data from a nation-wide longitudinal survey in China to investigate the short-term and long-term impacts of access to healthcare services on subsequent mortality and healthy survival. To our knowledge, this study is the first to use nationally representative data to examine access to healthcare services, at present as well as in childhood, on survival and healthy survival among Chinese elders under a multilevel context.

We find that current access to healthcare improves the odds of survival and healthy survival at old and very old ages controlling for demographics, child and adulthood SES, family caregiving resources, health practices, and childhood access to healthcare. This is generally consistent with previous work in Western societies showing the important and independent role that access to healthcare plays in the survival of the elderly (Adams et al., 2003; Alonso et al., 1997; Andersen, 1995). However, the protective effect is largely reduced and becomes statistically insignificant when health status at the baseline is accounted for. This confirms the finding by Adams et al. (2003) who showed that increasing access to healthcare would not significantly lower the conditional probabilities of new acute health events among the elderly given their health histories. One possible interpretation is based on a theoretical perspective from health economics, which suggests that current access to healthcare (i.e., current positive input) could only affect the current level of health capital (Grossman, 1972; Guimaraes, 2007). Accordingly, current access to healthcare may only yield a marginal impact on mortality risk. Such a marginal effect might be insignificant when the follow-up period is not sufficiently long, as in this study. On the other hand, the current health stock (or mortality) is largely determined by baseline health or cumulative health capital at a preceding time (Grossman, 1972; Guimaraes, 2007). Indeed, many social epidemiological studies focusing on associations between SES and mortality frequently find that health practice variables slightly mediate, and baseline health greatly modifies, the associations between SES and mortality (e.g., Feinglass et al., 2007; Hoffmann, 2005). Although the studied association in the present study is different from theirs, the underlying mechanism of mediation is likely the same. We would encourage additional research to further shed light on the role of baseline health in determining survival at late ages.

Table 4
Odds ratios and 95% CI of access to healthcare at present and in childhood on healthy survival among the Chinese elderly, CLHLS 2002–2005.

	Model I	Model II	Model III	Model IV
Having access to healthcare in childhood (no)	1.19 (1.05, 1.34)**	1.19 (1.05, 1.35)**	1.18 (1.03, 1.33)*	1.17 (1.03, 1.33)*
Having access to healthcare at present (no)	1.68 (1.34, 2.09)***	1.58 (1.26, 1.98)***	1.22 (0.97, 1.55)+	1.23 (0.97, 1.55)+
Individual level covariates				
Age	0.90 (0.89, 0.91)***	0.90 (0.89, 0.91)***	0.91 (0.90, 0.91)***	0.91 (0.90, 0.92)***
Men (women)	1.61 (1.41, 1.84)***	1.51 (1.30, 1.74)***	1.47 (1.27, 1.71)***	1.47 (1.27, 1.71)***
Urban (rural)	1.10 (0.96, 1.25)	1.06 (0.93, 1.22)	1.14 (1.00, 1.31)	1.14 (1.00, 1.31)
Han ethnicity (no-Han)	0.94 (0.71, 1.26)	0.94 (0.7',1.26)	0.98 (0.73, 1.32)	1.03 (0.77, 1.39)
Father had a white-collar job (no)	0.92 (0.68, 1.22)	0.93 (0.69, 1.25)	0.90 (0.67, 1.22)	0.91 (0.67, 1.23)
Went to bed hungry in childhood (no)	0.93 (0.82, 1.06)	0.93 (0.82, 1.05)	0.93 (0.82, 1.06)	0.93 (0.82, 1.06)
Economic independent (dependent)	1.00 (0.87, 1.15)	0.99 (0.86, 1.14)	0.99 (0.85, 1.13)	1.00 (0.86, 1.15)
1+ years schooling (no)	1.12 (0.98, 1.29)	1.10 (0.98, 1.29)	1.09 (0.94, 1.25)	1.09 (0.94, 1.25)
White-collar job (no)	0.90 (0.74, 1.10)	0.89 (0.72, 1.09)	0.92 (0.75, 1.13)	0.91 (0.74, 1.12)
Current married (no)		0.99 (0.86, 1.13)	0.99 (0.87, 1.14)	0.99 (0.87, 1.14)
High proximity to children (no)		1.07 (0.95, 1.21)	1.08 (0.95, 1.22)	1.07 (0.95, 1.22)
# Of living children		1.05 (1.02, 1.08)**	1.05 (1.02, 1.08)**	1.05 (1.02, 1.08)**
Currently smoking (no)		1.05 (0.91, 1.21)	1.00 (0.86, 1.16)	1.00 (0.86, 1.16)
Currently drinking alcohol (no)		1.21 (1.05, 1.39)**	1.11 (0.96, 1.28)	1.10 (0.96, 1.27)
Do regular exercise (no)		1.30 (1.15, 1.48)***	1.12 (0.98, 1.28)+	1.13 (0.99, 1.29)+
DI in 2002 2nd quarter (1st quarter)			0.54 (0.47, 0.63)***	0.54 (0.47, 0.62)***
DI in 2002 3rd quarter (1st quarter)			0.27 (0.22, 0.32)***	0.27 (0.22, 0.32)***
DI in 2002 4th quarter (1st quarter)			0.15 (0.10, 0.21)***	0.15 (0.10, 0.21)***
Community-level covariates				
Per capita GDP 2nd quartile (1st quartile)				1.26 (1.00, 1.57)*
Per capita GDP 3rd quartile (1st quartile)				1.08 (0.86, 1.37)
Per capita GDP 4th quartile (1st quartile)				0.91 (0.70, 1.19)
Dependency ratio 2nd quartile (1st quartile)				1.02 (0.81, 1.28)
Dependency ratio 3rd quartile (1st quartile)				1.11 (0.87, 1.43)
Dependency ratio 4th quartile (1st quartile)				0.85 (0.66, 1.10)
-LL	3973.2***	3955.0***	3793.7***	3788.3***
rho	0.10***	0.09***	0.10***	0.09***
Improvement as compared to the previous Model (LR chi square)	–	36.4***	320.6***	12.8*

Note: DI: cumulative deficit index.
Category in the parentheses of each variable is the reference.
+, $p < 0.1$; *, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$.

Our empirical results further show that access to healthcare services in childhood is a robust predictor of survival and healthy survival at old ages, independent of a variety of individual and community characteristics. Inability to get access to healthcare for severe childhood illnesses could affect psychological development (Cohen, Velez, Brook, & Smith, 1989) and accelerate the degradation of the functional level of specific organs at adulthood (Kuh & Ben-Shlomo, 2004). All these adversities may reduce an individual's reserve capacity to resist disease, thus increasing mortality and health problems at later ages. There is plenty of evidence in the literature showing that better socioeconomic conditions in childhood or even in the fetal stage could improve one's health and survival at older ages or even oldest-old ages (e.g., Finch & Crimmins, 2004; Fogel, 1994; Preston et al., 1998; Zeng, Gu, & Land, 2007). Our finding is in line with these prior reports. Overall, it seems that access to healthcare improves survival and healthy survival universally, regardless of age, gender, urban–rural residence, or other covariates, suggesting that getting adequate or timely treatment for a disease has similar beneficial effects for people with different characteristics.

There are several limitations of this study. First, we used a single subjectively rated assessment of access to healthcare services in the CLHLS, which may introduce some bias since the individual expectation or conceptualization might be different. However, this measure overcomes the shortcomings of the traditional measure that relied entirely on the actual use of healthcare services. Clearly, more measures reflecting the concept of access to healthcare proposed by Penchansky and Thomas (1981) would be preferable in future research. Second, people with different diseases need different medical treatments. However, the CLHLS did not collect specific information about what kind of healthcare service was difficult to get access to, so that we are unable to provide further answers. Third, the frequency or intensity of use of healthcare services and the quality of care received are not available, which prohibits us from further exploring their effects on healthy longevity. Fourth, both access to healthcare and SES in childhood were based on respondents' self-report in 2002, and thus might potentially be subject to recall bias. Nevertheless, prior research has indicated the validity of using current self-reports in the estimation of childhood SES (Krieger, Okamoto, & Selby, 1998). Fifth, the definition of community, geographically defined at the county level, is a relatively larger unit compared to neighborhood, blocks, and census-track that are frequently used in Western research. Given the large variation across counties in terms of population size or socioeconomic development, smaller units of analysis would produce more robust results. However, the data below county level are not available in contemporary China. Additional research is clearly warranted once the data at smaller geographical levels are available in China. Finally, we are unable to include community demand factors (e.g., percentage uninsured and percentage of free public medical services) in our models. We think that the inclusion of additional access measures (e.g., access to specific healthcare services, geographic distance from healthcare facilities, waiting time to receive the service, and variables representing community demand and supply sources) would improve our understanding of the mechanism linking access to healthcare services and healthy longevity.

In spite of these shortcomings, we have extended the existing research by focusing on a unique sample from a developing country where the healthcare system is relatively underdeveloped and eldercare is culturally dominated by informal family caregiving. The results of this analysis provide some empirical evidence to support

the argument that the protective effects of access to healthcare on health and longevity at old ages found in developed countries also exist in developing countries, at least in China.

Challenges and policy implications

Our findings imply that those who could get access to healthcare services both currently and in childhood could benefit from medical intervention throughout the life course, although it might be possible that only a fraction of health problems at old ages are amenable to effective medical care. In the coming decades China will face dramatic population aging that will strain the social healthcare system and challenge the practice of filial piety. The situation calls for immediate action and planning from the central and local governments, given that providing care to the increasing number of older adults is increasingly challenged by China's unique socio-political landscape, such as the one-child policy and the resulting 4-2-1 family structure (four grandparents, two parents, and one child), the increasing unavailability of adult children due to economic reforms and job mobility, increasing divorce rates, lack of a national social security system, and lack of public health insurance in rural areas (see Gu & Vlosky, 2008).

Another challenging issue to healthcare is the skyrocketing increase in healthcare expenses. In 1990, Chinese households overall paid for just 36% of healthcare expenses out-of-pocket, but this number climbed to 58% in 2002 (Jackson & Howe, 2004). According to the Second National Health Service Survey in 1998, 87% of the rural population had no health benefits and had to pay all medical costs by themselves (Ministry of Health, China, 1999). Data from the 2002 CLHLS further show that 65% of the rural elderly aged 65 and older who didn't seek healthcare cited the excessive costs and their inability to pay for prescription drugs as primary reasons. This figure climbs to 80% among low income families. Increasingly, the affordability of healthcare is becoming an urgent issue. Currently, while around 50–60% of elders in cities have pension or retirement wages, there is still little or no state support for rural elders who are the majority of the elderly population. The CLHLS data show that more than 90% of the rural elderly do not have a pension; more than 20% of the sampled elderly do not have sufficient financial sources to pay for their daily expenses; and less than 10% of rural elders have social security.

Therefore, our findings suggest that China should promote programs that can improve the affordability of medical care and reduce healthcare expense. The new cooperative medical scheme in rural areas is a great move and can substantially increase the access to healthcare services if it expands its service coverage. It is also imperative to develop affordable home/community-based services (such as home-bed) to allow poor elders to access basic healthcare services. We believe that both life expectancy and health expectancies of the Chinese elderly population will be increased if access to healthcare is improved, especially in rural areas.

Our results further indicate that policies promoting childhood healthcare can have large and long-lasting benefits extending into old age. Investments in improving children's access to health services will not only enhance the life quality of children and their families today, but also have large and long-term lasting effects on the health, survival and life quality for the future elders, their families and society in general.

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