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The effects of childhood health on adult health and SES in China

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ABSTRACT

The Effects of Childhood Health on Adult Health and SES in China^{*}

In this paper, we model the consequences of childhood health on adult health and socio-economic status outcomes in China using a new sample of middle aged and older Chinese respondents. Modeled after the American Health and Retirement Survey (HRS), the CHARLS Pilot survey respondents are forty-five years and older in two quite distinct provinces – Zhejiang, a high growth industrialized province on the East Coast, and Gansu, a largely agricultural and poor province in the West. Childhood health in CHARLS relies on two measures that proxy for different dimensions of health during the childhood years. The first is a retrospective self-evaluation using a standard five-point scale (excellent, very good, good, fair, or poor) of general state of one's health when one was less than 16 years old. The second is adult height often thought to be a good measure of levels of nutrition during early childhood and the prenatal period. We relate both these childhood health measures to adult health and SES outcomes during the adult years. We find strong effects of childhood health on adult health outcomes particularly among Chinese women and strong effects on adult BMI particularly for Chinese men.

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This research examines the impact of events during the childhood of CHARLS respondents in China on their health and economic status as adults. In the twentieth century during the time period that CHARLS respondents were children, China's history was often tumultuous including famines, external and internal wars, and numerous natural disasters. While less extreme in scope, the positive and negative situations in their own families and villages may have had long-lasting effects on their latter life adult circumstances in health and socioeconomic status (SES).

The health and economic environment in which CHARLS respondents were raised is far different than that of the contemporary China in which they now live. CHARLS respondents were born during years 1963 and earlier. During that time, the history of China was quite challenging and tumultuous, especially for children. There was a great famine (1959-1961), during which millions of people died especially in the rural areas. Add onto that an internal and external war and recurring natural disasters. While less grand in scale, the enormous diversity in the circumstances of the villages and families in which CHARLS respondents were raised may have lingering and significant impacts on their economic and health lives during adulthood.

The revival of interest in determinants and consequences of poor childhood health in general can be traced partly to the impact of studies by David J. Barker (1997). In his work, he provides evidence that even nutrition in utero impacts health outcomes much later during one's adulthood. While controversial, data from natural experiments lend some support to this view. For example, Ravelli et al. (1998) studied people born in Amsterdam who were exposed pre-natally to famine conditions in 1944-1945. When compared to those conceived a year before or after the famine, prenatal exposure to

famine, especially during late gestation, was linked to decreased glucose tolerance in adults producing higher risks of diabetes. Hoddinott et al. (2009) and Maluccio et al. (2008) draw on a protein supplementation experiment conducted in Guatemala during the 1970s in which children in randomly chosen villages were offered protein supplements during their pre-school ages and show that completed schooling was significantly higher for the supplemented group, as were labor market earnings when they became adults.

Several recent studies examined the impact of ‘natural experiments’ that impacted people during this critical stage of life and have tended to report significant effects on the subsequent adult health of those affected. In a similar vein, several papers studied the impact of the 1959-1961 Chinese Great famine on health and socioeconomic outcomes. Almond et al. (2007) used 1% sample of the 2000 Chinese Census to study the effects of fetal exposure to maternal malnutrition due to the 1959–1961 famine on a range of socioeconomic outcomes like literacy, labor market status and wealth. They used the all-age death rate by year and province to calculate two mortality based proxies of famine intensity and found that high famine intensity was associated with greater risk of illiteracy, out of the labor force, and larger reductions in house size, with somewhat greater impacts on women than on men. Similarly Delaney et al. (2010) demonstrated that improvements in early childhood conditions through improved sanitation and food safety eliminated the urban mortality penalty in infant mortality and subsequently resulted in improved adult health and lower adult disability.

In the last few years, economists have done some insightful work on this topic. As one example among many, Case, Fertig, and Paxson (2005) investigated persistent

impacts of childhood health on adult health, employment, and some measures of SES using a 1958 British birth cohort who were followed prospectively into their adult years. They find that people who experienced poorer health outcomes either in terms of low birth weight or the presence of chronic conditions when they were children not only had worse health as adults, but they passed fewer O-level exams, worked less during their adult years, and had lower occupational status at age 42 even after some standard key measures of parental background such as education and income were controlled.

Using the PSID, in a recent study Smith (2008) examined the impact of childhood health on adult SES outcomes, including levels and trajectories of education, family income, household wealth, individual earnings and labor supply. Smith's analysis was conducted with a panel who were originally children and are now well into adulthood. With the exception of education, Smith reports that poor childhood health has a large effect on all outcomes with estimated effects larger when unobserved family effects are controlled. An individual's general health status during childhood appears to have significant direct and indirect effects on several salient adult SES financial outcomes, including one's ability to earn in the labor market, total family income, and wealth. In a companion study, Smith and Smith (2010) demonstrate that a substantial component of this impact was due to psychological disorders during childhood. Whether these types of results carry over to the Chinese context is not yet known.

This paper is divided into five sections. The next section describes the CHARLS data and variables that will be used in our analysis. Section 3 outlines the types of statistical models that will be estimated in order to model the association between childhood health and the adult health and SES outcomes in the Chinese context. Our

main empirical findings are contained in section 4 and the final section highlights our main conclusions.

2.1 Data- CHARLS Pilot Survey

The 2008 wave of China Health and Retirement Longitudinal Study (CHARLS Pilot) was conducted in Zhejiang and Gansu provinces in China by the China Center for Economic Research of Peking University (see Zhao et al., 2009). Zhejiang, located in the developed coastal region, is one of the most dynamic provinces in terms of its fast economic growth, private sector, small-scale industrialization, and export orientation, while Gansu, located in the less developed western region, is one of the poorest, most rural provinces in China. In 2008, Zhejiang had the highest rural and urban incomes per capita after Shanghai and Beijing, and Gansu had the second lowest rural per capita income and fourth lowest urban per capita income.

The sampling design of the 2008 wave of CHARLS was aimed to be representative of residents 45 and older in the two provinces. Within each province, CHARLS randomly selected 13 county level units (rural counties or urban districts) by PPS (Probability Proportional to Size), stratified by regions and urban/rural. Within each county, CHARLS randomly selects 3 village-level units (administrative villages or resident communities) by PPS; within each PSU, CHARLS then randomly selects 25-36 from a complete list of dwelling units generated from a map for each province.¹ Based on this sampling procedure and accounting for age ineligibility and non-response, there were 5-24 households in each community; and 1 or 2 individuals in each household who were interviewed depending on marital status in the household. The total sample size was 2,685 individuals in 1,570 households.

The CHARLS Pilot experience was very positive. As indicated by the data in Table 1, the overall response rate was 85%, 79% in urban areas and 90% in rural areas. The response rate

¹ In situations where more than one age-eligible household lives in a dwelling unit, CHARLS randomly selected one and then determined the number of age-eligible members within a household and then randomly selected one.

was about the same in the two provinces 83.9% in Zhejiang and 85.8% in Gansu. These high response rates reflected the detailed procedures that were put in place to insure a high response to the survey.

Table 1
Sample Size and Response Rate %

	Total	Urban	Rural	Zhejiang	Gansu
Total sampled	2592	1281	1311	1350	1242
Age-eligible rate	69.3	65.1	73.4	71.3	67.2
Response rate*	84.8	79.3	89.7	83.9	85.8
Total Households responded	1570	691	879	831	739

*Response rate is based on the age-eligible households.
See Zhao et al, 2009)

2.1 Measurement in CHARLS- Adult Health

The CHARLS main household questionnaire of the 2008 survey consists of 6 modules, covering demographics, family, health status, health care, employment, household economy (income, consumption and wealth). All data are collected by face-to-face, computer-aided personal interviews (CAPI). Both questionnaire and field procedures were repeatedly tested to ensure high data quality.

In addition to the typical HRS survey content, a detailed community-level questionnaire was formulated. This community questionnaire focuses on important infrastructure available in the community, plus on the availability of health facilities used by the elderly and on prices of goods and services often used by the elderly.

The main adult outcome variables we will examine in this paper include key adult health outcomes, health behaviors, and SES outcomes. Adult health and health behavior variables come from the health module. They are current self-reported general health status, doctor diagnoses of chronic illnesses, depression, word recall, lifestyle and health behaviors (physical activities, smoking, drinking), subjective expectation of mortality, activities of daily living (ADLs), and

instrumental activities of daily living (IADLs). It is worth noting that some health variables, such as weight and height, are obtained from health measurements conducted in the field.

2.2 Measurement in CHARLS- Economic Resources

Unlike existing HRS type surveys, financial dimensions of SES are measured in terms of income, wealth and consumption expenditure. CHARLS also separately measures income and assets at the individual level as well as at the household level. CHARLS income components include wage income, self-employment income, agricultural income, pension income and transfer income, where wage income is collected for each of the household members, and transfer income separates government transfers specific to individuals from those to households.

Asset measurements collected at household level include housing, fixed assets, durables and land. Information on ownership status, value and characteristics of current residence as well as other housing owned by the household are recorded. Deposits and other investments are measured at the individual level, but debts are asked both for respondent and spouse, and for the household.

Household expenditures are collected in CHARLS since the literature has shown that expenditure can be a better welfare measures than income in developing countries. Consumption items are collected at weekly, monthly and yearly frequencies respectively to minimize recall bias. Food expenditure is collected on weekly basis. It includes expenditures on dining out, food bought from market and values of home-produced food consumed. Food expenditures induced by inviting guests for important events are collected to better reflect household food expenditure per capita in a normal week. Monthly-based expenditures are those usually spent each month, including fees for utilities, nannies, communications etc. Yearly-based items record expenditures occurred

occasionally in a year, including traveling, expenditures on durables, and education and training fees.

Table 2 displays mean and median values of income, expenditure, and net assets as revealed by CHARLS respondents. We distinguish between the urban and rural areas of the two sampled provinces. Examining first the more conventional measure of economic status, there are enormous differences in income across and within these geographic units. For example, mean income in urban Zhejiang is almost ten times that of rural Gansu. In both these geographic places, mean incomes are about twice that of median income indicating that there exists substantial income inequality within all regional sub-units as well.

If anything, these disparities are even larger when wealth is used as the economic yardstick. Now mean wealth in urban Zhejiang is forty-five times that in rural Gansu and wealth inequality is substantial in all sub-regions as indicated by the mean-median differences in each place.

Table 2
Per Capita Household Total Income, Expenditure, and Net Wealth Across Regions

	Income		Expenditure		Net Wealth	
	Mean	Median	Mean	Median	Mean	Median
Urban Zhejiang	22336	12200	10677	8258	218605	80600
Rural Zhejiang	10391	6513	7575	5810	63996	29908
Urban Gansu	8557	5367	7549	4641	51043	38900
Rural Gansu	2335	950	3843	2928	7858	3783

Significant differences in amounts of economic resources exist when per capita expenditures are used as the economic metric, but these disparities are far smaller than

those obtained with either income or consumption, which is to be expected because of both greater measurement error in income and wealth and because households tend to smooth their consumption. While differences between urban Zhejiang and rural Gansu in income were ten fold and in consumption were forty-five fold, mean consumption in urban Zhejiang was 2.8 times that of rural Gansu. Especially when comparing urban and rural areas when most of the economic activity in rural activities is not monetized, income and wealth exaggerate the magnitude of the economic disparities.

2.3 Measures of Childhood Health

We index childhood health in this study using two complementary concepts- (1) respondent retrospective summaries of their health during their childhood years and (2) their adult height.

For the first measure, each respondent is asked the following question: “How would you evaluate your health during childhood, up to and including age 15?” The choices offered are excellent, very good, good, fair, and poor. Following the prior practice in PSID and the HRS surveys, this childhood health question in CHARLS s represents a retrospective self-evaluation on a five-point scale (excellent, very good, good, fair, or poor) of the general state of one’s health when one was less than 16 years old.

Smith validated this variable in the context of the US as providing a good summary measure of overall childhood health. In the context of the United States, Smith (2009a) demonstrated that this childhood index was related to the presence of many childhood physical diseases during childhood including respiratory diseases, heart disease, childhood diabetes, headaches and migraines, ear infections, and stomach problems. One component of overall health during childhood that is clearly captured well by this retrospective subjective measure is psychological problems that occurred during the childhood and adolescence years (Smith and Smith, 2010).

Figure 1 shows the distribution of responses to the subjective childhood health question given to CHARLS respondents. Approximately, two in three CHARLS respondents said that their childhood health was either excellent or very good while one in three gave good, fair, or poor as a response. Figure 2 plots the fraction of CHARLS respondents by single year of age who gave a response of either excellent or very good childhood health. While average responses by single year of age are noisy, the overall pattern of response by age is relatively flat.

However, this does not imply that overall childhood health in these two provinces of China remained unchanged over time in spite of the rapid economic development that took place there. First, mortality selection which becomes more and more pronounced at older ages is systematically selecting out those who are less healthy and presumably had less healthy childhoods. Correcting for mortality selection would no doubt impart a negative slope with age (equivalently birth cohort) to Figure 2. Second, as mentioned above, the subjective childhood health summary includes both dimensions of physical illnesses and psychological illness during childhood (Smith and Smith, 2010). While it is reasonable that childhood physical illnesses decline with development, especially those physical illnesses related to nutrition and sanitation in early childhood diseases, that is far less clear with mental illness as children may find the demands of development and the changes associated with it stressful in their lives.

Finally, Figure 3 plots the relationship between childhood health and adult health. For each respondent's age, we plot whether adult health was either excellent or very good for two groups—those whose childhood health was good or more and those whose childhood health was fair or poor. The odds of being in good health as an adult are four times higher if the respondent was in good health as a child.

Adult height has an even longer tradition as a measure of childhood health especially in developing countries. Adult height has been used by economists, historians and nutritionists as a measure of population health (see Fogel, 2004, and Steckel, 1995, 2008, for surveys of the history literature). Mean adult height, particularly in the twentieth century rose in many countries,

including developing countries, as economic development proceeded (see Strauss and Thomas, 1995 and Steckel, 1995 for evidence). Adult height is determined both by childhood height and the adolescent growth spurt. Childhood height is often thought to be largely determined in pre-school ages, particularly before age 3 (Martorell and Habicht, 1985; Habicht, Martorell and Rivera, 1995). Childhood height reflects health generally, not only nutritional intakes and expenditures, but some illnesses, particularly from infectious diseases (Habicht and Martorell, 1986). Consequently, adult height will, in part, reflect these differences in childhood height, and some components of childhood health differences more generally.

Many studies have examined socio-economic determinants of early childhood heights (see Behrman and Deolalikar, 1988; and Strauss and Thomas, 1995 for reviews). Well known studies by Habicht et al. (1974) and Martorell and Habicht (1986) have measured the childhood heights of well-nourished children from many ethnic groups around the world and found that ethnic differences in pre-school child heights are very small in comparison to SES differences. Hence adult heights will reflect in part differences during childhood in SES.

Figure 4 plots the relationship between adult height and age (three year age averages) separately for men and women. While there exists some shrinkage especially at older ages, most of the age pattern in these graphs can be read as indicating cohort effects of improved nutrition associated with development leading to taller adults for both men and women. These effects are not trivial. For men in the thirty years between ages 45 and 75 younger Chinese men born thirty years earlier are on average five centimeters taller. This represents an average increase in adult heights of over 1cm per decade, which is faster than other growth in adult heights in other developing countries over this period (see Strauss and Thomas, 1995). The comparable number for women is an additional six centimeters in height over time. This sharp pattern of height by age is another indication that average height increases in periods of economic development reflecting the better nutrition in early childhood in particular.

2.4 Location and Communities

Respondents in CHARLS are at least forty-five years old, and hence their childhood lives reflect events in China that in part occurred many decades ago. In particular, many of these respondents entered and worked in the labor market before the period of China's rapid economic growth, which among other things generated considerable migration of younger workers particularly to the more economically dynamic provinces. These migratory streams raise the issue of the connection between the current locations of CHARLS respondents to their actual places of residence during their childhood.

Table 3 presents data on the relationship between current location and place at residence at birth. In the CHARLS Pilot, respondents were located in two provinces- Gansu and Zhejiang and in thirty counties and ninety-five communities and villages in those provinces.

Table 3
Location of Birth of CHARLS Respondents

Where were you born?	
Same place	49.3%
Another village in county	39.1%
Another county in province	7.5 %
Another province	4.1%

The mobility portrait that comes from Table 3 is clear. CHARLS respondents who are by design ages forty-five and over were relatively immobile. At the time of the CHARLS interview, half of CHARLS respondents lived in the same community or village in which they were born. Even among those who did migrate after birth, they did

not venture far. Eighty-percent of those who did move lived in another village in the same county. Eighty percent of these migrants were women most likely reflecting moves associated with marriage. Thus, about nine in ten CHARLS respondents are living in the same county in which they were born and less than one in every twenty are living in a different province in which they were born.

3.1 Statistical Models

In this paper, we model the association of our two measures of childhood health- the self-evaluation scale and adult height- on a set of adult health outcomes, health behaviors, and SES. Throughout this paper, we use ordinary least squares for continuous dependent variables and linear probability model (LP) for binary dependent variables. LP model estimates are consistent for estimating average partial effects of the regressors, which is our main interest. Robust standard errors of the regression coefficients are computed that also allow for clustering at the community level. By using robust standard errors for the linear probability regressions, we ensure that these standard error estimates are consistent (Wooldridge, 2002).

Since location dummies are very important to our story, we discuss them next in more detail. In our statistical specification presented in the next section, we will explore several alternative measures of location of respondents. One specification contains dummy variables for province and urban-rural residence defined at the village/community level within province.² Clearly this is a coarse definition of location.

² The rural definition we use in this paper is the State Bureau of Statistics (SBS) definition. Some of the SBS urban communities are in fact rural in nature and many of their populations are farmers with agricultural hukou.

An alternative and much finer definition controls for the PSU, or community in which people live by including community fixed effects. We have one dummy variable for each PSU, minus one of course.³ As noted in the discussion of the sampling above, our PSUs are either administrative villages or urban neighborhoods. These are small areas that are likely to be more homogeneous than cities or counties, or certainly than province. The idea here is that each community has factors that will affect health outcomes that are not captured by the provincial dummies interacted with rural or urban residence. These factors will include but are no means limited to health care prices, inherent healthiness of the area, common environmental forces especially those that impact health, public health infrastructure, local area economic resources, and other factors. F-tests for all combinations of dummy variables are reported as well.

In all models, we included both child health measures but they are typically only weakly correlated so that estimated effects are not sensitive to their simultaneous inclusion. In addition, all models presented in this paper include a set of age dummies that in principle control for age and cohort related variation in the outcome of interest. Our second specification adds controls for province and rural-urban residence while our third specification alternatively includes a set of dummy variables for community of residence. All models are estimated separately for men and women, and where the data indicate that important differences exist, we will present separate models for Gansu and Zhejiang province. Appendix Table 1 presents summary statistics for the variables we use in our analysis.

³ In a few cases there was no variation in the dependent variable among observations within the PSU. In these cases we refined the PSU to be a more aggregate area, usually the county or city.

4.1 Empirical Estimates- Adult Health

Table 4 examines the estimated relationship between our two measures of childhood health- the five point subjective childhood health scale and adult height at the time of the interview- with several alternative dimensions of poor health in adulthood. More specifically, these adult poor health measures include- poor adult health (adult health = poor on the subjective five point scale), being hypertensive (derived from a self-report that you were told by a medical person that you were hypertensive or having a hypertensive reading above 140/90), being an undiagnosed conditional on being hypertensive (above the hypertensive reading and not having been medically diagnosed), the number of Activities of Daily Living⁴ (ADLs), the number of Instrumental Activities of Daily Living⁵ (IADLs) that people report “have difficulty” or “cannot do”, and respondents subjective probability that they will not survive to age 75 (reported chance = “almost impossible” or “not very likely” as against “maybe”, “very likely” and “almost certain”). This health outcome is limited to respondents who were less than 65 years old at the time of the CHARLS Pilot interview.

The most salient pattern in Table 4 by far is that our childhood health measures are more related to this set of adult health outcomes for women than for men. Among women, better childhood health using the subjective childhood health scale as the indicator reduces the prospects of being in poor health as an adult, lowers the number of ADLs, a respondent has problems with as an adult and decreases the probability that one would not survive to age 75. With the exception of lowering the odds of being

⁴ ADLs include difficulty in dressing, bathing and showering, eating, getting in and out of bed, using the toilet and controlling urination and defecation.

⁵ IADLs include difficulties with household chores, preparing hot meals, shopping for groceries, managing money, making phone calls, and taking medications.

undiagnosed and the number of IADLs with problems, the estimated effects are more likely to be statistically significant at conventional levels with the subjective scale measure than with the adult height measure. In general but with some exceptions, these estimated associations of both measures of childhood health are statistically insignificant among men. For both men and women, being taller statistically reduces the number of IADLs respondents have problems with and increases the likelihood of having a doctor diagnosis of hypertension..

Table 5 presents estimates for a subset of these adult health outcomes estimated separately for the two provinces- Gansu and Zhejiang. The statistical power of any analysis conducted by province is necessarily smaller especially when we control for community fixed effects as we do here. The general pattern of adult effects within province are similar to those contained in Table 4- a concentration of the relationship between childhood health and poor adult health within women compared to men. In addition, the results obtained in Table 5 suggest that this association for women is stronger in the lower income growth traditionally agricultural province of Gansu compared to the more high economic growth province of Zhejiang.

4.2 Empirical Estimates- Adult BMI, Depression, and Memory

The next set of adult outcomes we explore relate to factors that are not directly measuring adult health outcomes, but that are closely related to adult health outcomes- BMI, memory, and depression. BMI is measured for each respondent by directly measuring their height and their weight. Direct measurement is preferable since it frees BMI of well-documented measurement error problems using self-reports. In addition to overall levels of BMI, we also model being undernourished ($BMI < 18.5$) and being

overweight (BMI >25). Memory is an average of the immediate word recall of ten words read to the respondent and a two-minute delayed recall of the same words. Depression is derived from a simple count using the CESD-10 set of items.

Our estimated relationships for these adult outcomes with our two childhood health index are presented in Table 6. We begin with the BMI related outcomes- total BMI, being undernourished (BMI < 18.5), and being overweight (BMI > 25). High levels of undernourishment are common and widespread problems in low income countries in their pre-development phase when food is scarce while being overweight and sometimes obese becomes more common as societies grow richer and foods become more calorie intensive. The question we ask in these models is how our childhood health measures are associated with these inter-related BMI outcomes.

Table 6 shows that estimated associations of childhood health with BMI are very strong for men, but very small among women. This is similar to the pattern found with current SES variables and BMI, which is monotonically increasing for men but inverted u-shaped for women; (Strauss et al., forthcoming). Among Chinese men, the childhood health summary measures are positively associated with higher levels of BMI, reducing the probability of being undernourished, while increasing the probability of being overweight. In contrast, these estimated associations are almost non-existent among Chinese women. The only BMI dimension that appears to be related to adult height is being overweight for men and women, an indication that the pounds added in weight are proportionately higher than the meters added in height.

There is a very strong relationship between poor childhood health using the five-point subjective scale and adult depression among Chinese women, but this estimated

relationship is weaker among Chinese men. This result closely parallels that found by Smith and Smith (2010) in the US context where the same retrospective childhood health index strongly predicted adult depression among middle aged and older Americans. This suggests that in evaluating their childhood health CHARLS respondents appear to be taking into account not only their physical health during their childhood years but their mental health as well. Taller Chinese men and women also appear to be less depressed. Depression among Chinese women is very high and rises sharply with age (Strauss et al., forthcoming).

The final outcome examined in Table 6 is memory- the average of the immediate and delayed recall of ten words. Chinese men and women who are taller are estimated to have better memories and the same appears with the subjective child health scale for women but not for men. Since childhood health is related to better childhood nutrition, this may indicate that better childhood nutrition also improves adult memory (see for instance, Miguel and Glewwe, 2008 and Strauss and Thomas, 2008)

Table 7 summarizes the results obtained for these same adult outcomes when the models are estimated separately for the two CHARLS Pilot provinces. The strong male BMI results from Table 6 characterize both provinces although perhaps not surprisingly the under-nourishment effects are stronger in the poor agricultural province of Gansu (and true for women as well) while the over-weight effects are concentrated in the richer more growth oriented Zhejiang. The reduction in depression among Chinese women associated with poor childhood health on the five point scale is true in both of the provinces but is clearly much larger in less economically advantaged Gansu. The female memory effects are also concentrated in Gansu.

4.3 Empirical Estimates- Adult Health Behaviors

We have seen in the previous sections that especially among Chinese women there were statistically strong relationships between their health during childhood and their adult health, and especially among Chinese men their adult BMI. In this section, we address some possible behavioral mechanisms through which these outcomes may evolve. With that in mind, Table 8 examines these relationships using a few common health behaviors as the outcomes in order to understand the possible pathways that may exist in affecting adult health. Neither heavy adult drinking or smoking appear to be related to either measure of childhood health. This is certainly not surprising for women since both alcohol consumption and smoking are extremely rare among Chinese women. These health behaviors are not uncommon among men, but we still find little connection between male childhood health and these health behaviors.

The one adult health behavior that does appear to be related to childhood health is hours per day engaged in moderate and vigorous exercise, and once again effects are quite different for men and women. Taller men and those who self-report in good or excellent health as children are less likely to engage in vigorous or moderate exercise as adults. For women, these effects are not statistically significant for vigorous exercise and the reverse sign on moderate exercise where women in excellent or very good health are actually take part in more hours of moderate exercise.

The last two panels in Table 8 present separate estimates of the moderate exercise models for the two provinces- Zhejiang and Gansu. The disparate male and female effects are clearly concentrated in Zhejiang, the economically dynamic province, and are not statistically significant in Gansu. This may have to do with the nature of work by gender.

As part of their better economic opportunities with rapid economic development in Zhejiang, taller men and men with better childhood health may be active in more financially lucrative occupations that were at the same time much more sedentary than the occupations they would have been engaged in traditional China.

4.4 Empirical Estimates- Economic Outcomes

To this point, we have examined health outcomes and health behaviors that may be related to these health outcomes. In this sub-section, we summarize our results concerning the relationship between our measures of childhood health and the principal economic resource related outcomes that are available in the CHARLS Pilot survey. As explained above, the three main economic outcomes are the logarithms of per capita expenditures (Log pce), income (Log income), and wealth (Log wealth). While all three outcomes capture some element of the economic resources available to the individual, the best overall measure is the Log pce. We also examine the relationships with the level of completed schooling (some primary, completed primary, and junior high school and above).

Using the same format as used for adult health outcomes in Table 4, Table 9 summarizes estimated associations obtained for these three economic outcomes. Once again, separate models were estimated for Chinese men and for Chinese women. Estimated associations for the two provinces separately are available in Table 10.

There are several salient patterns. In general, these adult economic outcomes are more strongly related to adult height than they are to the subjective child health index. Compared to the health related outcomes described above, these economic outcomes are also more sensitive to region-urban controls and particularly to community fixed effects

controls which both tend to weaken estimated effects of either measure of childhood health. In terms of the estimated magnitude of the effects for adult height, the impacts of being taller appear to be positive across all three measures of economic resources and actually are a bit larger for women compared to men.

The final panel in Table 9 examines the estimated associations with years of education completed using order probit models for the four education categories. There is little apparent relationship of the childhood subjective summary index which parallels results obtained by Smith for the United States (Smith, 2009b). However, adult height is strongly related to years of schooling completed. Boys and girls who grow up to be taller also have more schooling than their shorter contemporaries, a result also obtained by Case, Fertig and Paxson (2005) for the United States. Table 10 shows that these effects tend to be stronger in Zhejiang compared to Gansu.

4.5 The SES Health Gradient

In the previous sections of this paper, we have demonstrated that childhood health had subsequent impacts on both adult health and adult SES. These impacts appear to differ a good deal between Chinese men and Chinese women with the impacts being larger for women and the SES impacts greater for men. A natural question then is how childhood health affects the SES health gradient since both SES and health are included. To address that question, Figure 5 displays the adult health gradient using self-reported adult health status arrayed against yearly per capita expenditures (PCE). This variant of the SES health gradient is stratified by whether your childhood health was good or bad. Since our earlier analyses indicated different effects for men and women, we present these gradients in Figure 6 for men and women separately.

For both men and women, individuals who are in poor health as adults and were also in poor health as children have lower PCE than those in poor health as adults but not in poor health as children. This makes sense as the first situation implies a longer time spent in poor health which would presumably have negative consequences for adult PCE. On the top end of the gradient, being in poor health as a child appears to have negative consequences for PCE even if one was able to achieve very good health or more as an adult. However, this appears to be the case for women but not for men.

5. Conclusions

In this paper, we studied the consequences of childhood health on adult health and adult SES outcomes in China using a new sample of middle aged and older Chinese respondents. Modeled after the American HRS, the CHARLS Pilot survey respondents are forty-five years and older in two quite geographically and economically distinct provinces- Zhejiang a high growth industrialized province on the East Coast and Gansu, a largely agricultural and poor province in the West. Our work on childhood health in CHARLS relied on two complimentary measures that proxy for different dimensions of health during the childhood years. The first is a retrospective self-evaluation using a standard five-point scale (excellent, very good, good, fair, or poor) of the general state of health when one was less than 16 years old. The second is adult height thought to be a good measure of levels of nutrition during early childhood and the prenatal period. We related both these childhood health measures to adult health and SES outcomes during the adult years. We find strong effects of childhood health on adult health outcomes particularly among Chinese women and strong effects on adult BMI particularly for Chinese men. Turning to the best measure of economic resources available to the family

Log pce, we find strong associations of adult height for both men and women with Log pce.

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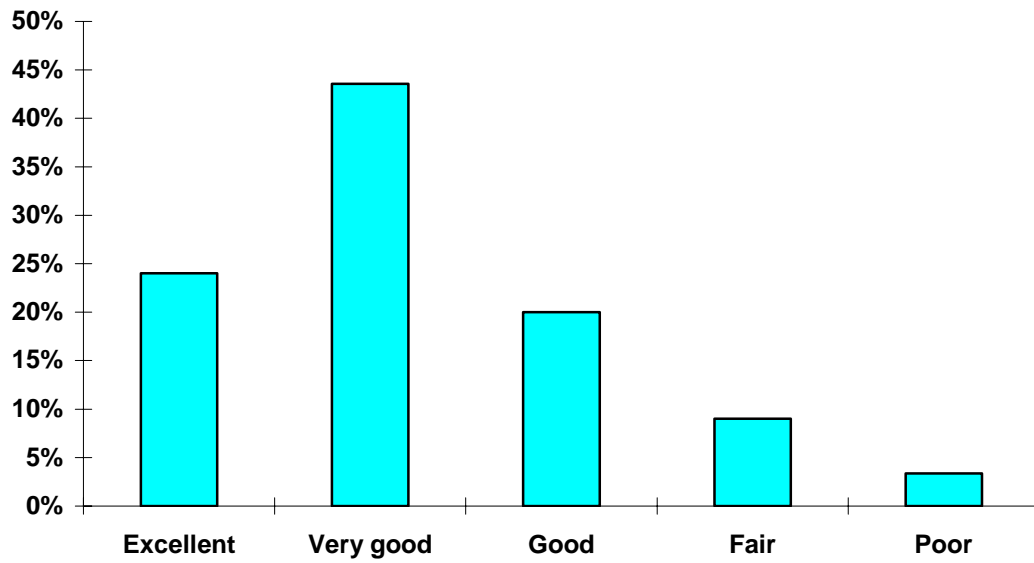
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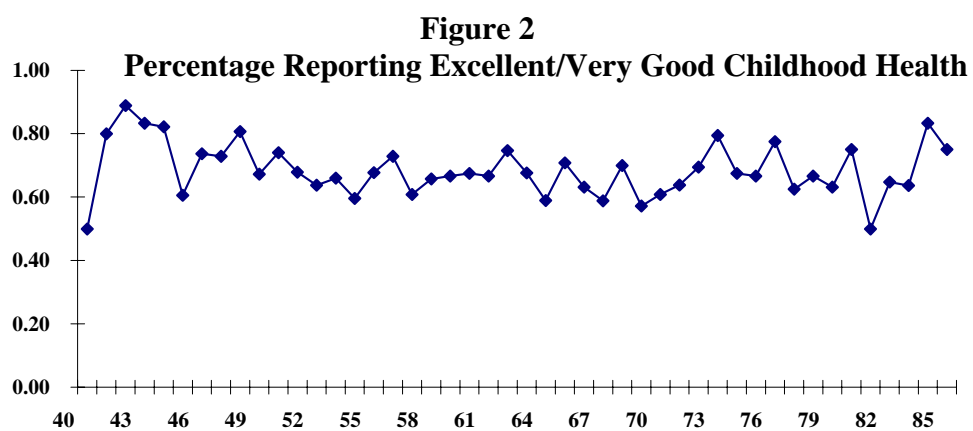
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Figure 1

Self-Reported Childhood Health of CHARLS Respondents



Source- CHARLS Pilot Data



Source – CHARLS Pilot Data

Figure 3

Adult Health by Child Health in CHARLS Pilot

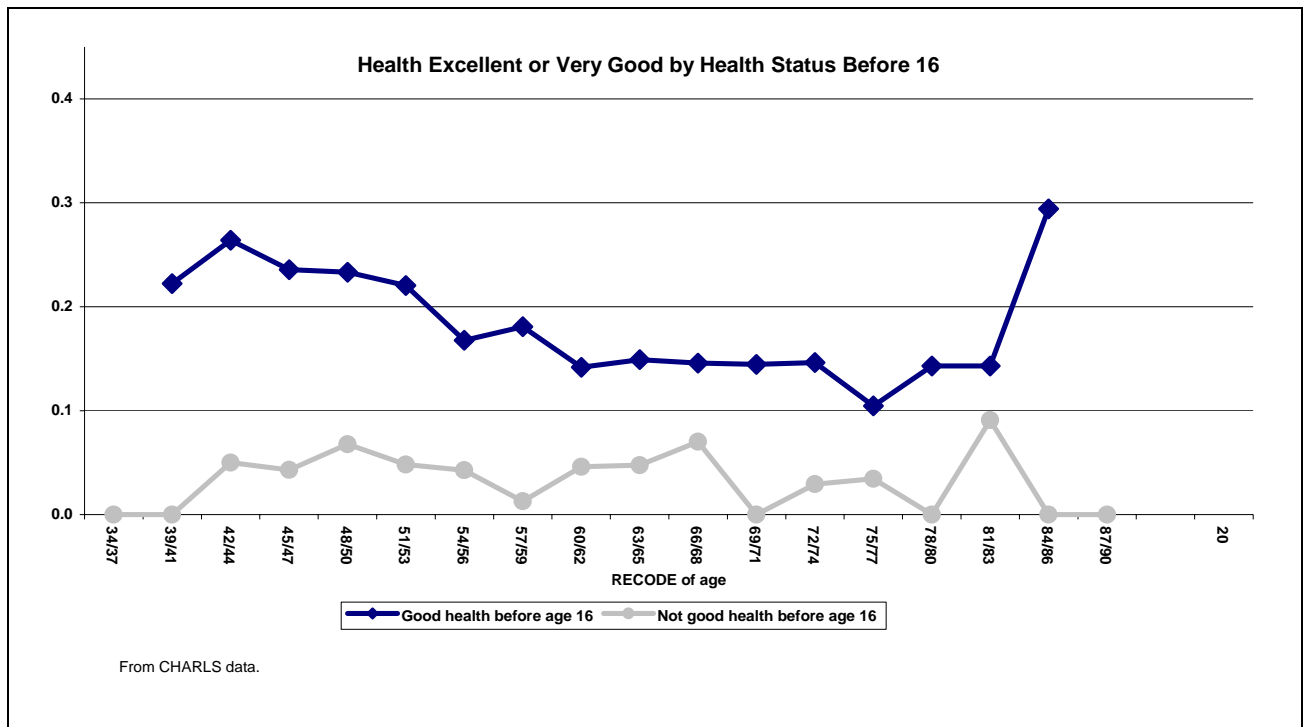
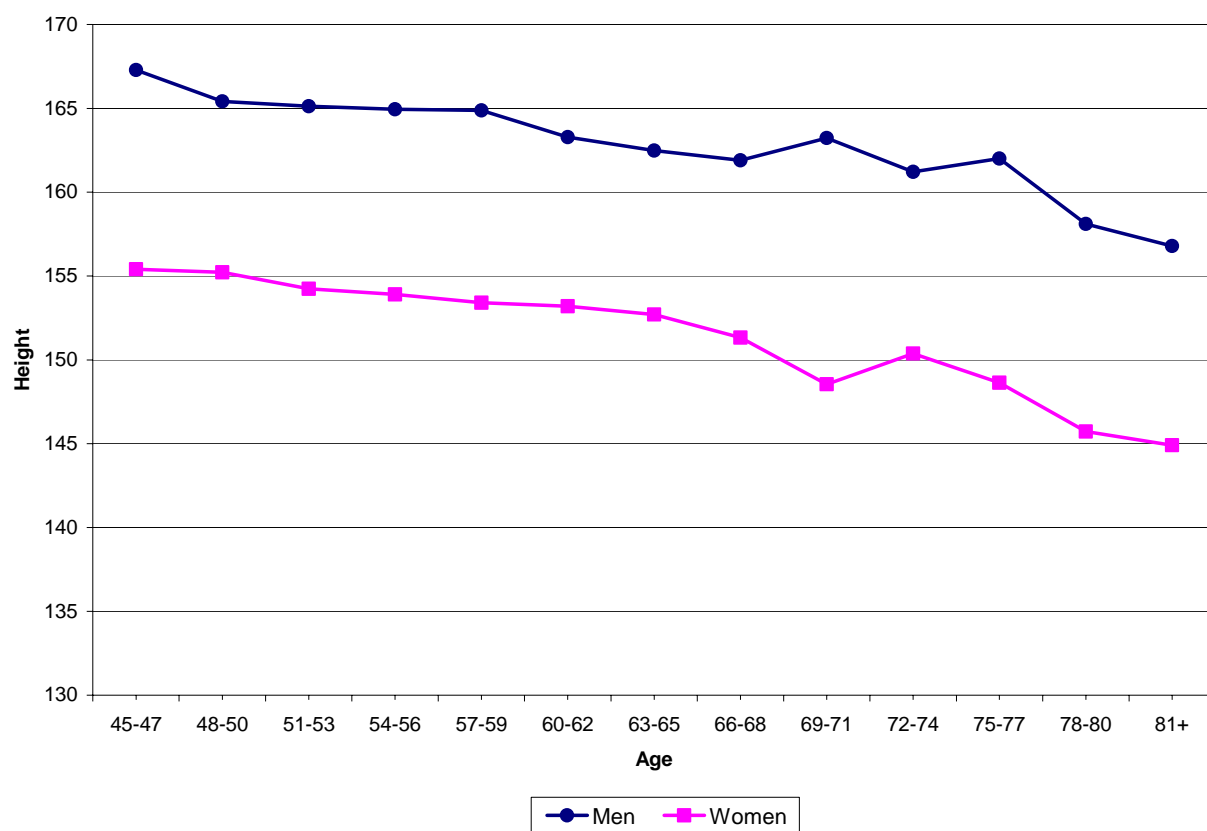
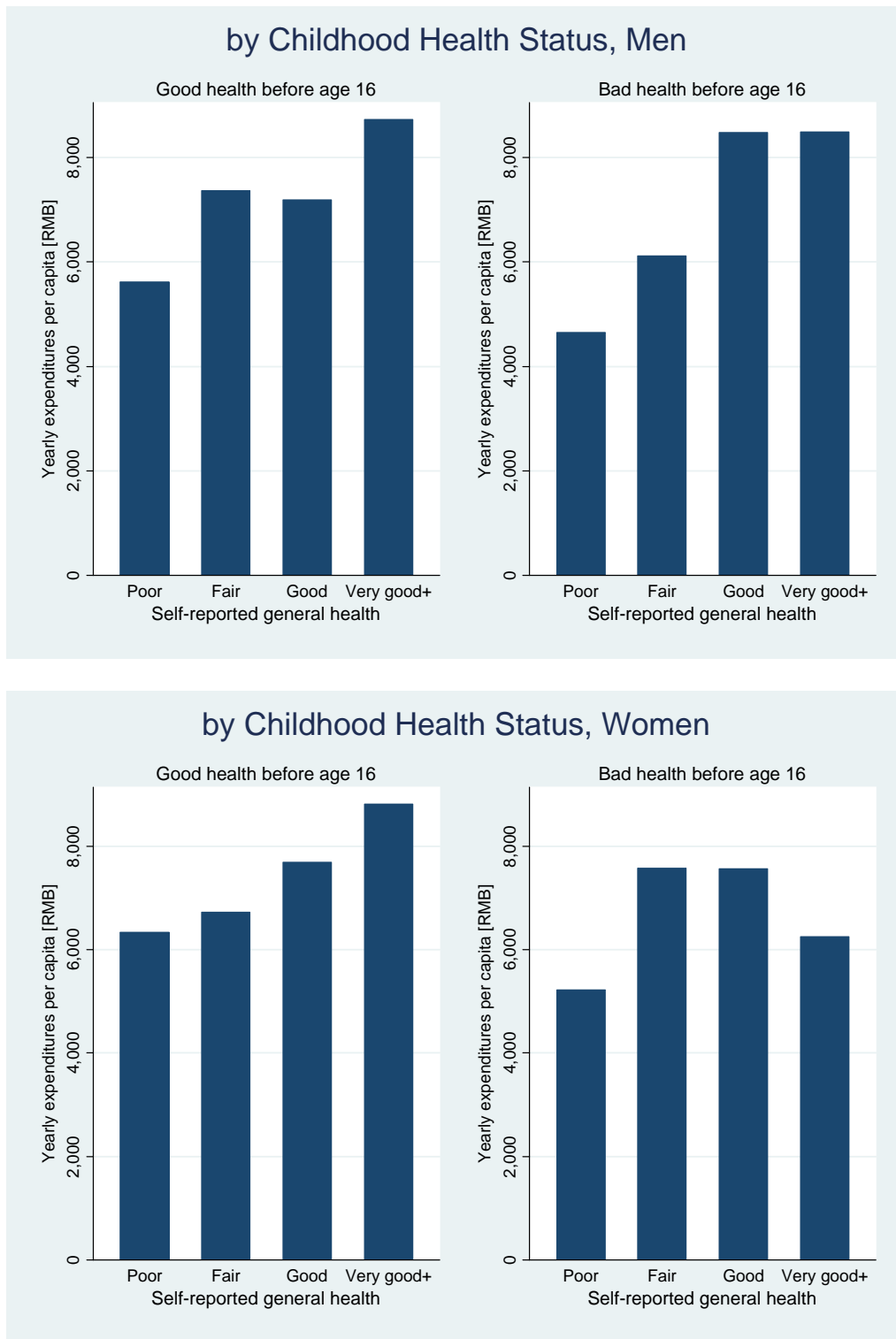


Figure 4
Adult Height by Age



Source –CHARLS Pilot Data

Figure 5
Adult Health/PCE by Childhood Health



Source- CHARLS Pilot Data

Table 4
Estimates of Measures of Childhood Health on Health Outcomes
(Robust standard errors in parenthesis below estimated coefficients)

	Men			Women		
	(1)	(2)	(3)	(1)	(2)	(3)
Poor Adult Health						
“Excellent” or “V good” child health	-0.046 (0.032)	-0.033 (0.031)	-0.033 (0.032)	-0.129*** (0.033)	-0.113*** (0.031)	-0.119*** (0.030)
height (cm)	-0.002 (0.003)	-0.003 (0.003)	-0.002 (0.003)	-0.004 (0.003)	-0.002 (0.003)	-0.001 (0.003)
Hypertensive						
“Excellent” or “V good” child health	0.058* (0.030)	0.059* (0.031)	0.050 (0.032)	-0.006 (0.042)	-0.007 (0.042)	-0.015 (0.046)
height (cm)	-0.001 (0.002)	-0.001 (0.003)	-0.002 (0.003)	0.006** (0.003)	0.006* (0.003)	0.002 (0.003)
Undiagnosed hypertension						
“Excellent” or “V good” child health	0.023 (0.054)	0.035 (0.054)	0.026 (0.059)	-0.048 (0.057)	-0.029 (0.054)	-0.047 (0.061)
height (cm)	-0.012*** (0.004)	-0.012*** (0.004)	-0.012*** (0.004)	-0.011** (0.004)	-0.010** (0.004)	-0.004 (0.004)
ADLs						
“Excellent” or “V good” child health	-0.000 (0.039)	0.018 (0.038)	0.012 (0.038)	-0.138** (0.056)	-0.123** (0.054)	-0.134** (0.059)
height (cm)	-0.004 (0.005)	-0.005 (0.005)	-0.005 (0.005)	-0.001 (0.004)	0.000 (0.004)	-0.001 (0.004)
IADLs						
“Excellent” or “V good” child health	-0.037 (0.069)	0.013 (0.064)	0.017 (0.061)	-0.147 (0.116)	-0.062 (0.097)	-0.066 (0.103)
height (cm)	-0.014** (0.006)	-0.016*** (0.006)	-0.015** (0.007)	-0.025*** (0.008)	-0.019*** (0.005)	-0.018*** (0.006)
Not very likely or almost impossible to survive to age 75^a						
“Excellent” or “V good” child health	-0.075* (0.038)	-0.038 (0.036)	-0.033 (0.035)	-0.126*** (0.044)	-0.096** (0.037)	-0.083** (0.038)
height (cm)	-0.002 (0.003)	-0.004 (0.003)	-0.002 (0.003)	-0.001 (0.003)	0.002 (0.003)	0.001 (0.003)

Model (1) has controls for age group dummies only. Model (2) adds controls for urban-rural residence and province residence. Model (3) adds dummy variables for all communities.

a. for respondents less than age 65.

*** is statistically significant at one percent level; ** is statistically significant at five percent level; * is statistically significant at ten percent level.

Table 5
Estimates of Measures of Childhood Health on Health Outcomes
(Robust standard errors in parenthesis below estimated coefficients)

	Men		Women	
	Zhejiang	Gansu	Zhejiang	Gansu
Poor adult health				
“Excellent” or “V good” child health	-0.000 (0.037)	-0.072 (0.053)	-0.133*** (0.039)	-0.098** (0.047)
height (cm)	0.001 (0.003)	-0.005 (0.004)	-0.004 (0.003)	0.003 (0.005)
ADLs				
“Excellent” or “V good” child health	0.012 (0.025)	0.010 (0.073)	-0.025 (0.040)	-0.285** (0.117)
height (cm)	-0.006 (0.005)	-0.005 (0.009)	0.001 (0.003)	-0.002 (0.009)
IADLs				
“Excellent” or “V good” child health	0.018 (0.048)	0.021 (0.123)	0.087 (0.070)	-0.323 (0.209)
height (cm)	-0.014*** (0.005)	-0.019 (0.013)	-0.008* (0.004)	-0.034*** (0.011)
Not very likely or almost impossible to survive to age 75^a				
“Excellent” or “V good” child health	-0.004 (0.031)	-0.067 (0.068)	0.017 (0.044)	-0.211*** (0.058)
height (cm)	-0.001 (0.003)	-0.005 (0.007)	0.002 (0.003)	-0.001 (0.006)

a. for respondents less than age 65.

*** is statistically significant at one percent level; ** is statistically significant at five percent level; * is statistically significant at ten percent level. Community fixed effects are included.

Table 6
Estimates of Measures of Childhood Health on BMI, Memory, and Depression
(Robust standard errors in parenthesis below estimated coefficients)

	Men			Women		
	(1)	(2)	(3)	(1)	(2)	(3)
BMI						
“Excellent” or “V good” child health	0.898*** (0.207)	0.855*** (0.208)	0.929*** (0.197)	-0.021 (0.238)	-0.046 (0.238)	-0.003 (0.255)
height (cm)	0.024 (0.015)	0.019 (0.014)	-0.007 (0.017)	0.034 (0.022)	0.027 (0.022)	0.003 (0.024)
Undernourished (BMI < 18.5)						
“Excellent” or “V good” child health	-0.048** (0.020)	-0.046** (0.019)	-0.046** (0.019)	-0.016 (0.018)	-0.013 (0.017)	-0.005 (0.019)
height (cm)	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)	-0.000 (0.002)	0.001 (0.002)	0.001 (0.002)
Overweight (BMI > 25)						
“Excellent” or “V good” child health	0.063** (0.025)	0.059** (0.025)	0.059** (0.025)	-0.023 (0.029)	-0.025 (0.030)	-0.039 (0.033)
height (cm)	0.005** (0.002)	0.005** (0.002)	0.005** (0.002)	0.007** (0.003)	0.006** (0.003)	0.003 (0.003)
Depression—CESD						
“Excellent” or “V good” child health	-0.756* (0.422)	-0.419 (0.391)	-0.395 (0.386)	-1.554*** (0.509)	-1.290*** (0.461)	- (0.437)
height (cm)	-0.062* (0.035)	-0.077** (0.032)	-0.079** (0.034)	-0.098** (0.047)	-0.076* (0.038)	-0.034 (0.040)
Memory						
“Excellent” or “V good” child health	0.029 (0.136)	0.028 (0.131)	0.037 (0.133)	0.178 (0.131)	0.169 (0.123)	0.246* (0.128)
Height (cm)	0.034*** (0.012)	0.031** (0.012)	0.029** (0.011)	0.043*** (0.012)	0.037*** (0.011)	0.030** (0.013)

Model (1) has controls for age group dummies only. Model (2) adds controls for urban-rural residence and province residence. Model (3) adds dummy variables for all communities.

*** is statistically significant at one percent level; ** is statistically significant at five percent level; * is statistically significant at ten percent level.

Table 7
Estimates of Measures of Childhood Health on BMI, Memory, and Depression by Province
of Residence
(Robust standard errors in parenthesis below estimated coefficients)

	Men		Women	
	Zhejiang	Gansu	Zhejiang	Gansu
BMI				
“Excellent” or “V good” child health	0.887*** (0.282)	1.003*** (0.281)	-0.305 (0.326)	0.0331 (0.390)
height (cm)	0.002 (0.023)	-0.017 (0.027)	-0.012 (0.034)	0.023 (0.031)
Undernourished (BMI < 18.5)				
“Excellent” or “V good” child health	-0.031 (0.020)	-0.064* (0.032)	0.049** (0.023)	-0.060** (0.027)
height (cm)	0.001 (0.001)	-0.000 (0.002)	0.004* (0.002)	-0.003 (0.002)
Overweight (BMI > 25)				
“Excellent” or “V good” child health	0.073** (0.033)	0.049 (0.035)	-0.063 (0.041)	-0.014 (0.053)
height (cm)	0.005 (0.003)	0.001 (0.003)	0.004 (0.004)	0.002 (0.005)
Depression—CESD				
“Excellent” or “V good” child health	-0.136 (0.376)	-0.716 (0.671)	-0.916** (0.394)	-2.538*** (0.893)
height (cm)	-0.043 (0.039)	-0.111** (0.054)	-0.043 (0.042)	-0.023 (0.082)
Memory				
“Excellent” or “V good” child health	0.040 (0.194)	0.045 (0.182)	0.031 (0.163)	0.491** (0.188)
height (cm)	0.019 (0.017)	0.036** (0.015)	0.029* (0.016)	0.032 (0.021)

*** is statistically significant at one percent level; ** is statistically significant at five percent level; * is statistically significant at ten percent level. Community fixed effects are included.

Table 8
Estimates of Measures of Childhood Health on Health Behaviors
(Robust standard errors in parenthesis below estimated coefficients)

	Men			Women		
	(1)	(2)	(3)	(1)	(2)	(3)
Ever smoked						
“Excellent” or “V good” child health	0.028 (0.036)	0.019 (0.036)	0.014 (0.035)	0.002 (0.012)	0.002 (0.012)	0.003 (0.012)
height (cm)	0.003 (0.002)	0.004* (0.002)	0.004* (0.002)	-0.000 (0.001)	-0.000 (0.001)	-0.000 (0.001)
Drinking						
“Excellent” or “V good” child health	0.063 (0.039)	0.045 (0.038)	0.049 (0.039)	-0.004 (0.024)	-0.008 (0.023)	0.019 (0.022)
height (cm)	0.002 (0.003)	0.003 (0.003)	0.003 (0.003)	-0.000 (0.002)	-0.000 (0.002)	-0.001 (0.002)
Hours of vigorous exercise						
“Excellent” or “V good” child health	-0.433* (0.236)	-0.358 (0.231)	-0.372 (0.225)	-0.117 (0.181)	-0.004 (0.176)	-0.115 (0.175)
height (cm)	-0.035** (0.014)	-0.030** (0.015)	-0.021 (0.016)	-0.014 (0.016)	0.001 (0.015)	0.011 (0.014)
Hours of moderate exercise						
“Excellent” or “V good” child health	-0.387** (0.165)	-0.343** (0.169)	-0.395** (0.183)	0.434** (0.176)	0.495*** (0.172)	0.425** (0.173)
height (cm)	-0.028** (0.014)	-0.027* (0.014)	-0.016 (0.015)	-0.008 (0.018)	-0.002 (0.018)	-0.005 (0.018)
Hours of moderate exercise—Gansu						
“Excellent” or “V good” child health	-0.045 (0.224)	-0.041 (0.230)	-0.192 (0.272)	0.413 (0.296)	0.443 (0.296)	0.287 (0.306)
height (cm)	-0.032 (0.022)	-0.027 (0.023)	0.001 (0.021)	-0.019 (0.029)	-0.011 (0.029)	0.026 (0.028)
Hours of moderate exercise—Zhejiang						
“Excellent” or “V good” child health	-0.635** (0.244)	-0.658*** (0.245)	-0.608** (0.250)	0.501** (0.205)	0.520** (0.202)	0.543*** (0.195)
height (cm)	-0.031* (0.018)	-0.027 (0.018)	-0.032 (0.020)	0.001 (0.023)	0.005 (0.022)	-0.028 (0.020)

Model (1) has controls for age group dummies only. Model (2) adds controls for urban-rural residence and province residence. Model (3) adds dummy variables for all communities.

*** is statistically significant at one percent level; ** is statistically significant at five percent level; * is statistically significant at ten percent level.

Table 9
Estimates of Measures of Childhood Health on Economic Outcomes
(Standard errors in parenthesis below estimated coefficients)

	Men			Women		
	(1)	(2)	(3)	(1)	(2)	(3)
Log PCE						
“Excellent” or “V good” child health	0.145** (0.068)	0.087 (0.073)	0.072 (0.094)	-0.009 (0.078)	-0.056 (0.071)	-0.035 (0.077)
height (cm)	0.014*** (0.005)	0.015*** (0.004)	0.009* (0.005)	0.025*** (0.009)	0.019** (0.008)	0.012 (0.008)
Log income						
“Excellent” or “V good” child health	0.058 (0.169)	-0.085 (0.164)	-0.120 (0.165)	0.213 (0.166)	0.094 (0.159)	0.064 (0.171)
height (cm)	0.040*** (0.014)	0.043*** (0.013)	0.026* (0.014)	0.049*** (0.016)	0.036** (0.015)	0.019 (0.014)
Log wealth						
“Excellent” or “V good” child health	0.353 (0.238)	0.163 (0.213)	0.211 (0.241)	0.224 (0.248)	0.050 (0.225)	0.140 (0.241)
height (cm)	0.027* (0.014)	0.032** (0.015)	0.027* (0.014)	0.072*** (0.019)	0.054*** (0.018)	0.032 (0.021)
Education (ordered probit)						
“Excellent” or “V good” child health	-0.144 (0.089)	-0.137 (0.091)	-0.148 (0.099)	-0.063 (0.087)	-0.105 (0.087)	-0.008 (0.100)
height (cm)	0.028*** (0.006)	0.026*** (0.006)	0.025*** (0.006)	0.032*** (0.008)	0.026*** (0.008)	0.019** (0.008)

Model (1) has controls for age group dummies only. Model (2) adds controls for urban-rural residence and province residence. Model (3) adds dummy variables for all communities.

*** is statistically significant at one percent level; ** is statistically significant at five percent level; * is statistically significant at ten percent level.

Table 10
Estimates of Measures of Childhood Health on Economic Outcomes by Province
(Standard errors in parenthesis below estimated coefficients)

	Men		Women	
	Zhejiang	Gansu	Zhejiang	Gansu
Log PCE				
“Excellent” or “V good” child health	0.184*	-0.047	-0.038	-0.033
	(0.094)	(0.169)	(0.078)	(0.144)
height (cm)	0.012**	0.006	0.005	0.022
	(0.005)	(0.009)	(0.010)	(0.014)
Log income				
“Excellent” or “V good” child health	-0.073	-0.171	-0.038	-0.047
	(0.187)	(0.286)	(0.078)	(0.308)
height (cm)	0.024	0.027	0.005	0.032
	(0.019)	(0.022)	(0.010)	(0.027)
Log wealth				
“Excellent” or “V good” child health	0.391	0.038	-0.037	0.311
	(0.318)	(0.366)	(0.332)	(0.371)
height (cm)	0.036*	0.017	0.057**	-0.005
	(0.018)	(0.021)	(0.021)	(0.039)
Education (ordered probit)				
“Excellent” or “V good” child health	-0.155	-0.153	-0.018	0.051
	(0.130)	(0.151)	(0.126)	(0.168)
height (cm)	0.019**	0.029***	0.011	0.032**
	(0.009)	(0.008)	(0.010)	(0.014)

*** is statistically significant at one percent level; ** is statistically significant at five percent level; * is statistically significant at ten percent level. Community fixed effects are included.

Table A.1. Summary sample statistics for all the variables

	Men			Women			All		
	Mean	SD	N	Mean	SD	N	Mean	SD	N
Aged 45-54	0.37	(0.48)	878	0.42	(0.49)	870	0.39	(0.49)	1748
Aged 55-64	0.35	(0.48)	878	0.33	(0.47)	870	0.34	(0.47)	1748
Aged 65-74	0.22	(0.41)	878	0.18	(0.38)	870	0.20	(0.40)	1748
Aged 75+	0.07	(0.25)	878	0.08	(0.27)	870	0.07	(0.26)	1748
Illiterate	0.25	(0.43)	878	0.62	(0.48)	870	0.44	(0.50)	1748
Can read or write	0.24	(0.43)	878	0.16	(0.36)	870	0.20	(0.40)	1748
Finished primary	0.25	(0.43)	878	0.11	(0.31)	870	0.18	(0.38)	1748
Middle school and above	0.26	(0.44)	878	0.11	(0.31)	870	0.18	(0.39)	1748
Rual	0.60	(0.49)	878	0.55	(0.50)	870	0.57	(0.49)	1748
Gansu	0.46	(0.50)	878	0.44	(0.50)	870	0.45	(0.50)	1748
Ln PCE	8.44	(0.98)	878	8.38	(1.13)	870	8.41	(1.06)	1748
Ln income	7.91	(2.32)	878	7.90	(2.30)	870	7.91	(2.31)	1748
Ln wealth	8.86	(3.17)	878	8.77	(3.26)	870	8.82	(3.21)	1748
"Excellent" or "Very good" child health	0.69	(0.46)	878	0.65	(0.48)	870	0.67	(0.47)	1748
Height (cm)	164.1	(6.7)	878	153.0	(6.1)	870	158.6	(8.5)	1748
Poor adult health	0.23	(0.42)	876	0.32	(0.47)	868	0.27	(0.45)	1744
Hypertensive	0.38	(0.49)	878	0.49	(0.50)	869	0.44	(0.50)	1747
Undiagnosed hypertension	0.50	(0.50)	348	0.42	(0.49)	444	0.45	(0.50)	792
ADLs	0.14	(0.54)	870	0.20	(0.65)	863	0.17	(0.60)	1733
IADLs	0.35	(0.89)	809	0.74	(1.29)	788	0.54	(1.12)	1597
Prob not survive to age 75	0.26	(0.44)	582	0.29	(0.45)	596	0.27	(0.45)	1178
BMI	22.3	(3.0)	878	23.6	(3.6)	869	22.9	(3.4)	1747
Undernourished (BMI<18.5)	0.06	(0.25)	878	0.07	(0.26)	869	0.07	(0.25)	1747
Overweight (BMI>25)	0.19	(0.39)	878	0.33	(0.47)	869	0.26	(0.44)	1747
Depression - CESD	7.50	(5.82)	789	8.76	(6.26)	723	8.10	(6.07)	1512
Memory	3.50	(1.71)	713	3.26	(1.78)	632	3.38	(1.75)	1345
Ever smoked	0.67	(0.47)	878	0.02	(0.15)	870	0.35	(0.48)	1748
Heavy drinker	0.19	(0.39)	875	0.02	(0.15)	869	0.11	(0.31)	1744
Vigorous exercise (hours/day)	2.77	(3.07)	875	1.37	(2.53)	868	2.07	(2.90)	1743
Moderate exercise (hours/day)	2.45	(2.70)	869	2.55	(2.67)	856	2.50	(2.69)	1725

Note: for each variable, the sample is restricted to observations who take nonmissing values in childhood health, height and that variable.