Relative-deprivation effects on child health in China

Yu Sun, Virginia Tech, ruthsun@vt.edu
Wen You, Virginia Tech, wenyou@vt.edu

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1. Introduction

China has reached the fastest rate of growth in economy since the implementation of reform and become the world’s second largest economy (Prasad 2015). Despite the past three decades of sustained economic growth, it lags behind other countries on many health indicators. For instance, its total health spending is only 5.6% of GDP, which is less than 10.3% in Japan and 17.1% in the U.S. (World Health Organization, 2013). Its health system ranks 144 among a total of 190 countries according to World Health Organization Ranking (World Health Organization, 2000). Its mortality rate in 2013 was 11 per 1000 live births which is still much higher than the 2 in Japan and 6 in the U.S. (The World Bank, 2014). In 2011, 6.9 million children under the age of five died in the world. Almost 60% of these under-five deaths occurred in China alone (World Health Organization). Meantime, childhood obesity, psychological and behavioral problems are becoming increasingly prominent as well as major threats to child health like preterm birth and low birth weight, childhood obesity and injuries in China (World Health Organization). Improvement in health fails to accompany the massive growth in material living standards for the Chinese population.

One potential explanation for the unfavorable development in health in a fast-growing economy is the income inequality hypothesis (Fuchs 1974, Wilkinson 1997a, 2002, Li and Zhu 2006, Wilkinson and Pickett 2006). China is a representative case for study because it has experienced rising income inequality and widening socioeconomic differences (Chen and Fleisher 1996, Kanbur and Zhang 2005, Liu, Dow et al. 2008). Through the transition after the big leap in economy, the distribution of wealth in China is a highly skewed one for more inequality (Xie and Jin 2015). The Gini index of income inequality skyrocketed from 0.28 in 1990s to 0.47 in 2014, with highest estimate of 0.49 in 2008 (Brockmann, Delhey et al. 2009, Statistics. 2014). They were above the warning level of 0.4 set by the United Nations, indicating that the gap between the rich and the poor is serious and urgent need for income distribution reform to narrow the wealth gap (Statistics. 2014). Income inequality has been evidenced to be linked to poorer health
status by previous studies (Fuchs 1974, Kennedy, Kawachi et al. 1996, Daly, Duncan et al. 1998, Subramanian and Kawachi 2004, Wilkinson and Pickett 2006, Preston 2013). For example, Wilkinson finds a strong and large correlation between the income inequality and life expectancies. He argues that inequality itself has hazardous effect on health (Wilkinson 1997b). Li et.al. found that high inequality in a community poses hazards to health using survey data from China (Li and Zhu 2006). One mechanism underlying the relation between income inequality and health is the negative psychosocial effects of relative deprivation (Wilkinson 1997b). The hypothesis states that an individual is adversely affected when he/she feels economically deprived as compared to peers in his/her reference group, suggesting that a person's health is a function of his own income as well as the incomes of others (Eibner and Evans 2001). A number of empirical studies have found relative deprivation to be an important predictor of health outcomes in developed countries (Stafford and Marmot 2003, Yngwe, Fritzell et al. 2003, Subramanyam, Kawachi et al. 2009). In addition, emerging studies have attempted to identify the relation between relative deprivation and health outcomes in developing economies (Cojocaru 2016), and several studies have focused on the effects in China (Li and Zhu 2006, Chen and Meltzer 2008, Ling 2009, Kuo and Chiang 2013, Jin and Tam 2015).

While several studies have investigated the association between relative deprivation and child health (Turley 2002, Lhila and Simon 2010, Elgar, McKinnon et al. 2015, Elgar, Xie et al. 2016), we are not aware of any research studying this relationship in China. Understanding whether and how relative deprivation affect child health may provide valuable information for designing proper policies and treatments. This study aims to investigate the link between relative deprivation and health outcome among children in China using data collected from China Health and Nutrition Survey. We hypothesize that being relatively deprived has an adverse effect on children’s health in China. The structure of this study is as follows: Section 2 presents a literature review of relative deprivation and health. Section 3 summarizes the relative deprivation measurement issues used in current literature and describes our methods of measures.
Section 4 describes the mechanisms to select reference groups. Section 6 reports the estimation results. Section 7 discusses the results and policy implications.

2. Relative Deprivation and Health

Absolute income hypothesis posits that higher income leads to better health outcomes. Some early evidence have showed that higher incomes protect health. Kitigawa et al., for example, found that white males with higher incomes were less likely to die than those with lower incomes (Kitagawa and Hauser 1973). Rogot et al. found that people aged 25 or older with family income less than $5000 were more likely to have lower life expectancy than those with family income of more than $50000 (Rogot, Sorlie et al. 1992). However, absolute income hypothesis could not explain why American mortality rate was higher than many poorer countries despite the United States was much richer in absolute income level (Wilkinson 1997a). Also, Wilkinson found that absolute income levels are no longer vital to mortality in the United States because the correlation coefficient for the association between mortality and median income level dropped to -0.06 when distribution of income within each stated was controlled for (Wilkinson 1997b). Hence, Wilkinson pointed out that income distribution played an important role in health inequality (Wilkinson 1992b, a, 1997a). Kaplan reported that income inequality was significantly associated with mortalities, rate of low birth weight and sedentary activities (Kaplan, Pamuk et al. 1996). Several mechanisms have been proposed to explain the link between income inequality and health, including disinvestment in human capital, erosion of social capital and social comparison (Kawachi and Kennedy 1999). Social comparison indicates that health is affected by social comparison through direct psychosocial effects, which is known as relative deprivation hypothesis.

The relative income and relative deprivation hypothesis are two different names for the same hypothesis. This idea was first perceived by economists centuries ago. Adam Smith (1776) pointed out that people who failed to consume in accordance to a reference group's normative consumption level might feel shameful and socially disgraceful. Stouffer et al. maintained that feelings of relatively deprived were formed when soldiers
compare themselves with those who have different opportunities for promotion (Stouffer, Suchman et al. 1949). The relative deprivation hypothesis was rooted in the fact that people compare themselves with other individuals (Runciman 1966) or their circumstances in relation to a set of objective circumstances (Townsend 1979).

There is considerable evidence for the impact of relative deprivation on health outcomes for adults in developed countries and empirical results were mixed among studies using different surveys. Self-reported/self-assessed health is a common measure for individual health status and is often reported to be negatively relate to relative deprivation. Most of these studies use cross-sectional data on different samples, such as a Dutch cohort of 15-74 years old people (Stronks, van de Mheen et al. 1998), a sample of 25-46 years adults from the Swedish Survey of Living (Yngwe, Fritzell et al. 2003), a sample of individuals aged 25-64 (Kondo, Kawachi et al. 2008) and persons aged 18 or more living in the U.S. (Subramanyam, Kawachi et al. 2009). Jones et al. used a panel data including 11 waves of data from the British Household Panel Survey and provided evidence in favor of a negative association between relative deprivation and self-assessed health (Jones and Wildman 2008). Eibner and Evans found that high relative deprivation was associated with poor self-reported health as well as higher probability of death and high blood pressure or disabilities using data from National Health Interview Survey. They also found relative deprivation was linked to a host of poor health habits, such as smoking, not wearing safety belts, high body mass index and little exercising (Eibner and Evans 2001). While other studies reported positive or no effect of relative deprivation on health outcomes. For example, Deaton et al found a protective effect of income inequality on mortality by investigating Current Population Survey from 1975 to 1995 (Deaton and Paxson 2001). Mellor et al. find little support for the relative deprivation effect on health using Current Population Survey (CPS) (Mellor and Milyo 2003).

Several studies began to extend the research of relative deprivation to developing countries. Cojocaru investigated that if relative deprivation determined well-being using data from The United Nations Development Program in six countries and reported that relative deprivation had a strong negative effect on subjective satisfaction (Cojocaru 2016). Chen et al. found that relative income was related to obesity and hypertension
among rural adults aged 20 and older in the China Health and Nutrition Surveys (Chen and Meltzer 2008). Ling used the same survey but found that an increase in relative deprivation level reduced the probability of being overweight for older adults in China. The results also indicated that those less relatively deprived were not necessarily healthier than those more relatively deprived (Ling 2009).

Very limited research have studied the relationship between relative deprivation and health outcomes among children. Drukker et al. also found that socioeconomic deprivation was associated with children’s general health and satisfaction (Drukker, Kaplan et al. 2003). Lhila investigated that if a mother’s relative deprivation was related to infant health and reported that pregnant women with lower socioeconomic status gave birth to slightly lighter babies (Lhila and Simon 2010). Charlton et al have proved that adolescents who live in more deprived neighborhoods tend to be inactive (Charlton, Gravenor et al. 2014). Elgar et al. used data on 11-15-year adolescents to find that having better off schoolmates can contribute to poorer health behaviors (Elgar, Xie et al. 2016). Also, neighborhood poverty and socio-economic deprivation have been reported to have negative effects on children’s mental health (Kalff, Kroes et al. 2001). However, the health outcomes of relative deprivation among children has not been thoroughly studied in China.

Several critics have been raised about the conflicting results among existing literature. Concerns include lack of individual-level data, omission of important variables and selection bias. Aggregate data may suffer spurious correlation problem. When aggregate-level study revealed a positive relationship between inequality and mortality, the individual-level study may not show a relationship between the two (Gravelle 1998). Omission of important variables is mainly due to lack of data on socioeconomic or health related information. Education, for instance, is not included in several inequality studies (Kaplan, Pamuk et al. 1996, Kennedy, Kawachi et al. 1996). Selection bias occurs because of unobserved factors such as characteristics of the same region (Eibner and Evans 2001) and true reference group for an individual. This study contributes to the literature by focusing on relative deprivation and health outcomes in the following
aspects. First, this paper focuses the attention on child health outcomes in China. To our knowledge, this study is the first one to explore the effect of relative deprivation on child health in China. Second, we take up the challenge of examining the mechanism of relative deprivation effects on both parents’ and child’s health outcomes. We modified an integrated two-stage collective household production model that is designed to depicting parent-child interaction developed by You and Davis (2010). We incorporate income deprivation into children and parents’ health production functions. Through the structure model we will be able to identify the direct and indirect effect household level income deprivation will have on child’s health outcome. We use individual-level information from CHNS, which is rich in household and individual characteristics and health-related information. The findings of this paper can inform a better evaluation on policies related to reducing income inequality since it will inform the spillover effect to children’s health which is important not only for short-term social health care cost burden relieve but also important for longer-term public health and social welfare improvement.

3. Relative Deprivation Measurement and Reference Group

In evaluating the link between relative deprivation and health, special attention was given to the measurement of relative deprivation. The empirical investigation of relative deprivation have used a variety of definitions and measures of relative deprivation. Most of the literature use the level of relative income as a measure of relative deprivation. However, other measures like affluence scores and self-reported feelings of relative deprivation are also in use.

3.1 Yitzhaki Index

The most commonly used measurement for relative deprivation is the Yitzhaki Index. In 1979, Yitzhaki developed a mathematical operationalization of relative deprivation based on Runciman’s definition. Runciman (1966, page11) defines relative deprivation as “A person is relatively deprived of X by the following four qualifications (1) he does not have X, (2) he sees some other person or persons, which may include himself at some
previous or expected time, as having X, (3) he wants X, and (4) he sees it as feasible that he should have X”.

Yitzhaki proposed income as the object of relative deprivation because income can be viewed as a measure of the individual’s ability to consume commodities (Yitzhaki 1979). The degree of relative deprivation is measured by the following relative deprivation function of person i with income $I_i$:

$$D(I_i) = \int_{I_i}^{I^*} [1 - F(z)] dz$$

Where $I^*$ is the highest income in the reference group. $F(z)$ is the cumulative income distribution. Yitzhaki Index measures the degree of relative deprivation by summing up income distance, and at the societal level it equals to the Gini coefficient multiplied by the mean income which is the absolute Gini index (Yitzhaki 1979). The absolute Gini index (Verme 2013) indicates that with same average income level the more unequal a society is the higher the degree of relative deprivation. It also implies that greater mean income leads to higher level of relative deprivation with Gini coefficient being equal.

Most of the studies that used Yitzhaki index as a measurement of relative deprivation are based upon different types of incomes: individual-level income (Eibner and Evans 2001, Subramanyam, Kawachi et al. 2009), household income (Reagan, Salsberry et al. 2007, Kondo, Kawachi et al. 2008, Subramanyam, Kawachi et al. 2009). A few studies use the Family Affluence Score (FAS) as a basis to calculate the Yitzhaki Index. FAS was initially a four-item index of material assets or common indicators of wealth such as car ownership and number of computers (Currie, Molcho et al. 2008). It was later updated to six-item by adding two more items: bathrooms and dishwasher (Currie, Inchley et al. 2014). Elgar et al. define relative deprivation of an individual with affluence score of $x_i$ as (Elgar, De Clercq et al. 2013):

$$RD_i = \frac{1}{N} \sum_j (x_j - x_i), \quad \forall (x_j > x_i)$$

(2)
Where \( N \) is the number of individuals in a reference group. The Yitzhaki Index is not sensitive to different income scale and leads to a problem in some cases (Eibner and Evans 2001). In use of Yitzhaki Index, for example, doubling in income for everyone in a reference group will lead to relative deprivation double. This would be problematic when examining relative deprivation over time or across different groups (Eibner and Evans 2001, Lhila and Simon 2010).

### 3.2 Hey and Lambert Index

In 1980, Hey and Lambert provided an alternative form of Yitzhaki Index motivated by Runciman’s remark (1996): “The magnitude of a relative deprivation is the extent of the difference between the desired situation and that of the person desiring it.” (Hey and Lambert 1980). They specify the level of deprivation felt by an individual with income \( I_i \) compared to other individual with income \( I_j \) as:

\[
D(I_i, I_j) = \begin{cases} 
I_j - I_i & I_j > I_i \\
0 & I_j \leq I_i 
\end{cases}
\]  

(3)

Chakravarty and Chakraborty (1984) extended this index to a normative index. They defined relative deprivation as the foregone utility due to lack of the economic item under consideration (Chakravarty and Chakraborty 1984).

The overall relative deprivation experienced by an individual \( i \) with income \( y \) is given as (Chakravarty 1990):

\[
d_i(F) = \mu [1 - F_i(I)] - y[1 - F(I)]
\]

(4)

Where \( \mu \) is the mean income, \( F_i(y) \) is the cumulative proportion of total income at \( y \) and \( F(y) \) is the cumulative proportion of the population up to the individual with income \( y \).

### 3.3 Deaton Index
Deaton Index overcomes the problem of income scale in using the Yitzhaki Index (Adjaye-Gbewonyo and Kawachi 2012) and extends it by dividing by the mean income of the reference group as follows (Deaton 2001):

\[
DRD_i = \frac{1}{\mu N} \sum_{j} (I_j - I_i) \quad \text{for all } I_j > I_i
\]

(5)

Where \( \mu \) is the average income of reference group and \( N \) is the number of individuals in a reference group. Deaton Index assumes that the proportion of total income earned by people with higher income in the reference group matters in the determination of degree of relative deprivation.

Different from Yitzhaki Index, change in income below an individual’s income will also affect his or her level of relative deprivation when using Deaton Index. Several studies have used Deaton Index directly or in a different way (Eibner and Evans 2001, Reagan, Salsberry et al. 2007, Ling 2009, Lhila and Simon 2010). Eibner and Evans use the Deaton index differently for they use the individual i’s own income instead of the mean income of the reference group and they argue this index is sensitive to changes in the income distribution for individuals with less income (Eibner and Evans 2001).

### 3.4 Income Distribution and Rank-based Measures

Measures related to income distributions in studies include income quartiles (Reagan, Salsberry et al. 2007, Ling 2009, Subramanyam, Kawachi et al. 2009), coefficient of income variations (Chen and Meltzer 2008) and Gini coefficient(Ling 2009). Dichotomous relative deprivation variable is rare but used in one study. Yngwe et al. defined a person to be relatively deprived as having an income below 70% of the mean level in the reference group (Yngwe, Fritzell et al. 2003). Turley used percentile rank (Ri) as a measure of relative economic standing. Percentile rank was defined as the ratio of families in the neighborhood with lower incomes than the individual to the total number of families in the neighborhood, indicating that people at higher ranking have higher values of Ri (Turley 2002). Another measurement of relative deprivation is based upon
rank, where socioeconomic positions matters, such as standard of living (Stronks, van de Mheen et al. 1998).

3.5 Self-reported Relative Deprivation

One feature shared by the above indexes is that the relative deprivation is constructed by the researchers instead of self-reported measurement. These measures are problematic because they may not be perceived to be relevant by the individual. For example, if an individual doesn’t realize that the neighbors are better off, he may not feel relatively deprived. Wilkinson has argued that subjective perceptions of relative ranking may be more important than income in the determination of health (Wilkinson 1999, 2002). Also, subjective index is found to be more strongly related to self-rated health status relative to objective index (Adler, Epel et al. 2000).

Subjective socioeconomic status (SES) rank is one of these type of indexes. Respondents were given a question as follows: “Think of a ladder of with 10 rungs as representing where people stand in the society. At the top of the ladder are the people who are the best off, who have the most money, most education, and best jobs. At the bottom are the people who are the worst off, those who have the least money, least education, and worst jobs or no job. Please place an X on the rung that best represents where you stand on the ladder.” Adler et.al. argued that this one-item indicator was related to physiological and psychological functioning by increasing stress or the vulnerability to stress (Adler, Epel et al. 2000).

Another type of subjective index is self-reported level of relative deprivation compared to certain reference groups. In a study using data from United Nations Development Program, respondents were asked to evaluate if their standard of living is better, same or worse compared to that of the majority of people in their settlement, district of residence or country of residence, they were also asked if their parent and grandparents had a higher/same/lower position in society when they were the same age as the respondent (Cojocaru 2016). Manyo and Park used a similar index by asking the respondents to
compare themselves with three non-geographical reference groups (relatives, classmates and coworkers) and four geographical reference groups (neighbors, people living in county or city, province and nation) (Mangyo and Park 2011).

Though subjective measurements are useful, information on subjective evaluation of relative deprivation is often unavailable in many surveys. In our study, self-reported measure is not available in CHNS. So we will use Yitzhaki Index and Deaton Index based on household income. First, information of income is rich in CHNS and can be used to evaluate the ability of household members to consume. Second, most of the literature have employed those two indicators, making comparisons between their results and ours reasonable. Also, we will use income rank as a measure of relative deprivation because Elgar et al. have concluded that socioeconomic status impacted adolescents’ health through the psychosocial impact of relative deprivation and social rank (Elgar, De Clercq et al. 2013).

4. Reference Group

4.1 Reference Group used in the Literature

When measuring the level of relative deprivation, it is a challenge to determine the ways in which the concept of reference group should be used. Because the true reference group is unknown and there is no best definition of reference group in the literature to date. Instead, the researchers have to select a reference group according to previous studies and data constraints.

Reference groups based on geographic proximity are common in the literature. For instance, national-level reference group is defined that the whole country constitutes a reference group and individuals compare with every other individual in the society (Wilkinson 2002, Jones and Wildman 2008). State/area-level reference group is defined as the state/area of residence as a reference group (Deaton 2001, Subramanyam, Kawachi et al. 2009, Lhila and Simon 2010). Neighbor-level reference group consists of neighbors of an individual. For example, Turley defined a child’s reference group as his/her neighbors and argued that neighborhoods were probably to provide many of a child’s
reference group members because children typically attend neighborhood-based schools (Turley 2002).

Reference groups defined by individual characteristics are also in use in the research. Ling defined reference group as those in the peer groups (Ling 2009). Multiple reference groups based upon a combination of different characteristics are not rare in the literature. Eibner et al. used reference groups that are defined in four different ways based on combination of state, age-group, race and education (Eibner and Evans 2001). Yngwe et al. defined 40 reference groups combining indicators of social class, age and living regions (Yngwe, Fritzell et al. 2003). Kondo et al. modeled reference groups using a combination of occupation, age and geographic area (Kondo, Kawachi et al. 2008). Cojocaru used both the local reference groups (e.g. town, district, country) and reference groups based on likeness (e.g. parents and grandparents) (Cojocaru 2016).

4.2 Summary of the Literature using Different Reference Groups

Reference groups based upon geographic proximity and combination of different characteristics are popular in research for adults. However, the effects of different reference groups are various. Cojocaru compared the effects of different reference groups and found that local reference groups were easier to be observed than other levels of geographic proximity. It was also found that the proportion of respondents who were unable to compare their standard of living with their grandparents is high, indicating that making a comparison with grandparents was more difficult than with parents because. And the effects were more positive relative to grandparents than relative to parents (Cojocaru 2016). Manyo and Park found that former classmates and relatives were salient reference groups for urban residents and geographic reference groups for rural residents (Mangyo and Park 2011). Eibner and Evans also found that the effects of relative deprivation varies as the definition of reference group changes. For example, the results showed that relative deprivation increased the probability of wearing seatbelt when only state defined reference group. However, the effects became negative and statistically significant when using reference group defined with state/age, state/age/race and state/age/race/education (Eibner and Evans 2001).
Information of social relationships like classmates or relatives cannot be identified in our survey. However, location information like community/village and other characteristics are provided in CHNS. We will model multiple reference groups and check all their effects on health outcomes. We construct reference groups based on the following combinations of geographic proximity and demographic characteristics. Reference groups are defined as: 1) province, 2) community/village, 3) age and community/village, 4) age, community/village and gender, 5) age, community/village, gender and education.

5. Model

5.1 Theoretical Model

In this section, we will follow the model developed by You and Davis (You and Davis 2010) and propose a collective household production model to investigate the effect of relative deprivation on child health. The model is based on the following facts: (1) health production depends on not only generic factor but also a set of health-related inputs such as food and exercise for both parents and child; (2) the child’s choice sets of goods and time are constrained by the parents’ choices on household resource allocation. The first component is elaborated through a collective household model and the second component is captured by imposing a two-stage Stackelberg game structure where the parents are leaders and child is the follower.

5.1.1 Child’s Optimization Problem

The child’s health outcome ($H_c$) is based on the amount of food consumption ($x^c_f$) and time for exercise ($t^c_{ri}$). This health production process is conditional on four exogenous factors: (1) child’s food consumption is limited by the quantity of food provided by the parents ($X^i_f$); (2) The quality of food plays an important role in the production of child health and is measured by parents’ time for food preparation and process ($T^i_f$); (3) the production efficiency is affected by child biological and genetic factors like age and gender ($k$); (4) home environmental factors $E_h$ may also impact child’s health. For example, the home/family environment has been proved to be a
critical factor in the development of childhood obesity (Strauss and Knight 1999, Crossman, Sullivan et al. 2006). Evidence also shows that childhood family adversity exerts negative long-term physical health outcomes (Luecken, Roubinov et al. 2013). The child health production function is therefore as:

$$H_c = H_c(x^c_f, t^c_{ex}, X^i_f, T^i_f, k, E_h)$$ (6)

The child’s conditional utility function depends on the child’s health outcomes ($H_c$), the amount of food consumed ($x^c_f$) and time for exercise ($t^c_{ex}$) as well as consumption of other time ($t^c_{ot}$) and goods ($x^c_o$). Child’s utility also depends on the home environment ($E_h$) and level of relative deprivation (RD). Psychological experiments have been conducted and provide evidence that children also make social comparisons. For example, two young children are content when being served the same amount of orange juice for several days. However, they notice the difference if one of them is served only three quarters of a glass and the other is served a full glass (Frank 1985). Through comparisons with other schoolmates, relative deprivation is associated with poorer health behaviors such as less physical activity, fewer breakfast and less healthy food choices among adolescents (Elgar, Xie et al. 2016). So the child utility function is written as:

$$u_c = u_c(H_c, x^c_f, x^c_o, t^c_{ex}, t^c_{ot}, E_h, RD^c)$$ (7)

Maximizing the child’s utility function in equation (7) subject to child’s health production function (6) and a time constraint of $t^c_{ex} + t^c_{ot} = T$ yields the child’s best response functions ($x^c_{f*}, x^c_{o*}, t^c_{ex*}, t^c_{ot*}$) with arguments ($X^p_f, X^m_f, T^p_f, T^m_f, k, E_h, RD^c$).

The child’s health production and utility functions are then respectively:

$$H^*_c = H_c(X^i_f, T^i_f, k, E_h, RD^c)$$ (8)  

$$u^*_c = u_c(X^i_f, T^i_f, k, E_h, RD^c)$$ (9)

5.1.2 Parents’ Optimization Problem
Parental health is based on their food consumption ($X^i_j$) and time for exercise ($T_{ex}^i$). The efficiency of parents’ health production is affected by the biological factors such as age and gender (K). Home /family environment ($E^i_h$) may have impact on parents’ health as well. For example, chronically stressful family environment may produce chronic anxiety, leading to enhanced health risks (Taylor, Repetti et al. 1997). High-density living is associated with increased likelihood of infections and higher death rates (Levy and Herzog 1978). Work environment ($E^i_w$) may also affect parents’ health. For instance, high job strain is related to mental ill health (Stansfeld and Candy 2006). Toxins at work lead directly to contraction of certain kinds of cancers for the poor and African-Americans (Taylor, Repetti et al. 1997). Accordingly, the health production functions for parents are formed as:

$$H_i = f(X^i_f, T_{ex}^i, K^i, E^i_h, E^i_w) \quad i = P, M$$

(10)

Utility for each parent is determined by consumption of food ($X^i_f$) and other goods ($X^i_o$). Time allocation also matters in the determination of their utility level like time for food purchase and process ($T^i_f$), time for exercise ($T_{ex}^i$), time for work ($T^i_w$) and other time consumption ($T^i_o$). In addition, parental utility is determined by his own health status ($H^i$), his spouse’s health status ($H^j$) and his child’s health status ($H^c$) and child’s utility ($u^c$). So utility for each parent is characterized as:

$$V_i = V_i(X^i_f, X^i_o, T^i_f, T_{ex}^i, T^i_w, T^i_o, H^i, H^j, H^c, u^c, E^i_h, E^i_w, RD^i) \quad i = P, M$$

(11)

The allocation process of resources within household is assumed to be Pareto-efficient. The household allocates the resources by maximizing a weighted sum of each parent’s utility. Hence, the household function of utility can be written as

$$V = \lambda(p, w, I, K, E^i_h, E^i_w) \cdot V_p(\cdot) + [1 - \lambda(p, w, I, K, E^i_h, E^i_w)] \cdot V_m(\cdot)$$

(12)

The Pareto weight, $\lambda \in [0,1]$, depends on factors affecting each member’s bargaining position like individual wages and non-labor income.
The household faces the following budget constraint (13) and time constraint (14):

\[ \sum_i (P_o X_i^o + P_f X_i^f) = \sum_i (W^i + T_w^i + I^i) \]  

\[ T_f^i + T_{ex}^i + T_w^i + T_o^i = T \]

\( P_f \) and \( P_o \) represent price of food and other goods. \( W^i \) and \( I^i \) denote individual wage rates and unearned income.

We assume parents maximize household utility function (12) subject to equations (10), (13) and (14). Hence, the maximization results the parents’ optimal input functions as:

\[ X_j^p = X_j(P_o, P_f, W^i, I^i, E_h, E_w, RD^f, RD^i, K^i, k) \]  

\[ T_k^c = T_k(P_o, P_f, W^i, I^i, E_h, E_w, RD^f, RD^i, K^i, k) \]

Parents’ health productions are as follows:

\[ H_c^p = H_c(P_o, P_f, W^i, I^i, E_h, E_w, RD^f, RD^i, K^i, k) \]

The final reduced-form health production for child is derived by substituting equations (15) to (17) into equation (8):

\[ H_c^{**} = H_c(P_o, P_f, W^i, I^i, E_h, E_w, RD^f, RD^i, K^i, k) \]

Ideally, analysis of total effect of relative deprivation requires estimation of child’s health production and its input functions because parents’ relative deprivation has effect on child health through inputs function. Unfortunately, reliable food expenditure is not available in our dataset. Besides estimating the final reduced-form health production for child, an analysis of a system of equations (8), (16) and (17) is also conducted to estimate the effect of relative deprivation on both child health and parent health. Knowledge of the health production technology for both parents and children is useful for predicting and assessing the effects of health-related policies. Also, such information is useful for helping parents to better achieve child health goals.

5.2 Empirical Analysis
This study will center on evaluating the effect of relative deprivation on child health through estimating both the reduced form health production function (18) and the system of equations (8), (16) and (17).

First, the reduced-form production of child’s health is estimable with appropriate data. We can estimate the direct effect of relative deprivation of child’s health outcome through equation (18). Since this type of reduced-form function is commonly used in other studies, our results are comparable with results in other literature.

The final reduced form for child’s health is estimated in the following linear form:

\[ H_{cit} = X^\prime_i \beta + u_t + \varepsilon_{it} \] (19)

Where \( H_{cit} \) is the health of child \( i \) at time \( t \), \( X_i \) represents a set of explanatory variables which may affect child health, including both child and parent’s relative deprivation. The \( u_t \) denotes the individual unobserved time-invariant error term component, assumed to be drawn from a distribution with a mean of zero and constant variance. The error term \( \varepsilon_{it} \) is assumed to be uncorrelated with \( X_i \) and \( u_t \).

Second, we also estimate the system of equations (8), (16) and (17) because parameter estimates in food-input (15) and parents’ health production functions (17) may provide additional information of interest. The indirect pathways of relative deprivation, through which the child’s health outcomes are affected, can be solved in the system. For example, relative deprivation may affect time allocation of parents through equation (16) and lead to a change in child’s health outcomes through equation (8). So parents can alleviate the effect of relative deprivation on child’s health through resources allocation such as the amount of food and their time for preparing and processing food. This indirect impact of relative deprivation on child’s health outcomes depends on the relative importance of \( X^i_j \) and \( T^i_j \) in the child’s health production function. To make it clearer, an estimation system of equations (8), (16) and (17) can be written in matrix notation as: (18)
\[ T^F = \alpha_0 + \sum_{j=F,M} \alpha^j_I + \sum_{j=F,M} \alpha^j_w + \sum_{j=F,M} \alpha^j_E + \sum_{j=F,M} \alpha^j_K + \sum_{j=F,M} \alpha^jRD + \alpha_P + \alpha_P + \alpha_L \]  
\[ T^M = \beta_0 + \sum_{j=F,M} \beta^j_I + \sum_{j=F,M} \beta^j_w + \sum_{j=F,M} \beta^j_E + \sum_{j=F,M} \beta^j_K + \sum_{j=F,M} \beta^jRD + \beta_P + \beta_P + \beta_L \]  
\[ H_c = \mu_0 + \sum_{j=F,M} \mu^jX + \sum_{j=F,M} \mu^jT + \mu_E + \mu_RD + \mu_k + \epsilon_3 \]  

Where \( T^F = (T^F_{ex}, T^F_{ex}) \) and \( T^M = (T^M_{ex}, T^M_{ex}) \). The derived reduced form can be obtained by substituting equations (18) and (19) into equation (20).

\[ \tilde{H} = \tilde{\theta}_0 + \sum_{j=F,M} \tilde{\theta}^j_I + \sum_{j=F,M} \tilde{\theta}^j_w + \sum_{j=F,M} \tilde{\theta}^j_E + \sum_{j=F,M} \tilde{\theta}^jK + \sum_{j=F,M} \tilde{\theta}^jRD + \tilde{\theta}_P + \tilde{\theta}_P + \tilde{\theta}_L \]  

where

From parameter estimates in equation (23), we can see that there are several pathways through which relative deprivation has effect on child health. Based upon our model, relative deprivation of both child and parents will affect child’s health outcomes. Relative deprivation of parent affect the child’s health outcomes through time and food consumption and these impacts depend on \( \alpha^j, \beta^j \) and \( \mu^j \).

One advantage of our framework is that our models underlie the importance of the family domain in understanding the effect of relative deprivation on child health outcomes, articulating the complicated pathways of direct effect of relative deprivation as well as the indirect effect through parents. Also, the collective model of estimating a system of input demands in equations (16)-(17) and child’s health production function in equation (8) is advantageous over the unitary framework. The collective model may help
researchers and policy makers identify different targets of interests, such as child’s health outcomes or parents’ time for food preparing and processing.

6. Data

The models are estimated using data from the China Health and Nutrition Survey (CHNS) because it contains detailed information on health outcomes, demographic, socioeconomic and geographical variables. The CHNS is an ongoing longitudinal project started in 1989 and followed up through 2011 as the newly released dataset, covering 9 waves of data in total. It was conducted by an international team of researchers from the Carolina Population Center at the University of North Carolina at Chapel Hill, the Institution of Nutrition and Food Hygiene, and the Chinese Academy of Prevention Medicine. A random clustering sample process was conducted to draw the sample in nine provinces in China, i.e., Heilongjiang, Liaoning, Shandong, Henan, Hubei, Jiangsu, Hunan, Guizhou, Guangxi with Beijing and Chongqing being added to this survey recently. Heilongjiang was not included in waves of 1989, 1991 and 1993 and Liaoning was not included in wave of 1997. The response rates at household level (from 79.3% in 1997 to 94.9% in 1991) was high on average (Popkin, Du et al. 2009). Hence, CHNS is representative of the diverse population in China. As our interest lie on the effect of relative deprivation on child health, we restrict our sample of households with children aged under 18 years old. Also, we deleted sample from 1989 because parent’s identifier was not reported.


6.1 Dependent Variables

We use two dependent variables to measure health outcomes, a dichotomized measure of self-reported health status (SRHS) and BMI.

6.1.1 Self-reported Health Status
SRHS is used to measure general health status and can be viewed as perception of an individual’s health relative to other people in the reference group (Jones and Wildman 2008). It has been proved to be highly correlated with communicable disease (Harding, Clucas et al. 2012) and mortality (Phillips, Der et al. 2010). Also, it has been shown to predict survival inequalities (Van Doorslaer and Gerdtham 2003). In multiple studies, it has been considered a valid measure of general health for different populations (Idler and Benyamini 1997, Kopp, Skrabski et al. 2004, Gray, Merlo et al. 2012, Tai, Buchanan et al. 2012).

SRHS is obtained from the children and adult questionnaires form CHNS. A question was asked to respondents aged 12 and older about their health status compared to others: “Right now, how would you describe your health compared to that of other people your age?” Respondents indicate on a four-step Likert scale measure (ranging from "poor" to "excellent"). This question was recorded in insurance file in year of 1991, 1993 and 1997 and then in physical exam file in year of 1997 and after. Hence, the question about health status was asked twice in different files. We use the observations from insurance file in 1997 because it included similar amount of observations and less missing value (14236 observations with 22 missing values in insurance file vs. 14323 observations with 2863 missing values in physical exam file). Following previous study, SRHS is dichotomized by one if the individual reporting good and better health and zero otherwise (Jones and Wildman 2008). Six waves (1991, 1993, 1997, 2000, 2004 and 2006) of data from CHNS were used for the analyzing the determinants of child’s SRHS. Our sample is restricted to children aged between 12 to 18 years old who have information of family income, age and race.

6.1.2 Body Mass Index

SRHS is self-reported and may be subject to potential response bias (Groot 2000, Mangyo and Park 2011). To control for such problems, actual physical health measure (BMI) is suggested by previous studies (Mangyo and Park 2011). BMI is a good measure for levels of body fat and can be used to indicate ill health during childhood and later in life. With increase in body mass index (BMI), more impaired health-related quality of life (a measure of overall impact of a condition on physical and mental health and wellbeing)
were reported by individuals (Doll, Petersen et al. 2000, Heo, Allison et al. 2003). Overweight/obese children and adolescents were associated with problems in physical and mental health (Wake, Salmon et al. 2002, Swallen, Reither et al. 2005, Williams, Wake et al. 2005, De Beer, Hofsteenge et al. 2007). Health risks related to obesity include mortalities due to heat disease, stroke, diabetes, and other causes (Eibner and Evans 2001). We therefore include BMI as another measure of an individual’s health.

Both weight and height are reported in the section of physical measurement. They are measured by a physician, nurse, health worker or other health professional and recorded in each wave of data. BMI for adults is calculated as body weight in kilograms divided by squared body height in meters for adults as in the following ratios:

\[
BMI = \frac{\text{Weight in kgs}}{(\text{Height in meters})^2}
\]  

(BMI calculation for adults)


6.2 The Independent Variables

6.2.1 Income Variables

The primary income variables used in the empirical models is annual per capita household income inflated to 2011 Chinese yuan. Household income doesn’t consider the household size. Individual income is also problematic because individuals who are not earners often report an income of zero, especially individuals from high income families. Per capita household income takes into account the above problems by dividing the total household income by the number of people in the household age 14 and plus ½ times the number of children under age 14.

In CHNS, household income variable is derived by summing of all sources of income and revenue minus expenditures. Specifically, the household income is comprised of wage income, net income from sources like farming, raising livestock and poultry, fishing and business. In addition, it includes state subsidies, food subsidies and transfers
from friends and extended family members. HHINC_CPI is a constructed variable of annual total household income inflated to the year of 2011. PCINC is obtained using HHINC_CPI divided by the number of people in the household age 14 and plus \( \frac{1}{2} \) times the number of children under age 14. Following previous studies (Ettner 1996, Ecob and Smith 1999, Jones and Wildman 2008), log of per capita household income is used to allow for a non-linear relationship of the inputs and health outcomes.

### 6.2.2 The Relative Deprivation Measures

Relative deprivation is measured by the following indexes: (1) \( YRD_{ij} \), measure of relative deprivation as proposed by Yitzhaki (1979); (2) \( DRD_{ij} \), measure of relative deprivation proposed by Deaton (2001); (3) \( Rank_{ij} \), percentile rank as proposed by Turley (2002). Where i represents the reference groups defined by different characteristics (1=province, 2=community/village, 3=age and community/village, 4=age, community/village and gender, 5=age, community/ village, gender and education) and j represents household member (p=father, m=mother and c=child).

### 6.2.3 Other Independent Variables

Time for food preparation and process \( T^f_i \) is sum of two parts: average minutes spent buying food per week and average minutes spent preparing food per week. Time for exercise \( T^e_{ex} \) (parents) and \( T^e_{cx} \) (children) is sum of time for exercise and time spent on traveling to and from work or school on foot or by bicycle. Exercise activities include martial arts, gymnastics, dancing, acrobatics, track and field, soccer, basket, tennis, badminton, volleyball and other activities. An individual’s time for transportation to and from work or school on foot or by bike was considered as another component of exercise time. Time for these activities was recorded for both adults and children.

When an individual knows about the Chinese Pagoda or the Dietary Guidelines for Chinese population, a value of 1 is assigned to variable “knowdiet”. Diet knowledge score is a measure of an individual’s diet knowledge according to a short survey of 12 questions in both adult and child questionnaire. If the statement of the question is in accordance with the suggestions given in the Dietary Guidelines, and the respondent...
agrees or strongly agrees with this statement, the respondent receives a value of 1 for this question. The total score for this survey is the sum of all scores of each question. Food preference is evaluated by a short survey asking the respondents how much he or she likes the two types of food items: unhealthy food (fast food, salty snack foods and sugared fruit drinks) and healthy food (vegetables and fruits). For each item if the respondent answered with “like some what”, he or she gets one credit for this question. If the answer is “like very much”, the credit value is two and the respondent receives 0 if the answer is other. We summarize the total score for healthy food (HFlike) and unhealthy food (UHFlike) separately. Similar method is applied to derive a respondent’s preference for activities. Total score for sedentary activities (sedentary) is sum of score of watching TV, playing computer, reading and doing homework. Total score for exercise activity (actlike) is sum of the score of walking, sports and bodybuilding. A dummy variable “ondiet” is used to indicate if a respondent is taking a treatment of special diet or weight control because of diagnosis of diabetes.

The family environmental factors include measures of family stability and density of living. Studies have found that family stability has positive effects on a child’s health outcomes (Harden 2004). Family stability is usually defined in terms of family structure, such as single parenthood. So, we use indicators for a single-father or single-mother household. Density of living is measured by the number of total members in the household (Hlshsize). Parent’s work environment is measured by a dummy variable with value of one indicating that if a person engages light physical activities during work time and a value of 0 indicating that a person engages moderate or heavy physical work. Office work, for example, is considered as light physical work, driving as moderate and farming as heavy physical work.

In the adult survey, an individual is inquired with the following question “On the average, what was your monthly wage/salary last year, excluding subsidies and bonuses”. Average monthly wage was collected for both parents as well as subsidies. Subsidies include grocery subsidy, health allowance, bath and haircut allowance, book and newspaper allowance, housing and other subsidies in Chinese yuan.
Use of food price is restricted in the CHNS, so we use CPI related to food at province level as a proxy for the food price and overall CPI as a proxy for the price of other commodities. Each year’s overall index of CPI (CPI) and food index of CPI (CPI_food) are obtained from Statistical Yearbook of China State Statistical Bureau ranging 1990 to 2011 (Yearbook 2012).

We also control for individual’s age, gender, race and education. A dummy variable “Insurance_j” is used to indicate if an individual has medical insurance (j represent household member, p=father, m=mother and c=child).

7. Results

Table 1 presents the descriptions of explanatory variables and Table 2 presents their sample mean and standard deviation (Per capita income is reported with median with 95% CI).

SRHS is almost the same across different reference groups. On average, proportion of mothers in the household reported with good or excellent health status is higher than fathers and children. Generally, relative deprivation measures of reference groups with more characteristics tend to have a lower level of relative deprivation. The percentage of individuals who has insurance is around 20%.

The models were estimated using a range of techniques. We only present the coefficient of relative deprivation as our research interest is focused on the effect of relative deprivation. Results from equation (18) for two subsamples (adult and child) are listed in Table 3. In each column of the reference group, we reported results controlled for income and not controlled for income together. When reference groups are defined by province and community separately, father and mother have almost the same level of relative deprivation. Hence, the coefficients are the same and reported only for father.

The effects of different relative deprivation measures are mixed. Father’s Yitzhaki relative deprivation exerts a significant negative effect in the reference group defined by province, though the effect is small. Father’s relative deprivation also has negative effect on child health when reference group are defined with community and with the most characteristics, but most of them is not significant. Mother’s relative deprivation presents
negative effects on child health except in the reference group defined by community and age using percentile rank. But most of the effects are not statistically significant. Children’s Yitzhaki relative deprivation is statistically significant when estimated with and without income within province. It shows negative effects on child health within province but the effects are not statistically significant.

8. Discussion
Recent studies are increasingly concerned about the impact of relative deprivation on health outcomes. Yet studies of this relationship are often evaluated for adults and children separately. In this study, we develop an integrated two-stage collective model to investigate this relationship within the household framework. We find that the effect of relative deprivation defined by different characteristics are mixed for father’s and children’s relative deprivation using different reference group. Mother’s relative deprivation exerts negative effects on child health except in the community reference group.
## Table 1 Variable Description

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent variable (LHS variable in the system of equations)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SelfHealthStatus&lt;sub&gt;i&lt;/sub&gt;</td>
<td>An individual’s self-reported health status: 1 is good or excellent; 0 otherwise</td>
<td>1/0</td>
</tr>
<tr>
<td>BMI&lt;sup&gt;a&lt;/sup&gt;</td>
<td>An individual’s body mass index</td>
<td>Kg./(mt.)²</td>
</tr>
<tr>
<td>FoodTime&lt;sub&gt;k&lt;/sub&gt;</td>
<td>An individual’s time for food purchase, preparation and cook</td>
<td>mins./day</td>
</tr>
<tr>
<td><strong>Independent variables (RHS Variables in the system of equations)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AllCPI&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Overall index of Consumer Price Index at province level</td>
<td>-</td>
</tr>
<tr>
<td>FoodCPI&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Food index of Consumer Price Index at province level</td>
<td>-</td>
</tr>
<tr>
<td>Wage</td>
<td>Father’s average monthly wage if a father lives in the household or mother’s average monthly in a single-household</td>
<td>Chinese Yuan</td>
</tr>
<tr>
<td>CapitalIncome</td>
<td>Per capita household income</td>
<td>Chinese Yuan</td>
</tr>
<tr>
<td>UEIncome</td>
<td>An individual’s household subsidies</td>
<td>Chinese Yuan</td>
</tr>
<tr>
<td>YReDepr&lt;sub&gt;ij&lt;/sub&gt;</td>
<td>Yitzhaki’s index of relative deprivation for an individual</td>
<td>Chinese Yuan</td>
</tr>
<tr>
<td>DReDepr&lt;sub&gt;ij&lt;/sub&gt;</td>
<td>Deaton’s index of relative deprivation for an individual</td>
<td>-</td>
</tr>
<tr>
<td>PercentileRank&lt;sub&gt;ij&lt;/sub&gt;</td>
<td>An individual’s percentile rank</td>
<td>-</td>
</tr>
<tr>
<td>ExerTime&lt;sub&gt;i&lt;/sub&gt;</td>
<td>An individual’s exercise time</td>
<td>hours./week</td>
</tr>
<tr>
<td>Age&lt;sub&gt;i&lt;/sub&gt;</td>
<td>An individual’s age</td>
<td>year</td>
</tr>
<tr>
<td>Ethnicity&lt;sub&gt;i&lt;/sub&gt;</td>
<td>An individual’s ethnicity, 1 is Chinese Han; 0 otherwise</td>
<td>1/0</td>
</tr>
<tr>
<td>Education&lt;sub&gt;i&lt;/sub&gt;</td>
<td>An individual’s level of education</td>
<td>rank</td>
</tr>
<tr>
<td>LightActivityWork&lt;sub&gt;k&lt;/sub&gt;</td>
<td>An individual’s activity at work, 1 is light activity at work; 0 otherwise</td>
<td>1/0</td>
</tr>
<tr>
<td>Insurance&lt;sub&gt;i&lt;/sub&gt;</td>
<td>An individual’s insurance, 1 is the individual has insurance; 0 otherwise</td>
<td>1/0</td>
</tr>
<tr>
<td>InSchool</td>
<td>A child is in school, 1 is this child is included in a school; 0 otherwise</td>
<td>1/0</td>
</tr>
<tr>
<td>Gender</td>
<td>A child’s gender, 1 is boy; 0 is girl</td>
<td>1/0</td>
</tr>
<tr>
<td>DietGuidanceScore&lt;sub&gt;i&lt;/sub&gt;</td>
<td>An individual’s score of diet knowledge survey</td>
<td>credits</td>
</tr>
<tr>
<td>DuoHeaded</td>
<td>A child’s parent live in the household, 1 is both parents live in the household; 0 otherwise</td>
<td>1/0</td>
</tr>
<tr>
<td>HouseholdSize</td>
<td>Number of members in the household</td>
<td>number</td>
</tr>
</tbody>
</table>
Note: i represents role in the household; i=p, father; i=m, mother; i=c, child.
   k represents father or mother.
   j represents different reference group, j=1, people in province as a reference group; j=2, people within community/village as a reference group; j=3, people of the same age within community/village as a reference group; j=4, people of the same age and gender within community/village as a reference group; j=5, people of the same age, gender and education within community/village as a reference group.
   aBMI z-score is reported for individuals aged under 18 years.
   b1989 is used as the Base Year.
Table 2. Descriptive Statistics, adult and children, Means and Deviations

<table>
<thead>
<tr>
<th>Variable</th>
<th>Reference group defined by</th>
<th>Province</th>
<th>Community</th>
<th>Community and age</th>
<th>Community, age and gender</th>
<th>Community, age, gender and education</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Subsample in analysis for self-reported health status (7796 observations)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>SelfHealthStatus_p</td>
<td></td>
<td>0.26 (0.44)</td>
<td>0.26 (0.44)</td>
<td>0.26 (0.44)</td>
<td>0.26 (0.44)</td>
<td>0.25 (0.44)</td>
</tr>
<tr>
<td>SelfHealthStatus_m</td>
<td></td>
<td>0.30 (0.46)</td>
<td>0.30 (0.46)</td>
<td>0.31 (0.46)</td>
<td>0.30 (0.46)</td>
<td>0.30 (0.46)</td>
</tr>
<tr>
<td>SelfHealthStatus_c</td>
<td></td>
<td>0.15 (0.36)</td>
<td>0.15 (0.36)</td>
<td>0.15 (0.36)</td>
<td>0.15 (0.36)</td>
<td>0.15 (0.36)</td>
</tr>
<tr>
<td>FoodTime_p</td>
<td></td>
<td>13.19 (35.54)</td>
<td>13.19 (35.54)</td>
<td>13.18 (35.67)</td>
<td>13.16 (35.73)</td>
<td>13.06 (36.31)</td>
</tr>
<tr>
<td>FoodTime_m</td>
<td></td>
<td>27.39 (46.20)</td>
<td>27.39 (46.20)</td>
<td>27.37 (46.43)</td>
<td>27.26 (46.61)</td>
<td>26.48 (44.91)</td>
</tr>
<tr>
<td>Wage</td>
<td></td>
<td>491.13 (630.51)</td>
<td>491.09 (630.62)</td>
<td>482.74 (614.67)</td>
<td>476.17 (621.55)</td>
<td>450.89 (516.61)</td>
</tr>
<tr>
<td>CapitalIncome&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>4353.79 (4250.42, 4457.16)</td>
<td>4353.51 (4250.14, 4456.90)</td>
<td>4315.88 (4212.65, 4419.1)</td>
<td>4256.16 (4149.01, 4363.23)</td>
<td>4111.57 (3958.69, 4264.45)</td>
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<tr>
<td>UEIncome</td>
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<td>8.81 (15.43)</td>
<td>8.81 (15.43)</td>
<td>8.93 (15.78)</td>
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<tr>
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<td>2393.59 (1757.53)</td>
<td>1533.23 (1700.12)</td>
<td>1378.39 (2156.55)</td>
<td>1563.60 (2833.30)</td>
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<td>1555.66 (1934.81)</td>
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<td>0.32 (0.37)</td>
<td>0.32 (0.44)</td>
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<td>PercentileRank&lt;sub&gt;p&lt;/sub&gt;</td>
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<td>0.35 (0.27)</td>
<td>0.38 (0.28)</td>
<td>0.34 (0.28)</td>
<td>0.12 (0.22)</td>
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<td>0.35 (0.28)</td>
<td>0.37 (0.28)</td>
<td>0.35 (0.29)</td>
<td>0.14 (0.24)</td>
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<td>0.40 (0.29)</td>
<td>0.35 (0.28)</td>
<td>0.27 (0.26)</td>
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<td>0.16 (1.16)</td>
<td>0.16 (1.17)</td>
<td>0.16 (1.20)</td>
<td>0.16 (1.61)</td>
</tr>
<tr>
<td>ExerTime&lt;sub&gt;m&lt;/sub&gt;</td>
<td></td>
<td>0.17 (1.48)</td>
<td>0.17 (1.48)</td>
<td>0.16 (1.49)</td>
<td>0.15 (1.40)</td>
<td>0.10 (0.43)</td>
</tr>
<tr>
<td>ExerTime&lt;sub&gt;c&lt;/sub&gt;</td>
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<td>0.60 (1.64)</td>
<td>0.60 (1.64)</td>
<td>0.59 (1.63)</td>
<td>0.58 (1.49)</td>
<td>0.55 (1.33)</td>
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<td>3250</td>
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*Median of per capita income and its 95% confidence interval is reported*
Table 3. Child Health Production Functions Parameter Estimates (Selected Results)
Dependent Variable: Self-reported health status reported by children aged 12 to 18

<table>
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<tr>
<th>Independent variable</th>
<th>Reference group defined by</th>
<th>Province, no income</th>
<th>Province, with income</th>
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<th>Community and age, with income</th>
<th>Community, age and gender, no income</th>
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<td>Without income</td>
<td>With income</td>
<td>Without income</td>
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</table>

** Significant at 5%, *significant at 10%.
Note: Relative deprivation measure is the same for father and mother when using people in province and community as reference group. Hence, only father’s results are reported.
References


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