URBAN-RURAL DISPARITIES IN CHILD OVERWEIGHT AND OBESITY IN CHINA: THE ROLE OF HUKOU POLICY

A Thesis
submitted to the Faculty of the
Graduate School of Arts and Sciences
of Georgetown University
in partial fulfillment of the requirements for the
degree of
Master of Public Policy
in Public Policy

By

Tian Tian, B.A.

Washington D.C.
April 10, 2017

URBAN-RURAL DISPARITIES IN CHILD OVERWEIGHT AND OBESITY IN CHINA: THE ROLE OF HUKOU POLICY

Tian Tian, B.A.

Thesis Advisor: Andrew Wise, Ph.D.

ABSTRACT

Childhood obesity has become an epidemic worldwide and regionally. According to the World Health Organization (WHO), globally, in 2015, the number of overweight children under the age of five was estimated to be over 42 million. Almost half of these overweight children under 5 lived in Asia and one quarter lived in Africa. In China, the incidence of childhood obesity has seen a rising trend in recent years, turning into a severe public health challenge. Obesity brings about an unprecedented heavy burden to children's health outcomes, and also plays a negative role in children's mental health and academic performance. In addition to genetic influences, many socioeconomic factors contribute to childhood obesity. This paper considers the effect of Hukou policy, the household registration system in China, and other socioeconomic factors on children's body mass index (BMI), which is an important indicator of children's health outcomes. My hypothesis is that compared to their rural counterparts, children with an urban Hukou status or living in urban areas are more likely to have a normal BMI, that is, a healthy weight. To test this hypothesis, I conduct a multivariate analysis of four rounds of the China Health and Nutrition Survey data from 2000 to 2009, estimating nine separate regressions using pooled LPM, logit and fixed effects analyses. The results strongly support my hypothesis.

The research and writing of this thesis

is dedicated to everyone who helped along the way.

Many thanks,

Tian Tian

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

I. Introduction

The goal of this thesis is to analyze disparities of children's health outcomes in China by illustrating the effect of relevant socioeconomic factors on children's BMI. My hypothesis is that children with an urban Hukou status or living in urban areas will have a better weight status than their rural counterparts. More specifically, I test whether the body mass index (BMI) of children is affected by Hukou policy, a household registration system dividing people into urban or rural groups, which would also determine if rural children had migrated with their parents or either were left behind in their rural hometown. I will also test the influences on BMI of several other socioeconomic determinants as control variables.

The calculation of BMI follows the World Health Organization standard. The dataset I use to test my hypothesis comes from the China Health and Nutrition Survey (CHNS), an ongoing open cohort, international collaborative project between the Carolina Population Center at the University of North Carolina at Chapel Hill and the National Institute for Nutrition and Health (NINH, formerly the National Institute of Nutrition and Food Safety) at the Chinese Center for Disease Control and Prevention (CCDC). My study will be the first to focus on the effects of Hukou policy on Children's BMI, as well as connecting the migration or left behind-ness of children with Hukou policy, and then examine whether and how much these categories -- urban/rural, migrated/left-behind -- affect children's health outcomes.

Children being overweight and obese occurs due to many reasons, including heredity, individual behaviors, and cultural environment and so on. To some degree, the weight status reflects people's health outcomes. More broadly, it is a mirror of many aspects of the public health sector, such as nutrition balance, maternal health, and health care. In China, the rise of this issue has its internal consistency with the times. Over the last few decades, rapid economic

development in China has helped to contribute toward remarkable progress in the health sector, as shown by the reduction of infant and child mortality and the increase in life expectancy, as well as the reduction in the prevalence of low-weight and wasting children.

However, problems in China's health sector remain massive. Relative to China's remarkable economic development during the last two decades, progress in the health sector has lagged. While China may be doing well on many child indicators in aggregate national terms, this masks major inequalities and disparities, particularly between urban and rural areas, and among eastern, central, and western regions. In less developed areas, health indicators lag far behind national averages. The size of China's disadvantaged populations, their poorer access to and lower uptake of health services, and the poor quality of these services mean that much work remains to be done.

While rapid economic development has helped to significantly reduce the prevalence of low-weight and wasting children in China, stunting remains a problem. Stunting is caused by poor feeding over a prolonged period and by the inadequate prevention and treatment of disease and infection. China has 6.5 percent of the world's stunted children, second only to India.[1] Based on the 2010 China Food and Nutrition Surveillance, the prevalence of stunted children under 5 years is as high as 20.3 percent in poor rural areas.

Moreover, excessive weight and obesity remain a severe problem. The China National Nutrition and Health Survey indicated that the prevalence of high weight and obesity[2] increased 200 percent from 1982 to 2002 among urban children and adolescents aged 7 to 17. In 2002, the

[1] UNICEF, Tracking progress on child and maternal nutrition: a survival and development priority, 2009.

[2] The estimation of the prevalence of overweight and obesity was based on cut-off points derived from international data as recommended by the Childhood Obesity Working Group. (Cole TJ, Bellizzi MC, Flegal KM et al., 'Establishing a standard definition for child overweight and obesity worldwide: international survey', British Medical Journal, 2000, Volume 320, Issue 7244, Pages 1240-1243)

prevalence was 11.5 percent in cities and was as high as 16.7 percent in bigger cities. Hence, in China, preventing child obesity is an emerging issue as a first priority.

With growing attention on maternal and child health, more specific studies regarding maternal care, breastfeeding, child nutrition and so on are conducted by professional research teams or institutions. For example, the China Health and Nutrition Survey (CHNS) was designed to examine the effects of the health, nutrition, and family planning policies and programs implemented by national and local governments and to see how the social and economic transformation of Chinese society is affecting the health and nutritional status of its population. This thesis uses data from CHNS to identify the factors that affect children's weight status and assess the variation in children's BMI based on demographic and regional categories. By conducting a multivariate analysis, I hope to get an overall view on childhood high weight and obesity in China, and provide suggestions on remedial policies.

In the next section, I review the relevant literature and background information surrounding the Hukou policy, child nutrition disparities, and other relevant socioeconomic indicators. In Section III, I outline the theoretical framework for testing my hypothesis. In Section IV, I describe in detail the data from the CHNS 2000-2009 dataset. In Section V, I propose an empirical model to test my hypothesis that children in urban areas tend to have a more normal BMI and better health outcomes than their rural counterparts. In Section VI, I report and analyze my regression results and in Section VII, I discuss my conclusions and possible policy implications resulting of my analysis.

II. Background and Literature Review

This section provides a background on urban-rural disparities of nutrition-related health outcomes, in which the Hukou policy plays a vital role. I present the overall status quo of China's child nutrition status, especially childhood high weight and obesity. I also cover other socioeconomic indicators that affect children's BMI and the related studies on their influences.

1. The Hukou system

Hukou is the household registration system in China that determines eligibility for various welfare benefits, such as health care, education, housing, and employment. The Hukou system includes two types of household registration -- urban and rural, which may lead to nutritional and health disparities. Previous studies indicate that child health disparities due to Hukou status have been declining since 2000. This probably reflects the improvement of rural children's nutrition intake associated with income growth, as well as the separation of some welfare benefits (i.e., primary education) from Hukou status during the ongoing Hukou reform. However, the results after the year 2000 show that child health disparities in terms of height are more seriously than that in terms of weight. [Liu, Rizzo, Fang, 2015].

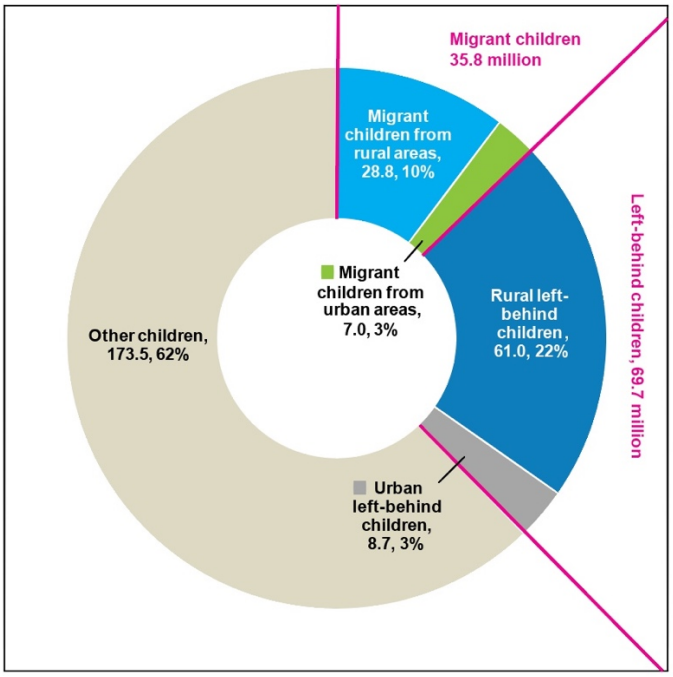

Figure 1: Children Affected by Migration in China, 2010

Source: Duan Chengrong et al. of the School of Sociology and Population Studies, Renmin University of China, estimation based on the 2010 Population Census conducted by the National Bureau of Statistics.

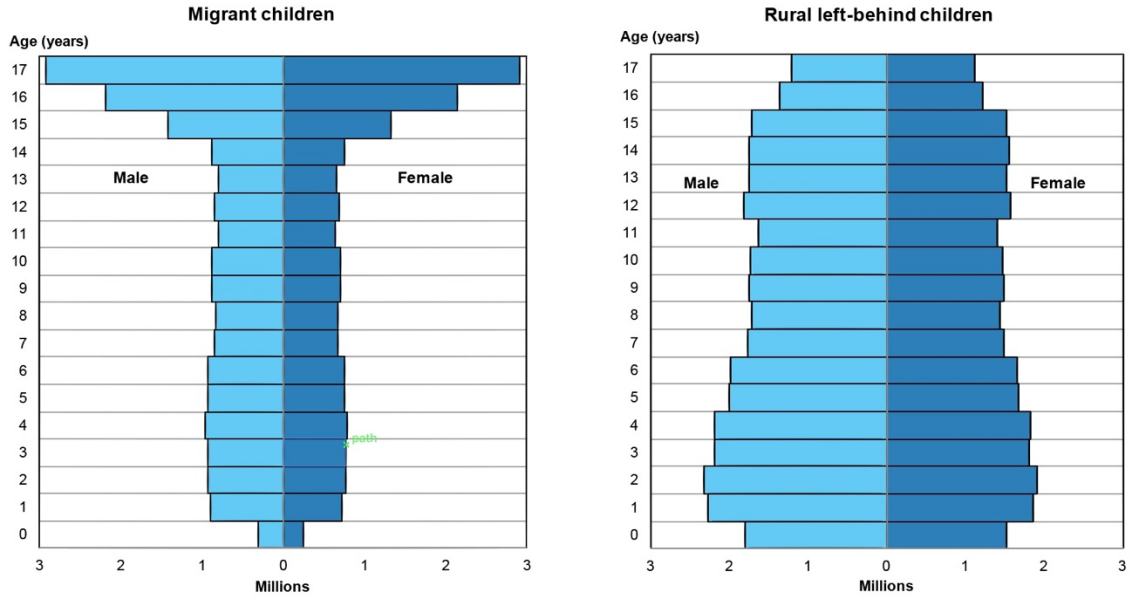

Figure 2: Age Structure of Migrant and Left-behind Children in China, 2010

Source: Duan Chengrong et al. of the School of Sociology and Population Studies, Renmin University of China, estimation based on the 2010 Population Census conducted by the National Bureau of Statistics.

There are other problems associated with Hukou status, such as migration and left-behind children, which makes things more complicated. As figure 2 indicates, by 2010, migrant children reached 35.8 million, while left-behind children reached 69.7 million. They accounted for 38 percent of all children in China, and this number continues to climb. Due to the limitations of Hukou status, parents who sought employment away from their hometown would choose either taking children with them or leaving them to be raised by grandparents or other relatives. Some studies have examined the effect of parental migration on the nutritional status of children left behind, and results were diverse. De Brauw and Mu's (2011) study of the nutritional status of left-behind children found that migration is positively associated with short-term measures of nutritional status presumably because of improved consumption level. And they also found that older children (aged 7 to 12) are more likely to be underweight, presumably because they spend more time doing household chores than children in non-migrant households. Younger children (aged 2 to 6) are found to be less likely to be overweight when no grandparent lives with them. The growth and development of migrated children were found to be better than left-behind children. Left-behind children usually lack breastfeeding and supervision from parents, and are more likely to consume low-quality milk powder. [Chen, Wang, Qu, 2010]

2. Child nutrition disparities and policy intervention

According to most studies, following the World Health Organization (WHO) standard, nutrition status in a population is indicated by the prevalence of stunting (low height-for-age), underweight (low weight-for-age), and wasting (low weight-for-height). In China, rapid economic development has helped to significantly reduce the prevalence of underweight and wasting, but stunting remains a problem. Based on the 2010 China Food and Nutrition

Surveillance, the prevalence of stunting in children under 5 years old in 2010 was as high as 20.3 percent in poor rural areas. Stunting is caused by poor feeding over a prolonged period and by the inadequate prevention and treatment of disease and infection. Many studies show that the nutritional status of children in China still face malnutrition, obesity, lacking of micronutrients, and other nutritional problems.

One critical problem is that the gap between urban and rural areas as well as between different regions is still wide. Previous studies indicate that the rate of malnourishment of rural children is higher than city children and the rate of obesity, and vitamin D deficiency disease of rural children is lower than city children. Previous studies also estimate the existence of reduced health outcomes among migrated and left-behind children. Undernourishment and underdevelopment remain severe problems among left-behind children, while migrated children tend to have a better nutrition and growth status. Left-behind children cannot be taken care of as well after their parents leave for work far away from their hometown, which might cause irregular diet and undernourishment. Besides, when grandparents replace parents' role as guardians, they usually have different diet habits from children and may be less conscious of necessary nutrients required for child growth, leading to stunting or underweight directly or indirectly. As for migrated children, they tend to be healthier than left-behind children because of obvious improvements in living conditions and health care. On the other hand, they also face greater risk of being overweight because of the prevalence of junk food in urban areas. In addition, due to limitations of Hukou status, migrated children are usually enrolled not in regular public schools, but in migrants' schools, where less attention is paid to students' diet and health status. [Chen, Wang, Qu, 2010]

Studies have also found that different household structures have distinctive effects on the health and nutrition status of left-behind children. For left-behind children from 0 to 5 years old, the absence of parents doesn't have a significant influence on their health status, which might be explained by the fact that grandparents who replace parents' role are relatively younger and able to take care of children as well as parents. But for left-behind children from 6 to 18 years old, the absence of parents plays a significantly negative role in health outcomes, especially when mothers don't live in the household with children. In addition, the influence of mothers' absence remains significant no matter how much income the household has, which indicates the importance of mothers' role in children's health outcomes. [Chen, 2009]

Evidence[3] indicates that the first 1,000 days of life is the most critical period for child development as this is when nutritional deficiencies have a significant and often irreversible adverse impact on children's survival and growth, affecting their ability to learn in school and to work productively in later life. With the growing attention paid to child health development, China has implemented many projects and systems to improve children's health-related outcomes. For example, the Chinese Food and Nutrition Surveillance System (CFNSS) was established to investigate trends of food purchase and nutritional status of people and to explore public nutrition-related problems during the great boost of economic development. Some policies such as distributing nutritional packages to children in poor counties took shape a long time after intervention in supplementary feeding for children. However, the perfection of a policy toward improving child nutrition still has a long road in China, since awareness about the importance of child nutrition has risen late among the people and governments.

[3] Horton S, Shekar M, MacDonald C et al., Scaling up nutrition: what will it cost? World Bank, 2009.

3. Other socioeconomic indicators

Massive studies have tested the influence of other indicators of child nutrition status, some of which I will take as control variables in my models. The impact of social policies and factors, household income and other family factors play an important role in children's health. Disease, and genetic and other personal factors have a direct impact on the nutritional status of infants. Factors such as place of residence, low birth weight, age and gender have statistically significant impacts on malnutrition. [Cai, 2015]

Parents' educational level and family income are critical measures. According to Zhao (2005), the effect of education on health is significantly positive. The positive relationship between health and education is also robust. This means that it is possible to use education as a practical tool to improve the health of the population. Investing in education not only increases productivity and income, but it also improves health status; meanwhile health is found to be positively correlated with income (Liu, et al. 2004). As figure 3 shows, both urban and rural household income have stably increased in the past two decades. When formulating human capital policy, it is reasonable to consider health and education together.

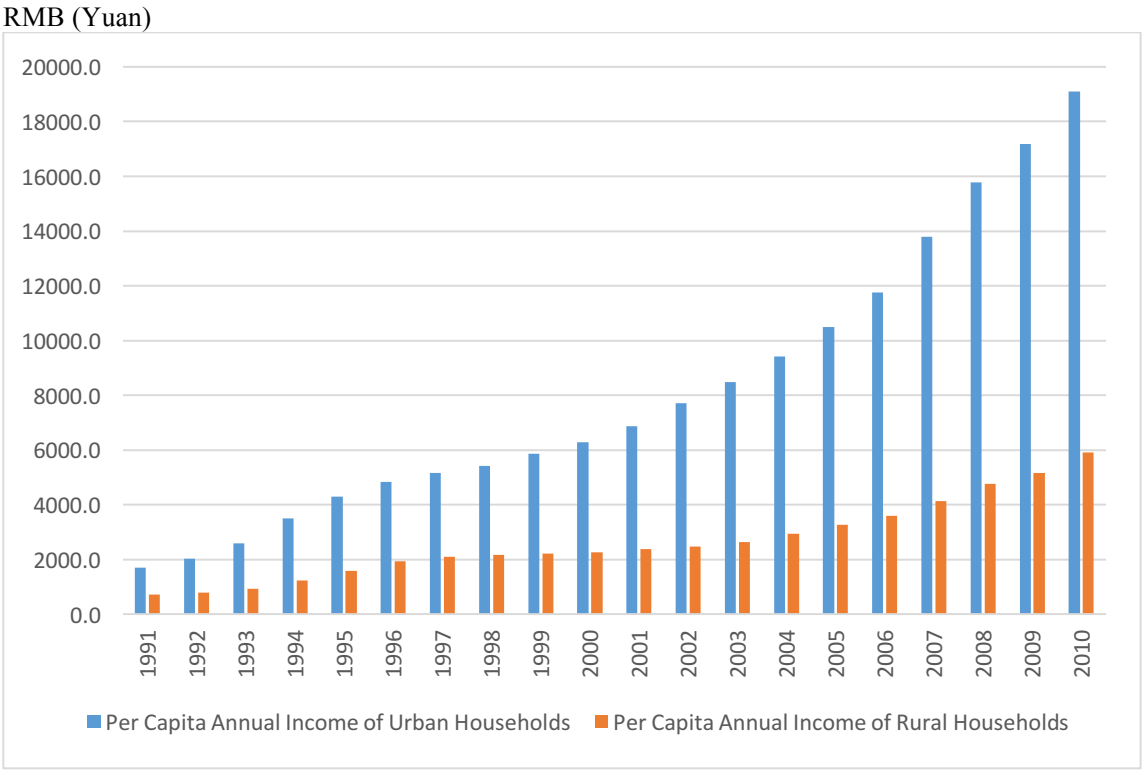

Figure 3: Per Capita Annual Income of Urban and Rural Households, 1991-2010

Source: National Bureau of Statistics, China Statistical Yearbook, 2011.

Extending from the discussion about family income above, parental health consciousness, household sanitation conditions, and nutrition intake are the channels through which family income affects child health (Goode, Mavromaras, Zhu, 2014), which can explain around 20 percent of the overall income effect. Another indicator associated with education is breastfeeding for babies, which has a profound impact on a child's survival, health, nutrition and development. Breastmilk provides all of the nutrients, vitamins and minerals an infant needs for growth during the first six months of life. In addition, breastmilk carries antibodies from the mother that help combat disease. While the majority of mothers produce enough milk to support the normal growth and development of their babies, breastfeeding in China is undermined by the aggressive marketing of infant formula. Other reasons why mothers do not breastfeed is that they are ill-

advised by relatives, friends or health workers or not adequately supported after returning to work. However, there are no studies that have proved that breastfeeding has a direct impact on childhood excessive weight or obesity over the long term.

4. The present paper

This paper will contribute to the literature by implementing a quantitative assessment of disparities in children's weight status in China, under several categories. My goal is for this analysis to specify inequalities and differences of children's weight status between urban and rural regions, and migrated and left-behind groups. My regression model will evaluate whether these categories, along with other relevant socioeconomic indicators, have an effect on child's body mass index, and how much BMI differ among children. As the literature I have highlighted shows, studies of the disparities of child nutrition status is nothing new, and there are many papers based on the CHNS data. However, my study will be the first to focus on childhood high weight and obesity, connect migration or left behind-ness of children with Hukou policy, and then examine the influence of these indicators as they are interacted and consolidated.

In the next section, I present my theoretical framework.

III. Theoretical Framework

In order to test the disparities of BMI between urban and rural, and migrated and left-behind children, I developed the theoretical model described below. This model provides a framework for the discussion that follows by comparing children's BMI under different categories and illustrating the factors that should, in theory, influence children's BMI. I developed the empirical model that follows with this framework in mind, and the empirical model tests the implications of the theoretical model. My theoretical model is:

$$BMI = f(\text{Hukou status}, \text{Current residence}, D, \mu) \quad (1)$$

Where Hukou status refers to children's household registration type, that is, urban or rural; and current residence indicates whether children live in urban or rural areas when surveyed. Note here that children with a rural Hukou type may also live in urban areas due to migration or other reasons. Inconsistency between Hukou status and current residence serves as an evidence for determining if children are migrated or left-behind in this research. D represents other socioeconomic factors that could impact children's health outcomes, such as parents' education, household income, or parental habits.

This general framework is intended to assess the relationship between children's Hukou type, current residence, some relevant socioeconomic determinants and their BMI, to test whether disparities exist in health outcomes between urban and rural children. The hypothesis of this study is that children living in urban areas tend to have a better nutritional status -- in this study, a normal BMI -- than their rural counterparts. In most cases, living in urban areas means that children have an urban Hukou status or children's current residence is in urban areas, even if they have a rural Hukou status. In the latter case, they are very likely to have migrated along with

their parents seeking employment in cities. This study also assesses the effect of some relevant socioeconomic factors, such as education and income, on children's BMI.

Previous studies showed that urban children have more access to high-quality health care, education, and multiple food choices and thus are more likely to obtain a better nutrition-related health outcome. Due to better living conditions and supervision from parents, they are more nutritionally healthy than children who live in or are left-behind in rural hometown. In addition, parents' education and income also have and important influence on children's nutritional outcomes. This study assumes that prior research has proven disparities valid, but they usually refer to overall health related outcomes rather than BMI. More specifically, the factors affecting discrepancies in normal weight, high weight or underweight among children from different groups remain unclear. Given that BMI is an important indicator for measuring health outcomes, I expect similar results to previous findings.

The next section describes the empirical model I estimate.

IV. Empirical Model Specification

I use three sets of regressions to determine the effect of Hukou status, current residence, absence of parents, education, income, and province on children's BMI. The first set of regressions are pooled Linear Probability Models (LPM) with the same variables for normal BMI, underweight BMI and overweight BMI respectively. These regressions include the Hukou status of the child, current residence of the child, whether parents live in the household, household income, and the education of the mother as independent variables and test their relevance to my three BMI categories. Furthermore, I will also control for children's gender, the province in which they currently live, and the survey year (covering 2000, 2004, 2006, and 2009).

My second set of regressions are logit regression models testing the same hypothesis with same set of independent variables. The results of these regressions provide a concrete comparison of BMI with multiple figures. The third set of regressions are fixed effects regression models with Province as the panel variable. Since Province is an ordinal variable, ranging provinces from lowest GDP to highest in 2011, results of these regressions reflect the effects to some degree of economic development level on children's health outcomes. Results of my logit and fixed effects models serve as supplements to my LPM results.

In all three sets of regressions, the dependent variable, BMI, is always a dummy variable with separate ways to categorize. But, I use the following model in all sets of regressions:

$$\begin{aligned}\text{BMI} = {} & \beta_0 + \beta_1 * \text{Hukou status of child} + \beta_2 * \text{ Current residence of child} + \\ & \beta_3 * \text{Whether father lives in household} + \beta_4 * \text{Whether mother lives in household} + \\ & \beta_5 * \text{Highest education level of mother} + \beta_6 * \text{Years of formal education taken by mother} + \\ & \beta_7 * \text{Household income} + \beta_8 * \text{Gender of child} + \beta_9 * \text{Age} + \beta_{10} * \text{Province} + \\ & \beta_{11} * \text{Survey year 2000} + \beta_{12} * \text{Survey year 2004} + \beta_{13} * \text{Survey year 2006} + \\ & \beta_{14} * \text{Survey year 2009} + \mu \end{aligned} \quad (2)$$

In this model, the dependent variable BMI is constructed using the prevalent reference standard, which is defined as the body mass divided by the square of the body height, and is universally expressed in units of kg/m^2, resulting from mass in kilograms and height in meters. In this study, there are three different kinds of BMI that fall into separate categories serving as dependent variables. A BMI over 18.5 and under 25 indicates that the child has a normal weight; and a BMI under 18.5 indicates that the child is underweight; while a BMI over 25 means that the child is overweight or obese.

There are several primary categorical independent variables. Hukou status of child is an indicator variable that equals 1 if the respondent has an urban Hukou type and zero if it is rural. The Hukou status refers to the household registration status of children, determining their eligibility for various welfare benefits, such as health care, education, housing, and employment, which may lead to nutritional and health disparities. There are two types of household registration, urban and rural. But in many cases, possessing a rural household registration doesn't mean that the respondent has to live in rural areas, which makes real situations more complicated. Hence, I use another critical independent variable, Current residence of the child. This variable represents children's present place of residence, and it doesn't have to be consistent with their Hukou status. In reality, if children with a rural Hukou status lives in urban areas, it is very likely that these children are migrants from rural areas. Given the hypothesis that children with an urban Hukou status or living in urban areas tend to have a better health outcome than those in rural areas, the anticipated sign on Hukou status and Current residence of child is positive, which would indicate a healthier weight status.

Whether the father or mother lives in household indicates the absence of parents during children's growth. If parents are absent from household, it is very likely that children are left

behind. I anticipate a negative sign on these two indicators. Besides, in the context of China, it is usually mothers that take most of responsibility to raise children. Therefore, expected that the result will show a significant difference in the magnitudes of the coefficients of father's and mother's absence.

I intend to test the relationship between children's BMI and several external factors. Education of mother represents mothers' educational status, which is measured by years of education in regular school and highest level of education attained by mothers. Parents with higher educational level are more likely to focus on their children's diet, which may yield a better health outcome of children. Note here I exclude the education of the father from the model, which is consistent with a commonsense that mothers have a bigger influence on children's nutritional outcomes. Besides, this variable is highly related to Household income. Higher household income is expected to increase the spending on food and thus enrich the diversity of nutrient intake of children. It is hard to anticipate where this result will go. In general, higher income is usually associated with better health consciousness of parents, especially mothers, and thus lead to a balanced diet and healthy weight of children. But on the other hand, more diversified food choice brought by high income would also increase risks of overweight or obese children.

Furthermore, I include several control variables to account for demographic factors that might impact consequences, the first of which is Age, a continuous variable for which I expect a positive sign. Gender is an indicator variable; it is unclear that gender has an apparent effect on children's BMI based on previous studies. Province is an ordinal variable that indicates provinces from lowest to highest GDP in 2011, which would be a helpful reference to assessing

the effect of other economic factors. Finally, Survey year 2000, 2004, 2006, and 2009 serve to account for total effects over time.

In the next section, I describe my data, covering data source, variables description, data combination, and descriptive statistics.

V. Data and Descriptive Statistics

In order to test my hypothesis, my study utilizes longitudinal data from the China Health and Nutrition Survey (CHNS)[4], which is an international collaborative project between the Carolina Population Center at the University of North Carolina at Chapel Hill and the National Institute for Nutrition and Health (NINH, formerly National Institute of Nutrition and Food Safety) at the Chinese Center for Disease Control and Prevention (CCDC). The CHNS was designed to examine the effects of the health, nutrition, and family planning policies and programs implemented by China's national and local governments and to see how the social and economic transformation of Chinese society is affecting the health and nutritional status of its population.

The survey was conducted by an international team of researchers whose backgrounds include nutrition, public health, economics, sociology, Chinese studies, and demography. The survey took place over a 7-day period using a multistage, random cluster process to draw a sample of about 7,200 households with over 30,000 individuals in 15 provinces and municipal cities that vary substantially in geography, economic development, public resources, and health indicators. In addition, detailed community data were collected in surveys of food markets, health facilities, family planning officials, and other social services and community leaders. The data sets cover the individual level, household level and community level, and have been updated to 2011.

In the original dataset, there are dozens of subsets that specifically target different aspects, such as individual information, household income, and education, and so forth. Therefore, before I conducted final regressions, I merged several subsets I need with Individual

[4] China Health and Nutrition Survey, http://www.cpc.unc.edu/projects/china.

ID, Household ID, and Survey year as the unit of dataset, including individual information (covering information about Hukou status, current residence, age, province, survey year, etc.), physical examination (covering information about height, weight, smoking, etc.), household income, education, and so on. After merging them into one single dataset, I construct BMI with height and weight data.

The three dependent variables, BMI, are dummy variables that categorize children's body mass index respectively into Normal/Abnormal, Underweight/Not underweight, and Overweight/Not overweight groups. For the first type of BMI, BMI is recoded as 1 if it is normal and 0 otherwise, so are the second and third type of BMI.

The two primary independent variables of interest are HUKOU STATUS OF CHILD and CURRENT RESIDENCE OF CHILD. The former accounts for the child's household registration type, which is coded as 1 for the urban group and 0 for the rural group. Similarly, the variable CURRENT RESIDENCE OF CHILD is coded as 1 for those living in urban areas and 0 for those in rural areas.

Both WHETHER FATHER LIVES IN HOUSEHOLD and WHETHER MOTHER LIVES IN HOUSEHOLD are indicator variables, coded as 1 if the parent in question lives in the household and 0 if they are absent. Although these two variables cannot accurately determine whether children are left behind, they provide a sense of whether parents accompany their children when they are growing up. Basically, left-behind-ness of children is also a kind of parental absence, and thus these two variables might indicate left-behind-ness.

The education of parents is an important indicator, which includes the variables FATHER/MOTHER'S HIGHEST LEVEL OF EDUCATION and YEARS OF FORMAL EDUCATION TAKEN BY FATHER/MOTHER. The highest level of education is an ordinal

variable recoded as 0 to 6, representing education level from none to master's degree or above. Years of formal education is a continuous variable that indicates how many years parents spend in regular schools. Another highly related indicator is income, which includes the continuous variables TOTAL NET INDIVIDUAL INCOME OF FATHER/MOTHER, TOTAL NET HOUSEHOLD INCOME and TOTAL GROSS HOUSEHOLD INCOME. Note here that I use only total net household income as an independent variable accounting for income factor in my regressions.

The dummy variables DOES FATHER/MOTHER EVER/STILL SMOKE and continuous variables NUMBER OF CIGARETTES TAKEN BY FATHER/MOTHER PER DAY are variables to reflect whether parents' unhealthy habits impact children's health outcomes. However, the importance of these variables is unclear because there is not a direct relationship between parents smoking and children's BMI. In addition, smoking is not the only unhealthy habit that could impact children's health. Therefore, it is very hard to determine whether smoking has an effect in reality.

AGE OF CHILD is a continuous control variable, indicating the age of the child when taking the survey, which was not recoded. GENDER OF CHILD is an indicator variable that equals 1 if the respondent is male and 2 if the respondent is female. PROVINCE is an ordinal variable that ranges provinces from lowest GDP to highest GDP, showing which province the child lives in when surveyed. Additionally, SURVEY YEAR from 1991 to 2011 (covering 8 rounds) is an indicator variable accounting for the effects of time. In my regressions, I include only four rounds of the survey – 2000, 2004, 2006 and 2009; because in these four rounds are most complete. HEIGHT and WEIGHT are used to construct the BMI variable.

Descriptive statistics for each of these variables are included in Table 1 below.

Table 1: Descriptive Statistics

VARIABLE	NUMBER OF OBSERVA-TIONS	MEAN	MIN	MAX	STANDARD DEVIATION
BMI CATEGORY[i]	21906				
Normal (=1)	5107	0.233	0	1	0.423
Abnormal (=0)	16799				
BMI CATEGORY[ii]	21906				
Underweight (=1)	14316	0.654	0	1	0.476
Not underweight (=0)	7590				
BMI CATEGORY[iii]	21906				
Overweight (=1)	2483	0.113	0	1	0.317
Not overweight (=0)	19423				
HUKOU STATUS OF CHILD	17567				
Urban (=1)	5522	0.314	0	1	0.464
Rural (=0)	12045				
CURRENT RESIDENCE OF CHILD	21906				
Urban (=1)	5980	0.273	0	1	0.446
Rural (=0)	15926				
WHETERH FATHER LIVES IN HOUSEHOLD	21072	0.035	0	1	0.185
Yes (=1)	745				
No (=0)	20327				
WHEHTER MOTHER LIVES IN HOUSEHOLD	20645	0.048	0	1	0.214
Yes (=1)	991				
No (=0)	19654				
FATHER'S HIGHEST LEVEL OF EDUCATION	19933				
None (=0)	1902				
Grad from primary (=1)	4296				
Lower middle school degree (=2)	8574	1.978	0	6	1.150
Upper middle school degree (=3)	3510				
Technical or vocational degree (=4)	823				
University or college degree (=5)	801				
Master's degree or higher (=6)	27				
YEARS OF FORMAL EDUCATION TAKEN BY FATHER	19421	11.456	0	26	5.299

Table 1: (cont.)

VARIABLE	NUMBER OF OBSERVA-TIONS	MEAN	MIN	MAX	STANDARD DEVIATION
MOTHER'S HIGHEST LEVEL OF EDUCATION None (=0) Grad from primary (=1) Lower middle school degree (=2) Upper middle school degree (=3) Technical or vocational degree (=4) University or college degree (=5) Master's degree or higher (=6)	20807 4869 4778 7208 2442 822 678 10	1.598	0	6	1.257
YEARS OF FORMAL EDUCATION TAKEN BY MOTHER	20138	9.335	0	26	6.178
TOTAL NET INDIVIDUAL INCOME OF FATHER	18221	7552.312	--	480000	15550.8
TOTAL NET INDIVIDUAL INCOME OF MOTHER	15917	5048.297	--	360400	10148.29
TOTAL NET HOUSEHOLD INCOME	18142	16343.39	--	622127.6	27641.12
TOTAL GROSS HOUSEHOLD INCOME	18135	19185.86	0	808916	31457.15
DOES FATHER EVER SMOKE Yes (=1) No (=0)	16841 11578 5263	0.689	0	1	0.481
DOES MOTHER EVER SMOKE Yes (=1) No (=0)	17077 322 16755	0.020	0	1	0.181
DOES FATHER STILL SMOKE Yes (=1) No (=0)	11355 11110 245	0.981	0	1	0.195
DOES MOTHER STILL SMOKE Yes (=1) No (=0)	303 293 10	0.967	0	1	0.179
NUMBER OF CIGARETTES TAKEN BY FATHER PER DAY	11073	16.625	--	90	8.984
NUMBER OF CIGARETTES TAKEN BY MOTHER PER DAY	290	10.441	0	30	6.878
GENDER OF CHILD Male (=1) Female (=2)	18221 9729 8492	1.466	0	1	0.499

Table 1: (cont.)

VARIABLE	NUMBER OF OBSERVA-TIONS	MEAN	MIN	MAX	STANDARD DEVIATION
AGE OF CHILD	18221	9.716	0	17.9	4.799
PROVINCE	17739				
Guizhou (=1)	2559				
Chongqing (=2)	126				
Guangxi (=3)	2635				
Heilongjiang (=4)	1182				
Beijing (=5)	187				
Shanghai (=6)	161	6.737	1	12	3.698
Hubei (=7)	2187				
Hunan (=8)	1889				
Liaoning (=9)	1413				
Henan (=10)	2075				
Shandong (=11)	1617				
Jiangsu (=12)	1708				
SURVEY YEAR	18221				
1991	3908				
1993	3383				
1997	3250				
2000	2436	1998.38	1991	2011	6.610
2004	1513				
2006	1141				
2009	1156				
2011	1434				
HEIGHT (CM)	16707	129.391	10.6	186	27.134
WEIGHT (KG)	16985	30.474	1	100.4	15.021

In the next section, I report my regression results.

VI. Findings and Analysis

Overall, I ran nine total regressions, including three pooled LPM regressions, three pooled logit regressions, and three fixed effects regressions with Province as the panel variable. Almost all results are all highly jointly significant, with F-statistics indicating joint significance well above the 99 percent level of confidence. The R-squared values are reasonable. There is a high number of significant coefficients, and the signs are consistent with reasonable interpretations.

To clarify, I include only variables that are most relevant to children's BMI based on previous literature, such as mother's education and household income. I drop some variables, like father's education, parents' individual income, or whether parents smoke because of either loose relevance or too many missing values. But a lack of data in some variables casts doubt on some of my LPM and fixed effects results. I hope to focus on indicators that are most critical. The results are summarized in Table 2, Table 3 and Table 4 below.

Table 2: Pooled LPM Regression Results

MODEL SPECIFICATION	WHETHER CHILD HAS A NORMAL WEIGHT		WHETHER CHILD IS UNWEIGHT		WHETHER CHILD IS OVERWEIGHT	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
Hukou status	0.037***	4.32	-0.031***	-3.20	-0.006	-0.86
Current residence of child	0.027***	3.38	-0.027***	-2.98	-0.0002	-0.03
Whether father lives in household	-0.006	-0.19	-0.042	-1.23	0.048	1.79
Whether mother lives in household	0.011	0.41	0.022	0.76	-0.033	-1.52
Highest education level of mother	0.020**	2.22	-0.034***	-3.31	0.014*	1.92
Years of formal education of mother	-0.003*	-1.61	0.005***	2.71	-0.003*	-1.83
Household income	5.42e-07***	4.63	-6.01e-07***	-4.83	5.84e-08	0.61
Gender of child	-0.002	-0.26	0.006	0.84	-0.005	-0.86
Age	0.030***	39.27	-0.028***	-32.47	-0.002***	-2.72
Province	0.008***	8.55	-0.014***	-13.63	0.006***	8.70
Survey year 2000	0.009	0.88	0.042***	3.66	-0.052***	-7.74
Survey year 2004	0.034***	3.27	-0.077***	-6.59	0.044***	4.92
Survey year 2006	0.027**	2.50	-0.082***	-6.41	0.055***	5.57
Survey year 2009	0.008	0.69	-0.042***	-3.15	0.034***	3.44
Constant	-0.149***	-9.92	1.047***	59.87	0.102***	8.14
Number of observations	15260		15260		15260	
F-statistics	132.93		115.01		19.35	
R-squared	0.1259		0.1012		0.0152	

* Statistically significant at 10% level;
** Statistically significant at 5% level;
*** Statistically significant at 1% level.

Table 3: Logit Regression Results

MODEL SPECIFICATION	WHETHER CHILD HAS A NORMAL WEIGHT		WHETHER CHILD IS UNDERWEIGHT		WHETHER CHILD IS OVERWEIGHT	
	Coefficient	z-score	Coefficient	z-score	Coefficient	z-score
Hukou status	.207***	4.14	-.137***	-3.06	-.057	-0.87
Current residence of child	.154***	3.25	-.123***	-2.92	-.005	-0.09
Whether father lives in household	-.025	-0.13	-.208	-1.27	.434*	1.78
Whether mother lives in household	.075	0.47	.110	0.79	-.326	-1.43
Highest education level of mother	.135**	2.42	-.169***	-3.45	.131*	1.94
Years of formal education of mother	-.019*	-1.69	.028***	2.80	-.025*	-1.81
Household income	3.15e-06***	4.32	-2.82e-06***	-4.53	4.17e-07	0.53
Gender of child	-.005	-0.11	.029	0.81	-.044	-0.87
Age	.198***	31.65	-.135***	-28.47	-.016***	-2.67
Province	.049***	8.85	-.066***	-13.62	.058***	8.56
Survey year 2000	.062	1.02	.201***	3.62	-.684***	-6.52
Survey year 2004	.153**	2.48	-.347***	-6.37	.378***	5.30
Survey year 2006	.140**	2.03	-.383***	-6.38	.460***	6.13
Survey year 2009	.037	0.50	-.201***	-3.15	.301***	3.68
Constant	-3.93***	-33.15	2.60***	27.60	-2.19***	-18.38
Number of observations	15260		15260		15260	
Chi-squared	1188.43		1135.36		225.63	
R-squared	0.1249		0.0812		0.0212	

* Statistically significant at 10% level;
** Statistically significant at 5% level;
*** Statistically significant at 1% level.

Table 4: Fixed Effects Regression Results with "Province" as the Panel Variable

MODEL SPECIFICATION	WHETHER CHILD HAS A NORMAL WEIGHT		WHETHER CHILD IS UNDERWEIGHT		WHETHER CHILD IS OVERWEIGHT	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
Hukou status	.026*	1.94	-.030	-1.31	.003	0.28
Current residence of child	.029***	4.04	-.027***	-3.59	-.002	-0.25
Whether father lives in household	-.009	-0.31	-.041	-1.50	.050**	2.75
Whether mother lives in household	.013	0.42	.010	0.46	-.023	-1.52
Highest education level of mother	.013	1.08	-.023	-1.60	.011	1.27
Years of formal education of mother	-.002	-1.05	.004*	2.05	-.002	-1.32
Household income	4.32e-07***	3.25	-6.26e-07***	-4.79	1.94e-07*	2.12
Gender of child	-.004	-0.61	.008	1.72	-.004	-1.34
Age	.030***	17.74	-.028***	-16.03	-.002	-1.73
Survey year 2000	.014	0.85	.035*	2.18	-.049**	-2.97
Survey year 2004	.040**	2.47	-.083***	-3.10	.043	1.36
Survey year 2006	.033**	2.84	-.087**	-3.00	.054*	1.88
Survey year 2009	.018*	2.03	-.048***	-3.88	.030*	1.97
Constant	-.086***	-6.12	.951***	51.71	.135***	8.71
Number of observations	15260		15260		15260	
Rho-value	.027		.023		.016	
R-squared	0.1208		0.0899		0.0103	

* Statistically significant at 10% level;
** Statistically significant at 5% level;
*** Statistically significant at 1% level.

In general, my regression results reflect a highly significant connection between children's Hukou status and their BMI. Among all three kinds of regression, children with an urban type of household registration are more likely to have a normal weight, while being less likely to be underweight. Meanwhile, children's current residence indicates that children living in cities are also coming off better in terms of healthy weight than children living in rural areas. These results are consistent with the hypothesis that the living conditions and health resource access of urban areas outbalance those in rural areas, which may lead to the fact that urban children have a better nutritional health status compared to their rural counterparts. The main reason for child health disparities due to the Hukou system is that Hukou restricts access to health care, education, employment, and other welfare benefits for rural people.

There are two channels linking Hukou and children's nutritional status. The first channel is that rural children are usually left behind due to the Hukou restrictions on their eligibility for local compulsory education, as well as high urban living costs given their migrant parents' limited incomes. Rural parents, who move to long-distance destination cities or have lengthy commutes to and from work, and may spend less time on food preparation and child healthcare. Left-behind children who are living with their grandparents or attending boarding schools in rural China are more likely to suffer from malnutrition problems because of limited health knowledge of grandparents, poor food quality in boarding schools, or a lack of access to safe drinking water in rural villages.

The results also show that mothers' education contributes a lot to children's BMI. If a mother gets higher level of education, children are more likely to have a normal weight and are less likely to be underweight. This is consistent with the hypothesis that mothers with higher level of education pay more attention to children's nutrient intake and have more awareness of

guiding children to eat a balanced diet. Meanwhile, consistent with the assumption that higher household income is associated with better health status of children, household income is significantly positively associated with children's normal weight in those models.

The influence of Hukou status on children's BMI is a focal point of my research. All three kinds of regressions show a statistically significant association between Hukou status and children's BMI. In my pooled LPM regressions, having an urban Hukou is associated with a 0.037 change in BMI towards a normal weight, and with a negative 0.031 change in BMI away from being underweight. The effect of Hukou status on whether a child is overweight is not statistically significant, but shows a sign that urban Hukou type reduces the possibility of being overweight by 0.006. The results in my logit regressions have the same outcomes in direction as the results of my pooled LPM models. Children with an urban Hukou type are 1.23 times more likely than rural children to have a normal weight, and their odds of being underweight are 0.87 times lower. In my fixed effects regressions, although the coefficients on Hukou status are not statistically significant, they both show the same direction with other two kinds of models.

The current residence of child is another critical independent variable. As presumed, the significance, sign, and magnitude of the coefficients on this variable are very close across regressions, with most significant at the 99 percent level of confidence, with a positive sign, and a magnitude well below one. In my pooled LPM regressions, an urban Hukou is associated with a 0.027 change in a child's BMI towards a normal weight, and is associated with a negative 0.027 change in BMI away from being underweight. In my logit regressions, children with an urban Hukou are 1.17 times more likely than rural children to have a normal weight, and their odds of being underweight are 0.88 times lower. In my fixed effects regressions, children with an

urban Hukou type are associated with a 0.029 change towards a normal weight, and are negatively associated with a 0.027 change away from being underweight.

In addition, my results showed that the education of a mother matters a lot to children's BMI, especially at the highest level of a mother's education. Generally, children whose mother obtains a higher level of education are more likely to have a normal weight and are less likely to be underweight, at a 95 percent or higher significance level. In my pooled LPM models, one unit of increase in the mother's highest education level is associated with a 0.020 unit increase toward having a normal BMI, and is associated with a 0.034 unit decrease away from having an underweight BMI, as well as a 0.014 unit increase toward being overweight at the 90 percent significance level. In my logit models, one unit of increase in the mother's highest education level is associated with children being 1.14 times more likely to have a normal weight, being 0.84 times less likely to be underweight, and 1.14 times as likely in being overweight. In my fixed effects regressions, the results are not statistically significant, but show the same direction as the other models.

Another significant indicator is household income. The significance, sign, and magnitude are very close across regressions, with most significant at the 99 percent level of confidence, with a positive sign on normal BMI and overweight BMI, and a negative sign on underweight BMI, and a magnitude well below one. Another similar indicator is province, which is an ordinal ranking of provinces from lowest to highest GDP, also with the significance, sign and magnitude very close across regressions. In my pooled LPM models, each one unit increase in a Province ranking (like from 4 to 5) is associated with a 0.008 change towards a normal BMI. For the underweight BMI, each one unit increase in a Province ranking is associated with a 0.014 change in BMI away from an underweight BMI. For the overweight BMI, each one unit increase in a

Province ranking is associated with a 0.006 change in BMI toward an overweight BMI. This result is consistent with the assumption that either from an individual perspective or social perspective, being richer makes children healthier overall (a normal BMI is more likely), less likely to be underweight but a little more likely to be overweight or obese.

My models also include statistically insignificant results that contradict in my assumptions. For example, for overweight BMI, the logit and fixed effects regressions shows a statistically insignificant association between a father/mother living at home and BMI. However, father living in the household is negatively associated with an abnormal BMI and an underweight BMI, and positively associated with an overweight BMI, perhaps because the father living in the household is also correlated with Province GDP, which, measured by the Province variable, shows the same results. In the regressions where this variable is significant (at the 90 percent level of confidence for overweight BMI for logit, and the 95 percent level of confidence for fixed effects), the results indicate that children with at least one parent living in a household are taken care of better and thus are more likely to be overweight or obese.

VII. Limitations

My study has some limitations that must be acknowledged. First, due to data limitations, I use only body mass index to measure child nutrition-related health outcome. But child health status is multidimensional and body mass index is only one dimension, albeit an important one. In addition, the method I use to construct BMI follows WHO's standards for measuring adults' BMI because of a lack of relevant data in original dataset, which might cause inaccuracy of my results.

Second, I am unable to identify the place of origin and migration status of parents and children in the CHNS data, and cannot control for this effect in the multivariate analysis. The Hukou system not only splits the population into urban and rural Hukou holders, but also links people with their place of origin. Migrants without local Hukou status, especially in large cities, are not entitled to the full spectrum of welfare programs provided by local governments. With an increasing trend of internal migration in China since the 1990s, it is important to further evaluate the distinction between local and non-local Hukou as a critical factor in predicting children's health status in future research, when the data become available. Therefore, in my study, whether father or mother lives in the household cannot accurately reflect whether the child is a migrant, but is used for indicating whether child lives with only one parent.

VIII. Conclusions and Policy Implications

1. Conclusions

The purpose of this study was to examine whether children with an urban Hukou status or living in urban areas are more likely to have a normal BMI, that is, a healthy weight, compared to their rural counterparts. Given that previous literature that largely supports the argument that disparities based upon Hukou status, place of residence and other socioeconomic characteristics do exist for all children in different groups, I hypothesized that disparities in terms of children's weight status would exist for urban and rural children.

My hypothesis regarding urban and rural disparities in terms of children's BMI was based upon the fact that Hukou status determines eligibility for various welfare benefits, such as health care, education, housing, and employment, which could lead to disparities in health outcomes between urban and rural children. Besides, due to the limitation of Hukou status, many rural children either migrated with or are left behind by parents who seek employment in bigger cities. Parental absence could also contribute to children's health outcomes.

To test this hypothesis, I completed a multivariate analysis of the year from 2000 to 2009 of the China Health and Nutrition Survey. Specifically, I conducted 9 separate regressions using pooled LPM, logit and fixed effects analyses. I set out to study how much difference of children's BMI is caused by Hukou status, migration and left-behind-ness, along with interactive effects on the child nutrition status of these indicators. On this point, the literature supports the theoretical framework I have developed in a quantitative sense. I hoped to see the output that there is an obvious distinction regarding BMI between children living in urban areas and in rural areas, in which Hukou policy plays a vital role. Meanwhile, I also expected to see the influences

of migration and left-behind-ness were statistically significant, reflecting more complex social problems and requesting a specific policy framework.

My hypothesis was strongly supported, as most results of these regressions yield consistent results for my assumptions. In all three sets of regressions, it showed that children with an urban Hukou status are more likely to have a normal weight, while being less likely to be underweight. Meanwhile, children's current residence indicates that children living in cities are also coming off better in terms of healthy weight than children living in rural areas in terms of BMI. Additionally, the education of mother and household income is proved to have a positive influence on children's BMI.

However, my regressions also failed to yield some assumed results. Contrary to my assumption that parental absence has a negative influence on children's health outcomes, whether father or mother lives in the household showed a statistically insignificant impact on children's BMI. This might be caused by shortcomings of data, in which these two indicators cannot reflect the actual situations of parental absence. In another words, in this dataset, it cannot be determined accurately whether a child is a migrant from rural areas or just left behind. However, based upon previous literature and common sense, I believe parental accompaniment is very important to children's health outcomes.

2. Policy implications

In general, policy implications for preventing childhood overweight and obesity should be put into the broader scale of improving children's nutritional status, since BMI is an important indicator for child health, and childhood obesity is a type of malnutrition. The policy implications cover multiple sectors. Since the Hukou system is going to function for a long

period and consequent disparities between urban and rural population cannot be changed within this system, policy implications outside of the Hukou system should be considered. Such policies should be aimed at improving the living environment of children, especially for those living in poor areas. Effective interventions should be implemented in the areas where the problems are prominent, such as distributing nutritional packages to disadvantaged children. The child nutrition monitoring system should be improved to provide reliable data. Additionally, efforts from the public should be encouraged. Multi-sector cooperation among the government, NGOs, and charities should be strengthened in order to cope with the multilevel health hazard. And local economics should be developed to decrease the gap between urban and rural areas. From an academic perspective, health education should be strengthened and more child nutrition research should be launched to expand child nutrition knowledge. Specific policy interventions could be considered in the following two areas.

2.1 Leadership and organization

Improving children's nutritional status requires a strong political commitment, which should be dominated by central and local governments. As a long-term fundamental task, services to improve child nutrition should be delivered as a public good. However, due to a lack of awareness about the harm caused by malnutrition, governments in developing countries usually have a relatively weak political commitment to improving child nutrition status. Therefore, a high-level of planned policy intervention in the political scheme is required to solve this problem.

Besides, child nutritional intervention policy should be included in the national anti-poverty and economic development policy scheme due to the fact that poverty and low income

are statistically significantly associated with malnutrition. Studies show that economic growth is overall beneficial to improving nutritional status, but it is not the decisive factor for children's nutritional status. Basically, the child nutrition issue is not isolated from the whole social system. Combining nutrition policy with education, health care, social safety nets and other policies would achieve multiple positive outcomes.

2.2 Institutional design and implementation mechanism

Supporting the steady function of nutrition policy requires building sustainable financial budgetary packages. Without stable financial support, the commitments of government are only empty words. The budgetary proposals for improving nutritional status should be clarified in government reports and working plans, which should include funding sources, amounts, and allocation of funding.

Second, a community-involved implementation mechanism should be developed to help in improving children's nutritional status. Communities have direct interaction with children and play a critical role in children's growth. Therefore, building the capacities of communities to design, monitor and manage community-based nutrition intervention policies could have a major influence on people's consciousness about nutrition and child development. Moreover, a community-based working mechanism would cost less than a top-to-bottom management model.

References

Hong, Liu; John, A. Rizzo; Hai, Fang. 2015. Urban-rural disparities in child nutrition related health outcomes in China: The role of hukou policy. *BMC Public Health* 15:1159.

Mu, Ren; De Brauw, Alan. 2013. Migration and Young Child Nutrition: Evidence from Rural China. *IZA Discussion Paper*, No. 7466.

Alan, de Brauw; Ren, Mu. 2012. Unattended but Not Undernourished -- Young Children Left Behind in Rural China. *International Food Policy Research Institute*.

Leng, Lee; Albert, Park. 2010. Parental Migration and Child Development in China. *ScholarlyCommons*. http://repository.upenn.edu/gansu_papers/24.

Zhong, Zhao; IZA, Bonn; CCER, Peking University. 2015. Health Determinants in Urban China. *Discussion Paper,* No. 1835 (2015).

Alison, GOOD; Kostas, MAVROMARA; Rong, ZHU. 2014. Family income and child health in China. *China Economic Review* 29 (2014) 152–165.

Lei, Xiaoyan; Yin, Nina; Zhao, Yaohui. 2010. SES health gradients during the epidemiological transition: The case of China. *Discussion paper series // Forschungsinstitut zur Zukunft der Arbeit*, No. 4914.

Li, Guo; Piazza, Alan; Glewwe, Paul; Hannum, Emily; Park, Albert; Chen, Chunming; Meng, Hongwei; Wang, Jiayi; & Zhang, Jianxin. 2002. The Interaction of Health, Education and Employment in Western China. *Research Proposal*. University of Pennsylvania.

Tor, Eriksson; Jay, Pan; Xuezheng, Qin. 2013. The Intergenerational Inequality of Health in China. School of Economics, Peking University. *Working Paper* No. E-2013-001.

Seonghoon, Kim; Belton, M. Fleisher. 2010. The China Great Leap Forward Famine: The Lasting Impact of Mothers' Fetal Malnutrition on Their Offspring. http://www.econ.ohio-state.edu/pdf/fleisher/wp09-04.pdf.

Francesco, Schettino; Alberto, Gabriele. 2006 Development of Productive Forces and Relative Social Underdevelopment Under Market Socialism: Progress in Reducing Child Malnutrition and Mortality in China and Vietnam in A Comparative Perspective. http://202.121.129.208/conference/ces/paper/ces_pdf/25/25-2.pdf.

Ruizhi, Xie; Titus, O. Awokuse. 2014. Is Maternal Employment Related to Childhood Obesity in China?: Evidence from the China Health and Nutrition Survey. *Agricultural Applied Economics Association's 2014 AAEA Annual Meeting*, Minneapolis, MN, July 27 -- 29, 2014.

Chen, Chunming; He, Wu; Fu, Zenying; Wang, Yuying. 2006. Analysis on the changes of nutritional situation in past 15 years (1990 -2005) in China The 15 -year establishment of Chinese Food and Nutrition Surveillance System(CFNSS). *Journal of Hygiene Research*. Nov 2006.

Shi, Guang; Zou, Jun; Tian, Xiaoxiao; He, Jiangjiang; Leng, Zhiwei. 2010. Experiences and lessons from children nutrition policy in developing countries. *China Health Policy Research*. Feb 2010.

Cai, Jiayin; Wang, Fang; Liu, Xiaoxi; Dai, Tao. 2013. International experience and revelation of the child nutrition improvement measures. *China Health Education*. Mar 2013.

Zhong, Jican; Wang, Jian. 2006. Heath Problems of Children Staying Behind in the Countryside. *Chinese Primary Heath Care*. 2006, 20(1):69-70.

Zhao, Liyun; Yu, Dongmei; Liu, Aidong; Jia, Fengmei. 2008. Analysis of health selective survey result of children and pregnant/lying-in women in China in 2006. *Journal of Hygiene Research*. Jan 2008.

Nancy, Butte. 2012. Prevention and Treatment of Childhood Obesity —— What works? *Sports Science Research.* Dec 2012, No. 1006-1207(2013)01-0030-03.

Tang, Qing; Chen, Shaoke; Luo, Jingsi; Fan, Xin; Feng, Ying. 2011. Epidemiologic Status and Influencing Factors of Obesity in Children and Adolescents. *Chinese Journal of Child Health Care.* Nov 2011, Vol 19, No. 11.

Zhao, Liqun. Analysis of Factors to Obesity in Children and Effect Evaluation of Interventions. 2014. *Doctoral thesis*, Fudan University.