Is Maternal Employment Related to Childhood Obesity in China?: Evidence from the China Health and Nutrition Survey

Ruizhi Xie
Department of Applied Economics and Statistics
University of Delaware
Newark, DE 19716
Tel: 302-229-5405
Email: rxie@udel.edu

Titus O. Awokuse
Department of Applied Economics and Statistics
University of Delaware
Newark, DE 19716
Tel: 302-831-1323
Fax: 302-831-6243
Email: kuse@udel.edu

Selected Paper prepared for presentation at the Agricultural & Applied Economics Association's 2014 AAEA Annual Meeting, Minneapolis, MN, July 27-29, 2014.

Abstract

The prevalence of childhood obesity in China has been increasing over the past few decades. In this paper, we investigate the causal relationship between maternal employment and children's weight status in China. We use the matched mother-child data from China Health and Nutrition Survey from 1991 to 2009 and employ various econometric techniques to control for observable and unobservable heterogeneity that affect the relationship between children's weight and mothers' work. The estimation results on the probability of a child being overweight/obese shows that maternal employment has a significantly negative effect on the likelihood of childhood overweight/obesity for the full sample and rural children, but not for the urban children. Moreover, for the 1990s group, the impact of maternal employment is not statistically significant, but for the 2000s group, it does. This result is contradictory to most of the findings from developed countries. Unlike developed countries, the maternal employment might have different relationship with the potential pathway variables (e.g. sedentary activities, physical activities). This study may lay the groundwork for the causal relationship between maternal employment and child's weight in China. Further work is needed to understand the mechanisms through which maternal work affects children's weight.

1. Introduction

The prevalence of childhood obesity in China has been increasing over the past few decades. A recent study shows that the rate for children who are obese increased from 0.4% in 1981-1985, to 7.5% in 2006-2010 (Yu et al. 2012). These values represent an average annual increase rate of 12.4%. In recent decades, Chinese children have experienced larger increase in Body Mass Index (BMI) compared with their peers in the U.S. and U.K. (Ji et al. 2013). Notably, obese children have a 25-50% risk of progressing to obesity in adulthood, where obesity is closely linked to many immediate and long-term effects on health status and well-being (Li 2013). These effects include elevated risks of having cardiovascular diseases, type 2 diabetes and some psychosocial issues.

The surge in childhood obesity could be related to changes in parental behavior, lifestyle or attitudes (Patrick and Nicklas 2005). A substantial body of empirical research on childhood obesity in the developed countries focuses on the role of maternal employment. Most of the research (Anderson et al. 2003; Chia 2008; von Hinke Kessler Scholder 2008; Fertig et al. 2009) finds evidence that rising maternal employment contributes to the increasing trend in child weight. The underlying explanation is that reduced maternal time spent on household production might affect activities related to children's eating patterns and physical activities. For example, employed mothers more often purchase ready-made and convenience foods, which contain more calories. Moreover, employed mothers have less time supervise their children in their physical activities. Therefore, when mothers start working and/or increase work hours, their children may be more likely to gain weight.

While there is a substantial body of literature on the relationship between maternal employment and childhood obesity, we are aware of no published articles that have analyzed this causal relationship in the biggest developing country: China. Therefore, our analysis results will be the first one to examine this evidence in China, where female labor force participation rate is one of the highest in the world and a sharp increase in the childhood obesity is observed in the recent period.

In this study, we examine the causal relationship between maternal employment and childhood obesity in China. We focus on the role of maternal employment because women still bear a comparatively greater responsibility of child rearing in China. We use the matched mother-child data from China Health and Nutrition Survey in the waves from 1991-2009. We build upon Anderson et al. (2003)'s work and investigate the effect of maternal employment on childhood obesity in China. We employ various econometric techniques to control for observable and unobservable heterogeneities that affect the relationship between children's weight and mothers' work.

2. Background

China is facing a rapid growth in the prevalence of overweight status/obesity in children. The measure of children's weight status, which is the key outcome variable, is based on body mass index (BMI). BMI is defined as weight in kilograms divided by height in meters squared. For children, BMI percentile indicator is a sex-age-specific BMI index based on the 2000 CDC growth charts. Specifically, every child's BMI number is plotted on the CDC BMI-for-age growth charts (for either girls or boys) to obtain a percentile ranking. This percentile indicates

the relative position of the child's weight among children of the same gender and age. Obesity for children is typically defined as having a BMI ranking at the 95th percentile or more. Children are considered overweight if their BMI ranking is 85th percentile or more, but less than 95th percentile, and underweight if their BMI ranking is 5th percentile or less.

Yu et al. (2012) did a meta-analysis including 35 papers (41 studies) on the trends in overweight status and obesity among children and adolescents in China from 1981 to 2010. Yu et al. found that the prevalence of overweight status/obesity increased from 1.8% (95% Confidence interval (CI): 0.4%-3.1%) and 0.4% (95% CI: -0.1% to 0.8%) respectively in 1981-1985 to 13.1% (95% CI: 11.2%-15.0%) and 7.5% (95% CI: 6.6%-8.4%) in 2006-2010. They also found that the prevalence of overweight and obese children was higher in urban areas than in rural areas. Another study conducted by Ji et al. (2013) suggested that in 2010 the overall prevalence for overweight status was 9.9% (12.3% for males and 7.5% for females) while for obesity, the prevalence rate was 5.1% (6.7% for males and 3.4% for females). Ji et al. also argued that regional epidemic rates of overweight status and obesity are in direct proportion to the development status of the regions. Specifically, they find that the obesity rate of male students in Beijing went up to 15%, which doubled the 1990 rate and were parallel to that of developed countries by the end of 2000. Figure 1 is a self-constructed graph showing the compositions of children's weight status across survey years[1].

[1] w_status of 0, 1, 2 and 3 represent being underweight, normal weight, overweight and obese respectively. Data source: China Health and Nutrition Survey. Please refer to the data section for details.

[2] Height-for-age is used to measure nutritional status. For example, chronic malnutrition is defined as height-for-

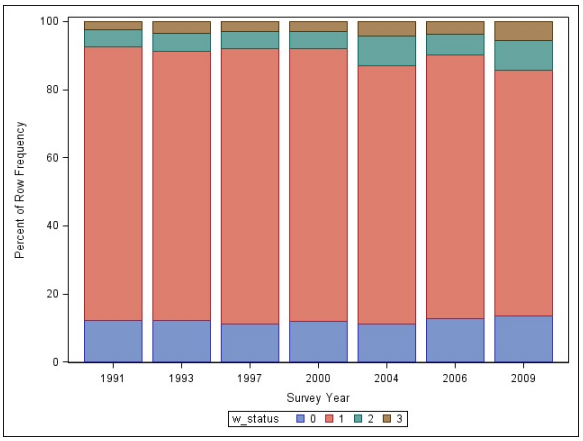

Figure 1: Weight Distribution for Children in Each Survey Year

The pattern of children's weight status in China has distinctive features that are largely different from developed countries, which may result in some heterogeneous effects of maternal employment in subgroups. First, urban and rural children have different prevalence of obesity (Cheng 2004). The reason is that in urban areas, both parents mostly have full-time work so that they have less time to prepare high-quality meals. Second, children raised in families of high socio-economic status are more likely to be obese (Wang 2001). Elder Children from high-income families usually have more pocket money where they can buy snack foods that are often high in calories. Moreover, these rich elder children dine out more often and the places are usually Western-style fast food restaurants. Third, boys have a higher prevalence of obesity (Song et al. 2013). Due to the traditional culture, boys are usually favored over girls and they are fed with more food.

Although the question about the association between maternal employment and children's weight status is important, the answer is not very clear-cut as the relationship is complicated by China's distinct institutional setting, recent structural reforms and great diversity across

country. Since the pattern of children's weight status in China has distinctive features that are largely different from developed countries, the institutional setting in China probably plays a role in it. Therefore, a review on the institutional factors related to maternal employment and childcare policy in China is necessary and helpful.

2.1 Female Labor Market Participation

In general, female labor force (population ages 15-64) participation rate is relatively high and constant in recent two decades. The highest value was 79.70% in 1993, while the lowest value occurred in 2011 with 75.10%. The compositions of non-working females are heterogeneous, including homemakers, full-time students, the disabled and the unemployed women. Another associated finding is that female labor force participation was related to spousal income, but spousal income was insufficient to explain the decrease in maternal employment rate (Yao and Tan, 2005). The high female labor force participation rate makes the conflict between maternal care and maternal employment very acute.

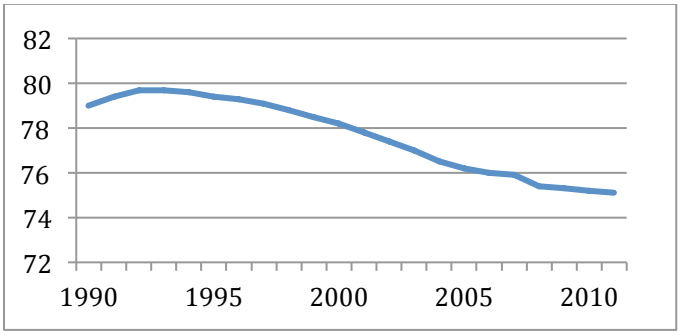

Figure 2：Female Labor Participation Rate (%) in China (ages 15-64)

2.2 Female Work Types

The recent structural reforms in China have caused several changes that might relate to the female labor supply pattern shifts. First, due to industrialization, more and more women have switched from agricultural farms to light industrial sectors and thus increase working hours (Yao 2011). Second, in the process of rural-urban migration, less skilled female rural workers had a higher labor force participation rate compared with the others (Yao 2011). Third, more rural young female workers began to work in the off-farm sector (Zhang et al. 2004). Fourth, due to the rural-urban migration, women need to commute more and the time for non-market activities such as cooking and childcare reduces accordingly (Yao 2011). Fifth, the reforms of industrial restructuring have different effects on men and women. Women have more difficulty in maintaining employment status due to gender differentiated retirement policies, rising education requirements and the loss of childcare and maternal benefits (Du et al. 2006).

The possible role of mother's work type is of special interest. China has been through structural reforms where more and more women switched from farm employment to off-farm employment due to the expansion of manufacturing industries (Yao 2011). The off-farm employment reaches 6.8% of the rural labor force by April 2009 (Huang et al. 2011). A striking feature is that mothers might have more difficulty in taking care of children because of the change in nature of work. It might be that this coincident labor pattern shift plays an important role in the relationship between maternal employment and children's weight status in China, or the effect of maternal employment on children's weight status is expected to vary significantly for mothers who work in different industries. Some variations include the nonstandard times at work, such as jobs in hospitality or service industry, which make it difficult for mothers to have regular time

at home. This analysis related to female work type is important since the results may help public policy to better target the groups where maternal work is particularly deleterious for childhood obesity.

2.3 Welfare Policies Related to Maternity Leave and Childcare

The relatively high female labor force participation rate among Chinese mothers is probably in part due to the relatively generous maternity leave policies and an abundance of childcare programs. The health of women and children is always a priority in China. Chinese government has put efforts to ensure that all women and children get access to comprehensive health care services. China is among 173 countries in the world that provide paid maternity leave (Bachelet 2011). China also has formulated many laws to protect women's rights and interests, such as Law on Maternity and Child Care, Labor Protection Regulations for Female Workers and Staff, and Provisional Regulations for the Health Care of Female Workers and Staff. Another striking feature of China's childcare system is comprehensive kindergarten system for the 2 to 6 years old children. Toddlers and preschoolers are sent to the kindergartens because both parents work full-time and they do not want to send the children to grandmothers. Due to the decline of government funding for social services, the patterns of childcare provision changed (Du and Dong 2013). Between 1997 and 2006, the number of publicly funded kindergartens decreased by 65% (Ministry of Education, 1995-2006), while the share of private kindergartens increased from 13.5% to 57.8% (Du and Dong 2013). Publicly subsidized high-quality childcare is only provided to parents who are employees of nonprofit public organizations and large state-owned-enterprises, while other parents have to resort to private or commercialized public kindergartens (Du and Dong 2013).

Other than that, one of the biggest distinctive features concerning childcare is the "one-child policy" which greatly shapes the relationship between childhood and parenting in model China. Because of this strict policy, a newborn is unlikely to be taken care of by their elder sisters or brothers. Moreover, the illegal second child may be denied medical and educational services and their parents face the risks of losing their jobs. However, the positive side of one-child policy is that parents are more likely to strengthen the emphasis on the child and invest their time in their only child.

3. Literature Review

The literature review section is organized into two parts. In the first part, we review the studies related to children's weight status in China. In the second part, we review the findings about the linkage between maternal work and children's weight status in developed countries.

3.1 Children's Weight Status in China

The reason that a child gains weight is straightforward: energy consumption is greater than energy expenditure. However, the imbalance between energy consumption and expenditure can be attributable to various factors. Many researchers argue that the rise in prevalence of overweight/obesity in China is due to the nutrition transition associated with the rapid economic growth and expansion of agricultural production (Popkin et al. 1993; Du et al. 2002). These recent changes have shifted the dietary structure toward consumption of more energy-intensive foods. Meanwhile, the dietary changes have been accompanied by an increase in sedentary lifestyles that discourage physical activities. However, these explanations cannot answer why

there is only a surge in childhood obesity, but not in adulthood. Therefore, it is important to consider other factors that cause a child to be overweight. Li et al. (2007) investigate the important determinants of childhood overweight status and obesity using the China Health and Nutrition Survey. They find that parental weight status is an important risk factor. Parents do not only have a genetic influence, but also play an important role in the development of children's physical activity patterns and eating behaviors. They also find that fat intake, low intensity activities and transport to/from school may be suitable to be considered as entry points for overweight prevention among Chinese children.

3.2 Relationship of Maternal Work and Children's Weight

Previous studies for developed countries have drawn a strong linkage between maternal employment and overweight children, although they use different methods and control variables (Anderson et al. 2003; Chia 2008; von Hinke Kessler Scholder 2008; Fertig et al. 2009). For example, one pioneering study from U.S. indicates that a child is more likely to be overweight if his/her mother worked more hours per week (Anderson et al. 2003). Anderson et al. use the National Longitudinal Survey of Youth (NLSY) and firstly document a simple association between maternal employment and the probability that a child is overweight. Then they use several techniques such as probit model, sibling difference and instrumental variables models to identify whether the relationship is causal. They conclude that mothers who work more hours per week over the child's life are significantly more likely to have an overweight child. Moreover, they do not find any evidence that these differences are driven by unobservable heterogeneity, such as mothers who work are those less attentive to their children's weight.

They also find that the relationship is more pronounced among higher socioeconomic status families.

The subsequent studies investigate the channels through which maternal employment affects children's weight status. For instance, Fertig et al. (2009) use time diaries and interview responses from the Child Development Supplement of the Panel Study of Income Dynamics and find that supervision and nutrition play significant but small roles in the association between maternal employment and childhood obesity. Specifically, they find the impact of maternal employment is reduced when accounting for the number of meals consumed in a day, but the decline associated with including watching TV is small. A related study by Cawley and Liu (2012) explores how maternal employment is associated with childhood obesity through the calculation of the decrease in time investment on children. They find that maternal employment causes working mothers to spend four fewer minutes per day grocery shopping, 17 fewer minutes cooking, 10 fewer minutes eating with children, 12 fewer minutes playing with children, 4 fewer minutes supervising children and 37 fewer minutes caring for children. This evidence provides possible mechanisms how maternal employment affects childhood obesity. In contrast, there are other studies demonstrating that the channels cannot help explain the effect. For example, Morrissey et al. (2011) find no impact of TV watching or physical activity

Other than the channels, some studies investigate the potential pathway through the type of childcare. The overall conclusion is that the quality of childcare matters in affecting children's weight. For example, Pearce et al. (2010) finds that informal care (primarily by grandparents) is related with high probability of being overweight, but no such relationship exists for formal care

in UK. Herbst and Tekin (2011) find that prior to kindergarten, children in center-based care or other non-relative care are more likely to be overweight compared to parental care.

Alternatively, the increase in maternal employment may have no adverse effect on childhood weight issue. The increase in income allows the flexibility in purchasing goods that substitute for the mother's time (e.g. food preparation, professional supervision in physical activities.) Moreover, the quality of childcare also matters. Greve (2011) uses Danish data and finds no statistical relationship between maternal employment and the probability of children's being overweight. She tests four hypotheses to explain the evidence: the effect of maternal employment on childhood obesity varies across weight distribution; the quality of childcare is relatively higher in Denmark; care provided by Danish mothers is of low quality; Danish fathers have a significant contribution in child care. Greve (2011) finds evidence consistent with the second and fourth ones. Table 1 below summarizes typical examples of research on the effect of maternal employment on childhood obesity:

Table 1: Previous Studies of the Effect of Maternal Employment on Childhood Obesity

Source	Country	Dataset	Statistical Techniques	Conclusion
Anderson et al. (2003)	U.S.	National Longitudinal Survey of Youth (NLSY)	1) standard probit models including a full range of observable characteristics;2) long-difference models to difference out any unobserved child-specific fixed effects;3) sibling difference models to difference out any unobserved family-specific fixed effects;4) instrumental variable models (instruments: variation between states and over time in the unemployment rate, child care regulations, wages of child care workers, welfare benefit levels and the status of welfare reform in the state)	Mothers who work more intensively, in the form of more hours per week, are significantly more likely to have overweight child.
Garcia et al. (2006)	Spain	National Health Survey	Discrete Choice Models (probit model estimation)	The marginal effects of maternal employment on children's probability of being overweight or obese are positive and significant.
Phipps et al. (2006)	Canada	National Longitudinal Survey of Children and Youth (NLSCY)	Logistic regression controlling for relevant socioeconomic characteristics	Higher hours of paid work by mothers are associated with higher risk of being overweight for children aged 6-11
Zhu (2007)	Australia	Longitudinal Survey of Australian Children (LSAC)	2SLS; full information maximum likelihood model; joint binary and multinomial model	Maternal employment has a positive and statistically significant impact on the likelihood of a child being overweight.
Fertig et al. (2009)	U.S.	Time diaries and interview responses from the Child Development Supplement of the Panel Study of Income Dynamics	Estimate the effect of maternal work hours on child's weight controlling for a variety of potential channels (treat the potential channels as omitted variables and test whether the inclusion of those channels will cause difference in the estimation).	Supervision and nutrition play significant but small roles in the relationship between maternal employment and childhood obesity
Chia (2008)	Canada	National Longitudinal Survey of Children and Youth (NLSCY)	OLS estimates; sibling difference models; results for subgroups	The maternal employment time period between child's birth and the time started school is associated with the risk of the child's becoming overweight or obese later in the childhood
Von Hinke Kessler Scholder (2008)	U.K.	1958 National Child Development Study	Exploring timing of effects; subgroup analyses; exploring possible unobserved heterogeneity	1) there is a significant correlation between maternal employment at age 7 of the child and the probability that a child is overweight at age 16.
Greve (2011)	Denmark	Danish Longitudinal Survey of Children (DALSC)	1) probit estimation; 2) two stage conditional maximum likelihood estimation to control for endogeneity of maternal work hours; 3) test for hypotheses to explain the difference in the relationship from other countries	No statistical relationship between maternal work hours and the probability of children's being overweight is found
Morrissey et al. (2011)	U.S.	National Institute of Child Health and Human Development's Study of Early Child Care and Youth Development	Random-effects and fixed-effects	An increase in the total time a mother is employed is associated with an increase in the child's BMI.

Cawley and Liu (2012)	U.S.	Amerian Time Use Survey (ATUS)	Use OLS model that describes the relationship between maternal employment and time investment in children	Maternal employment would cause working mothers to spend 4 fewer minutes grocery shopping, 17 fewer minutes cooking, 10 fewer minutes eating with children, 12 fewer minutes playing with children, 4 fewer minutes supervising children and 37 fewer minutes caring for children.
Anderson (2012)	U.S.	Early Childhood Longitudinal Survey-Kindergarten Class of 1998-1999	Run separate regressions of each family routine (e.g.mealtimes, bedtimes, TV watching rule) on employment hours while controlling for demographic variables and child care type dummies; Run separate regressions for each of six real diet and activity behaviors, then add the family routines to these behavioral regressions.	More maternal work hours tend to be negatively correlated with family routines; However the role of family routines does not help explain the mechanism behind the effect of maternal employment on children's weight status.

Notably, none of the above research of maternal employment and children's weight status is about developing countries. However, what needs to be emphasized here is that research analyses on developing countries have not been left behind. Previous studies on developing countries focus more on the linkage between maternal work and child health. For instance, Glick and Sahn (1998) investigate a random sample of women in a poor African urban area and confirm that additional time devoted to work is associated with reductions in height-for-age[2] of children under age 5. Liu (2008) uses data from China Health and Nutrition Survey and finds that maternal employment still has a negative impact on child health. This negative impact is greater when mothers participate in the non-agricultural work. In the analysis of migratory employment, Chen (2009) also finds a negative impact for children having a shortage of maternal care in China. More recently, Yao (2011) estimates a joint system of dynamic empirical equations containing mother's work time, childcare time, health shocks to the child, mother's income and health production. He also confirms that maternal decisions play a crucial role in determining the health status of children. Moreover, the different work types in rural areas affect children's health in different ways.

[2] Height-for-age is used to measure nutritional status. For example, chronic malnutrition is defined as height-for-age below the reference population median for more than two standard deviations.

4. Conceptual Framework

This section provides an analytical framework to describe the relationship between children's weight status, maternal employment and other observed/unobserved characteristics. It adapts from Ruhm (2004)'s discussion on maternal employment and adolescent development. First, we start with a model of household decision-making adapted from Glewwe and Miguel (2007). In general, the utility of each household is a function of household production, leisure and purchased goods and services. Parents allocate resources (in this case, time) in these three activities to maximize the household utility: i) household production (in this case, child's health production); ii) leisure; iii) labor supply (generating income to purchase goods and services).

(1) $U_t=U(W_t, L_{mt}, L_{ft}, G_t)$

where household utility at time t (U_t) is a function of child's health production function (denoted by W_t, weight status in this case), mother's and father's leisure time (L_{mt} and L_{ft}) as well as the purchased goods and services (G_t). Child's health production function can be further written as:

(2) $W_t=f(L_{mt}, L_{ft}, g_t, H_t, F_t, \tau_t)$

where g_t is the purchased goods and services for the child, which is a function of G_t, H_t is the child's specific health endowments, F_t is the family-specific characteristics and τ_t is the family-

specific unobserved characteristics. Next, it comes to the constraints. Equation (3) illustrates parents' time constraint:

(3) $L_{mt}+L_{ft}+E_{mt}*avgT_m+Eft*avgT_f=T_p$

where E_{mt} and E_{ft} are mother's and father's employment status, $avgT_m$ and $avgT_f$ are mother's and father's work time, which we assume for now are fixed numbers, T_p is the total time of parents. Apparently, G_t is a function of household income and household income is a function of $E_{mt}*avgT_m+E_{ft}*avgT_f$. Solving equation (3) for L_{mt} and substituting it in equation (2) yield a structural child's health production function:

(4) $W_t=f(E_{mt}, H_t, F_t, \tau_t, P_t)$

where P_t is a function of father's information (e.g. L_{ft} and E_{ft}). In equation (4), H_t and τ_t are not observable. P_t's information is mostly included in F_t (e.g. household income). Therefore, the reduced form of child's health production function could be written as:

(5) $W_t=f(E_{mt}, X_t, \varepsilon_t)$

where X_t is a vector of child and family-specific characteristics at time t and ε_t is a disturbance term at time t. Therefore, the overarching principle in guiding the empirical investigation is the health production function for children. The estimated coefficient on E_{mt} from equation (5) shows the net effect of maternal employment on child's weight status.

In all, we start from a household utility maximizing problem (equation (1)) subject to a child's health production function (equation (2)) and budget constraint (equation (3)). Child's health production function is the key here where we solve equations (2) and (3) to get a structural form of child's health production function (equation (4)). Since some variables in equation (4) are not observed, we come to a reduced form of child's health production function (equation (5)). This conceptual framework is useful because it indicates which data would be ideal to include in the econometric equation for studying the impact of maternal employment on child's weight. Unfortunately, some limitation still exists since not all of the desired variables are included in the data set. Therefore, we may not expect a fully specified model.

Two issues need to be discussed here. First, there exist potential tradeoffs for mother between the benefit from income in terms of purchased goods and services for the child and maternal time investment in the child (see equation (2) and (3)). Second, equation (5) shows an overarching principle in guiding the empirical investigation. Ideally, X should contain all factors that affect child's weight. In fact, some of the variables are unobservable, which might yield the biased estimate in the maternal employment coefficient. This will be explained and addressed in more details afterwards.

5. Data

5.1 Overview of the Dataset

We use data from China Health and Nutrition Survey (CHNS), conducted by the Carolina Population Center and the National Institute of Nutrition and Food Safety at the Chinese Center

for Disease Control and Prevention. This survey adopts a multistage, random cluster process and gathers sample in nine provinces: Liaoning, Heilongjiang, Jiangsu, Shandong, Henan, Hubei, Hunan, Guangxi and Guizhou. These provinces are representative of China as a whole. The urbanization percentages for the above provinces are 59%, 54%, 53%, 47%, 34%, 44%, 40%, 36% and 28% respectively (Donald and Benewick 2008). Counties in these nine provinces are stratified by income, and four counties and two cities are randomly selected in each province through a weighted sampling scheme. 20 households are randomly selected in each community and all household members[3] are interviewed in the process (Popkin et al. 2010). Overall, about 4400 households with a total of 26,000 individuals are drawn in the sample. The CHNS sample is randomly selected to ensure that it captures a wide range of economic and demographic circumstances in China.

This survey is designed to analyze the effects of health and nutrition polices in the context of social and economic transformation in China. It covers risk factors, health outcomes, social and economic factors at the individual, household and community levels. The individuals in the sample come from towns that vary significantly in economic development, geography, public resources and health indicators. For adults, CHNS provides information on occupation, education, income, time use, marriages, land ownership, assets, housing conditions and other demographic traits. For children, CHNS contains rich information on health outcomes, weight, height, food and nutrition intake, nutrition knowledge, sedentary activities and physical activities. In this analysis, we restrict the analysis sample to females who have at least one child, and match the children and their parents through the relationship identifier in the datasets.

[3] There is an exception in CHNS 1989, where only children aged less than 6 years and adults aged 20-45 years are interviewed.

CHNS have nine rounds in total: 1989, 1991, 1993, 1997, 2000, 2004, 2006, 2009 and 2011. The data are longitudinal where each person has his/her own ID, which is consistent across all survey years. We only use data from years of 1991, 1993, 1997, 2000, 2004, 2006 and 2009. The first round CHNS 1989 will not be used because it only has data from children aged less than 6 years and all adults aged 20-45 years. The last round CHNS 2011 will not be used because the dataset is not completely available. We combine all the rounds into two groups: 1991-1997 (1990s) and 2000-2009 (2000s). We analyze these two groups separately in order to trace the changes of effects over time.

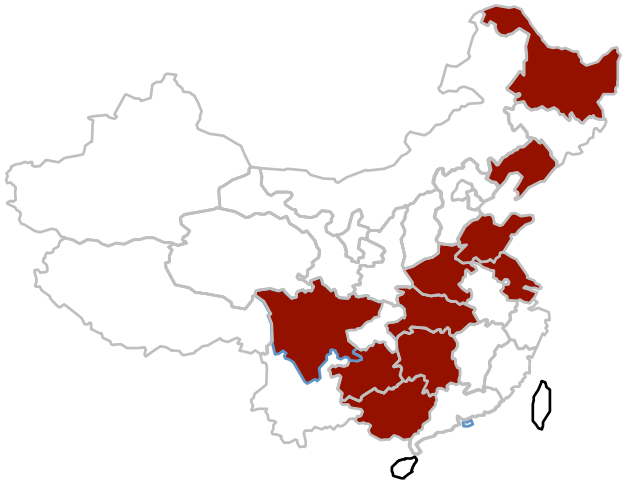

Figure 3: Representativeness of the nine provinces in China

5.3 Basic Statistics of the Data in Use

Table 2 displays selected sample means in the 1990s and 2000s. The sample size in 1990s is 8,732 while the sample size in 2000s is around 6,254. Each observation is a matched mother-child data point containing both mother's and child's information. Due to China's one-child policy, each mother most likely corresponds to one child. Yet there still could be possibilities

that certain mother's information appears more than once. However, this could be considered as a natural weighted sampling scheme for mother's information, because a two-child mother's information should contain more weight than a one-child's mother. Looking at the first row, the percentage of obese children rises from 3.17% in 1990s to 4.37% in 2000s. Compared with Yu et al.'s metal-analysis result, the obesity rates in our sample are low. The reason is that there are some biases in Yu et al.'s data since four different diagnostic criteria are used to assess overweight/obesity in the studies combined. Moreover, in our study, the rural sample accounts for almost 80% of the full sample, which lowers the overall overweight status and obesity rates since the rural children are less likely to suffer from overweight/obesity issues. Nevertheless, our rates are comparable to Ji et al.'s results where they find that the rates for obesity and overweight status are 5.1% and 9.9% respectively in 2010. Another concern is that the low childhood obesity rate (less than 5%) results in a small sample of research interests, which makes it difficult to present a reliable analysis result. Therefore we combine the overweight and obese children and examine the impact of maternal employment on the likelihood of children having greater than the normal weight. Maternal employment rates are constantly high in the 1990s and 2000s, although a decrease is observed in 2000s.

Table 2 Selected Sample Means, CHNS 1991-2009

	1990s	2000s
% of Obese Children	3.17%	4.37%
% of Overweight Children	8.45%	11.16%
% of Maternal Employment	90.98%	76.64%
Mother's Education Level		
No Education	22.66%	5.71%
Primary School Level	32.74%	28.56%
Middle School Level	27.70%	41.56%
High/ Vocational School Level	13.54%	16.57%
College Level	3.36%	7.61%
Urban	0.211	0.213
	(0.408)	(0.409)
Asset Income		
Live with Elderly	0.362	0.321
	(0.473)	(0.468)
Mother's BMI	21.987	22.746
	(2.746)	(3.134)
# of Observations	8732	6254

Note: The values in parentheses are standard deviations.

5.4 Data Issues

One econometric issue involves the endogeneity of the main variables: maternal employment and household income. For maternal employment, we are still looking for suitable instruments and currently admit the errors in using maternal employment in the estimation equations. For household income, we use asset rentals income to replace household income. Asset rentals income represents a small fraction of total resources available for household to consume or invest, and varies substantially between individuals. Household who receives high asset rentals income from real estate, vehicles and agricultural equipment is usually expected to have a high wealth level. Therefore, as a subset of total income, asset rentals income should be positively

correlated with household income. Furthermore, since asset rentals income includes the rents from real estate, vehicles and agricultural equipment, both the rural and urban household are fully considered (e.g. rural household is more likely to receive rents from agricultural equipment while urban household is more likely to receive rents from real estate and vehicles). Therefore, asset rentals income as a replacement for household income can be applied to the whole data sample.

Our argument that asset rentals income is valid for replacing household income in this context rests on some assumptions. First, asset rentals income needs to be exogenous and is unaffected by current labor supply choice. This is true in most circumstances since asset rentals income is non-labor income, which does not depend on current labor supply. Second, the previous labor supply decision in t-1 would not end up in the error term in the current time t, so that the error term and asset income is not correlated. Third, the rent from agricultural equipment to that from real estate and vehicles might need to be comparable to the household income of rural family to that of urban family. This holds as well since rural household usually has a lower household income than urban household, and the rent from agricultural equipment is expected to be lower than rent from vehicles and real estate.

Another econometric issue is the sample attrition associated with geographic mobility. CHNS has a longitudinal feature where a large number of interviewees are followed for several years. However, CHNS does not continue tracking people who leave home faraway. The information of long-distance migrants is systematically excluded from follow-up interviews. Since 1980s,

the household registration system[4] in China was relaxed and there were migrants from rural to urban areas. 2000 census data shows there were 12.46 million migrants, about 10.6% of the total population (Cai and Wang, 2003). However, evidence from the previous studies suggests that sample attrition might be not a serious concern. Thomas et al. (2001) state that CHNS dataset is probably among the most successful in terms of keeping attrition low. Chen (2005) analyzes the residential pattern of parents and their married children, and finds that missing couples are not selective on most of the independent variables. The sample attrition should not pose a major threat to the validity of the findings, as they are not the main variables of interest and do not interact with the main variables. Zhang (2012) does an analysis on the impact of water quality on health and finds that no significant differences show up between the demographic characteristics of missing people in the treated and untreated villages, except for the marital status. Zhang concludes that sample attrition does not appear to cause much bias since little observed sorting of migrants on whether villages have access to plant water is found.

5.4 Selected Publications Using CHNS Dataset

Table 3 shows some recent publications using CHNS dataset. This implies that CHNS dataset is a very popular and reliable source to study how the social and economic transformation of Chinese society in affecting the nutrition and health behaviors of the population.

[4] Household registration system is mainly designed to control the mobility of people between rural and urban areas, although it also has the purposes of resource distribution and the monitoring of targeted groups of people.

Table 3: Selected Publications Using China Health and Nutrition Survey

Author Name(s)	Year	Title	Journal
Adjaye-Gbewonyo K, Kawachi I.	2012	Use of the yitzhaki index as a test of relative deprivation for health outcomes: A review of recent literature.	*Social Science & Medicine*
Carter CA, Zhong F, Zhu J.	2012	Advances in Chinese agriculture and its global implications	*Applied Economic Perspectives and Policy*
Chen Y, Jin GZ.	2012	Does health insurance coverage lead to better health and educational outcomes? Evidence from rural china	*Journal of Health Economics*
Fang H, Rizzo JA.	2012	Does inequality in china affect health differently in high- versus low-income households?	*Applied Economics*
Liu H, Fang H, Zhao Z.	2012	Urban–rural disparities of child health and nutritional status in china from 1989 to 2006	*Economics & Human Biology*
Wu XY, Li LX.	2012	Family size and maternal health: Evidence from the one-child policy in china	*Journal of Population Economics*
De Brauw A, Mu R.	2011	Migration and the overweight and underweight status of children in rural china	*Food Policy*
Fang H, Rizzo JA.	2011	Income inequality dynamics in rural china from 1991 to 2006: The role of alternative income sources.	*Applied Economics Letters*
Zhang J.	2011	The impact of water quality on health: Evidence from the drinking water infrastructure program in rural China	*Journal of Health Economics*

6. Method and Preliminary Results

6.1 OLS Regression

First, we estimate a simple OLS model as a benchmark result. In contrast to the evidence found in developed countries, we do not expect to reach the conclusion that rising childhood obesity is due to the increase in mothers' labor force activity. The reason is that the relationship between maternal employment and children's weight status in China might be a very complicated and intriguing issue due to China's distinct institutional setting, recent structural reforms and great diversity across country. Thus it may not be obvious or definite that maternal employment is detrimental to children's weight status in China, as has been documented in many developed countries. For example, in China, full-time working mothers are more likely to send children to childcare center, which has a higher quality of care than at home. Hence, children may not suffer

from overweight/obesity issues because mothers are working. In fact, they may benefit from maternal employment through a greater possibility to afford professional physical activity trainings.

Table 4 and 5 show the preliminary OLS results on the probability of being overweight and the probability of being obese respectively. Same as what we expected before, the relationship between maternal employment and childhood weight issue is significantly negative for the full sample. This finding is different from the evidence in developed countries. However, this result is explainable, since the relationship between maternal employment and children's weight status in China might be complicated due to China's distinct institutional setting, recent structural reforms and great diversity across country. To valid our argument, we conduct separate analysis for rural and urban groups. The economic condition, after school activities and the food available are largely different for those two groups. The preliminary analysis shows that maternal employment has little implication on the childhood overweight status/obesity for urban children, but has a significantly negative impact on the rural children. The message is simple. Urban is more developed than rural. So the finding in the urban area, rather than rural area, is more closed to the findings in developed countries. The detailed mechanism is waiting to be explored. But the warning sign is obvious. As China becomes more developed, it might experience the issues that those developed nations have. Therefore, the initial detection and prevention are important, especially for the health benefits of people.

Table 4: Estimated effects on the likelihood of being overweight in the full sample, rural sample, urban sample, 1990s and 2000s

	Full Sample	Rural Sample	Urban Sample	1990s	2000s
Maternal Employment	-0.022 **	-0.030 ***	0.001	-0.011	-0.037 ***
Mother's Education Level					
Primary School	-0.020 ***	-0.016 **	-0.033	-0.010	-0.027
Middle School	-0.017 **	-0.013	-0.027	-0.024 ***	0.002
High/Vocational School	0.007	0.004	0.005	-0.010	0.041**
College	0.009	-0.007	0.013	-0.022	0.032
Mother's BMI	0.013 ***	0.013 ***	0.014 ***	0.011***	0.016***
Live with Elderly	0.011	0.001	0.029	0.006	0.028
Female	-0.018 ***	-0.010 **	-0.052 ***	-0.019***	-0.018**
Urban	0.025 ***			0.025***	0.027**
Child's Age	-0.014 ***	-0.014 ***	-0.014 ***	-0.014***	-0.014***
Asset Rentals Income	0.000	0.000	0.000	0.000	0.000
wave					
1993	0.008	0.013	-0.012		
1997	-0.002	-0.009	0.023		
2000	0.001	0.001	0.000		
2004	0.029 ***	0.023**	0.050 **		
2006	0.036 ***	0.028**	0.062**		
2009	0.049 ***	0.033***	0.098***		
Constant	-0.028	-0.021	-0.035	0.017	-0.065
Number of Observations	13099	10320	2779	8233	4866

Note: ***, **, and * imply the 1%, 5% and 10% significance level.

Table 5: Estimated effects on the likelihood of being obese in the full sample, rural sample, urban sample, 1990s and 2000s

	Full Sample	Rural Sample	Urban Sample	1990s	2000s
Maternal Employment	-0.009	-0.013 **	0.007	0.000	-0.019 **
Mother's Education Level					
Primary School	-0.012 ***	-0.011 **	-0.012	-0.009 *	-0.008
Middle School	-0.008	-0.007	-0.009	-0.014 ***	0.011
High/Vocational School	-0.001	0.000	-0.003	-0.006	0.019
College	0.000	-0.003	0.000	-0.024**	0.026 *
Mother's BMI	0.005 ***	0.005 ***	0.005 ***	0.004 ***	0.006 ***
Live with Elderly	0.007	-0.001	0.020	0.002	0.019
Female	-0.012 ***	-0.011 ***	-0.018 **	-0.013 ***	-0.011 **
Urban	0.007 *			0.011 **	0.002
Child's Age	-0.007 ***	-0.007 ***	-0.009 ***	-0.007 ***	-0.008 ***
Asset Rentals Income	0.000	0.000	0.000	0.000	0.000
Wave					
1993	0.006	0.009 *	-0.006		
1997	0.000	-0.004	0.014		
2000	0.002	0.003	0.001		
2004	0.011 *	0.009	0.018		
2006	0.023 ***	0.025 ***	0.019		
2009	0.020 ***	0.016 **	0.035 **		
Constant	0.020	0.019	0.025	0.032 *	0.012
Number of Observations	13099	10320	2779	8233	4866

Note: ***, **, and * imply the 1%, 5% and 10% significance level.

6.2 Probit Regression

Next, we will estimate a standard probit model for whether the child is obese as a function of standard demographic variables and a measure of maternal employment.

(6) Probit $(W_i)= \alpha + \gamma E_i + X\beta + \mu_i$

where W is the weight status for a child. Specifically, W=1 if the child has a BMI above or at 85^{th} percentile (i.e. being overweight or obese). Otherwise, W=0. E represents maternal employment status, X is a set of child and family control variables, which accounts for observable difference across individuals, and control variables are child's gender, child's age,

mother's education level, urban/rural status, whether lives with the elderly in the household, mother's BMI, asset rentals income and survey year dummies. μ is an i.i.d. error term. The coefficient γ estimates the effect of maternal employment on the outcome of interest.

The preliminary probit results show that maternal employment has little implication on the childhood overweight status/obesity for urban children, but has a significantly negative impact on the rural children. Moreover, the effect of maternal employment on child's weight becomes significant in the 2000s. For the other variable, mother's BMI influences child's weight significantly across all subgroups.

Table 6: Probit results on the likelihood of being overweight in the full sample, rural sample, urban sample, 1990s and 2000s

	Full Sample	Rural Sample	Urban Sample	1990s	2000s
Maternal Employment	-0.136**	-0.186***	0.021	-0.082	-0.209***
Mother's Education Level					
Primary School	-0.131**	-0.112**	-0.215	-0.076	-0.157
Middle School	-0.090*	-0.077	-0.141	-0.136**	0.036
High/Vocational School	0.073	0.051	0.059	-0.033	0.262*
College	0.074	0.000	0.078	-0.135	0.227
Mother's BMI	0.081***	0.084***	0.080***	0.079***	0.086***
Live with Elderly	0.065	-0.005	0.165	0.044	0.139
Female	-0.128***	-0.076**	-0.311***	-0.138***	-0.115**
Urban	0.162***			0.161***	0.161**
Child's Age	-0.093***	-0.097***	-0.081***	-0.106***	-0.081***
Asset Rentals Income	0.000	0.000	0.000	0.000	0.000
wave					
1993	0.066	0.102*	-0.077		
1997	0.001	-0.050	0.157		
2000	0.034	0.037	0.036		
2004	0.202***	0.162**	0.291**		
2006	0.230***	0.176**	0.358***		
2009	0.300***	0.229***	0.475***		
Constant	-2.195	-2.175***	-2.183***	-2.033***	-2.282***
Number of Observations	13099	10320	2779	8233	4866

Note: ***, **, and * imply the 1%, 5% and 10% significance level.

Table 7: Probit results on the likelihood of being obese in the full sample, rural sample, urban sample, 1990s and 2000s

	Full Sample	Rural Sample	Urban Sample	1990s	2000s
Maternal Employment	-0.124	-0.190**	0.172	-0.011	-0.222**
Mother's Education Level					
Primary School	-0.187**	-0.178**	-0.190	-0.156*	-0.002
Middle School	-0.092	-0.085	-0.099	-0.187**	0.278
High/Vocational School	0.014	0.007	0.019	-0.067	0.379***
College	0.019	-0.020	0.020	-0.335*	0.467**
Mother's BMI	0.064***	0.066***	0.063***	0.065***	0.065***
Live with Elderly	0.070	-0.041	0.223	0.040	0.162
Female	-0.205***	-0.197***	-0.252***	-0.231***	-0.170**
Urban	0.112*			0.143*	0.046
Child's Age	-0.115***	-0.115***	-0.117***	-0.130***	-0.103***
Asset Rentals Income	0.000	0.000	0.000	0.000	0.000
wave					
1993	0.113	0.162***	-0.065		
1997	0.042	-0.026	0.219		
2000	0.078	0.089	0.063		
2004	0.171**	0.135	0.264		
2006	0.327***	0.344***	0.245		
2009	0.313***	0.270**	0.439**		
Constant	-2.141	-2.118***	-2.280	-2.058***	-2.304***
Number of Observations	13099	10320	2779	8233	4866

Note: ***, **, and * imply the 1%, 5% and 10% significance level.

6.3 Quantile Regression

The goal in this section is to investigate the effects of maternal employment across all BMI distribution. The traditional least squares model estimates the effect of independent variables on the conditional mean of the dependent variable. However, the traditional least squares model is inappropriate in the context of obesity analysis, because BMI is not a monotonic indicator of health conditions (either too high or too low is not ideal). And the effects of independent variables in different percentiles of BMI distribution convey very different implications. For

example, suppose a variable only has a positive effect on lower percentile of BMI distribution, it cannot be considered contributing to obesity. Instead, it helps underweight people return to normal weight.

Quantile regression, proposed by Koenker and Bassett (1982), is a useful tool to estimate the conditional quantiles of a response given a vector of regressors. It is a semi-parametric method, because it has no assumptions on the conditional distribution, although the conditional quantile has a linear form. Quantile regression measures the effects of regressors not only in the center of the distribution, but also in the upper and lower tails. Indeed, we may expect that in the lower quantiles of BMI distribution and in the upper quantiles of BMI distribution, the effects of maternal employment are different. Therefore, we estimate quantile regression models at selected points, e.g. 25% and 75%, in addition to the median of the BMI.

Table 8 shows the estimated effects on child's BMI at 5%, 25%, 50%, 75% and 95% quantiles. The effects of maternal employment and education are generally more significant in the upper quantiles, implying that they have more significant impacts for the overweight and obese children. For mother's BMI, it consistently has significantly positive impact on child's weight. For the gender factor, female has more weight in the lower BMI quantile but has lower weight in the upper BMI quantile. Urban children are generally heavier than rural children across the BMI distribution.

Table 8: Estimated effects on Child's BMI at selected quantiles

	5%	25%	50%	75%	95%
Maternal Employment	0.238	0.229	-2.614*	-5.374***	-0.922
Mother's Education Level	0.022	0.059	0.672*	1.605***	0.889***
Mother's BMI	0.308***	2.003***	3.077***	3.087***	1.308***
Live with Elderly	0.458	2.354*	6.080***	3.968*	1.658
Female	0.326**	0.465	-0.053	-0.809	-1.836***
Urban	0.006	2.024***	4.257***	5.669***	2.722***
Child's Age	-0.001	-0.605***	-1.472***	-2.132***	-1.527***
Asset Rentals Income	0.000***	0.000	0.000**	0.000**	0.000***
Constant	-5.785***	-24.667***	-18.531***	14.472***	74.028***
Number of Observations	13099	13099	13099	13099	13099

Note: ***, **, and * imply the 1%, 5% and 10% significance level.

7. Concluding Remarks

In sum, we use data from China Health and Nutrition Survey and find that maternal employment has a significantly negative effect on the likelihood of childhood overweight status/obesity. A further investigation on the subgroup shows that maternal employment does not show significant effect on child's weight for urban children. This study may lay the groundwork for the causal relationship between maternal employment and child's weight in China. Further work is needed to understand the mechanisms through which maternal work affects children's weight. For China, there could be many hypotheses about how maternal employment and child's weight are related. When mothers work outside the home, many changes follow. First, the household level income increases and this will generate at least two impacts on children's weight. Families can afford more healthy food. On the other hand, the elder children may have more pocket money, and buy more western-style food and snacks, which are usually high in calories. Second, mothers will spend less time at home, which results in a reduction in child supervision. Less-supervised

children may spend more time watching TV, which has a negative impact on their health. Alternatively, these unsupervised children may engage in some physical activities with friends after school.

The contribution of this study will be several folds. First, to our best knowledge, this will be the first research documenting the causal relationship between maternal employment and child's weight in China, which hopefully will raise public's awareness of child's weight issue from labor economics perspective. Second, the distribution of children's weight is heterogeneous among countries. For example, there are more observations at the upper quantile of BMI for U.S. than for China. Therefore, the use of quantile regression, which will capture the effect of maternal employment at different points of the BMI distribution, should have merits in this line of research. Third, the subgroup analysis is important since the results may help public policy to better target the groups where maternal work is particularly deleterious for childhood overweight/obesity. Fourth, our result for China is in sharp contrast with the findings in developed countries, which may raise future investigation on the institutional factors to explain the discrepancy.

Reference:

Anderson, Patricia M., Kristin F. Butcher, and Phillip B. Levine. 2003. "Maternal Employment and Overweight Children." *Journal of Health Economics* 22 (3): 477-504.

Anderson, Patricia M. 2012. "Parental Employment, Family Routines and Childhood Obesity." *Economics & Human Biology* 10 (4): 340-351.

Bachelet, M. 2011. *Tackling Gender Inequality on Multiple Fronts: An Agenda for Women and Girls for the Decade*. World YWCA International Women's Summit, Geneva.

Cai, Fang, and Dewen Wang. 2003. "Migration as Marketization: What Can We Learn from China's 2000 Census Data?" *The China Review* 3(2): 73-93.

Cawley, John and Feng Liu. 2012. "Maternal Employment and Childhood Obesity: A Search for Mechanisms in Time use Data." *Economics & Human Biology* 10 (4): 352-364.

Chaput, Jean-Philippe and Angelo Tremblay. 2007. "Does Short Sleep Duration Favor Abdominal Adiposity in Children?" *International Journal of Pediatric Obesity* 2 (3): 188-191.

Chen, Feinian. 2005. "Residential Patterns of Parents and Their Married Children in Contemporary China: A Life Course Approach." *Population Research and Policy Review* 24(2): 125-148.

Chen, Feinian, Susan E. Short, and Barbara Entwisle. 2000. "The Impact of Grandparental Proximity on Maternal Childcare in China." *Population Research and Policy Review* 19 (6): 571-590.

Chen, Zai-Yu. 2009. "The Health Status of the Left-Behind Children in Rural China." *Chinese Journal of Population Science* 5: 95-102.

Cheng, Tsung O. 2004. "Obesity in Chinese Children." *Journal of the Royal Society of Medicine* 97 (5): 254-254.

Chia, Yee Fei. 2008. "Maternal Labour Supply and Childhood Obesity in Canada: Evidence from the NLSCY." *Canadian Journal of Economics/Revue Canadienne d'Économique* 41 (1): 217-242.

Chowhan, James, and Jennifer M. Stewart. 2013. "While Mothers Work Do Children Shirk? Determinants of Youth Obesity." *Applied Economic Perspectives and Policy* 1-22.

Deb, Partha, and Pravin K. Trivedi. 2006. "Maximum Simulated Likelihood Estimation of a Negative Binomial Regression Model with Multinomial Endogenous Treatment." *Stata Journal* 6(2): 246-255.

Donald, Stephanie Hemelryk, and Robert Benewick. 2008. *Pocket China Atlas: Maps and Facts at Your Fingertips*. University of California Press.

Du, Fenglian, Jianchun Yang, and Xiao-yuan Dong. 2006. "*Women's Employment and Industrial Restructuring in China: Investigation Using Urban Household Surveys*." Final Report for the 5th PEP Meeting.

Du, Fenglian, and Xiao-yuan Dong. 2013. "Women's Employment and Child Care Choices in Urban China During the Economic Transition." *Economic Development and Cultural Change* 62 (1): 131-155.

Du, Shufa, Bing Lu, Fengying Zhai, and Barry M. Popkin. 2002. "A New Stage of the Nutrition Transition in China." *Public Health Nutrition* 5(1): 169-174.

Fertig, Angela, Gerhard Glomm, and Rusty Tchernis. 2009. "The Connection between Maternal Employment and Childhood Obesity: Inspecting the Mechanisms." *Review of Economics of the Household* 7 (3): 227-255.

Frölich, Markus and Blaise Melly. 2010. "Estimation of Quantile Treatment Effects with Stata." *Stata Journal* 10 (3): 423.

Gable, Sara, Yiting Chang, and Jennifer L. Krull. 2007. "Television Watching and Frequency of Family Meals are Predictive of Overweight Onset and Persistence in a National Sample of School-Aged Children." *Journal of the American Dietetic Association* 107 (1): 53-61.

Garcia, Emma, Jose M. Labeaga, and Carolina Ortega. 2006. "Maternal Employment and Childhood Obesity in Spain." *Documento De Trabajo* 2006: 17.

Gennetian, Lisa A., Heather D. Hill, Andrew S. London, and Leonard M. Lopoo. 2010. "Maternal Employment and the Health of Low-Income Young Children." *Journal of Health Economics* 29 (3): 353-363.

Glewwe, Paul, and Edward A. Miguel. 2007. "The Impact of Child Health and Nutrition on Education in Less Developed Countries." *Handbook of Development Economics* 4: 3561-3606.

Glick, Peter, and David E. Sahn. 1998. "Maternal Labour Supply and Child Nutrition in West Africa." *Oxford Bulletin of Economics and Statistics* 60 (3): 325-355.

Greene, William H. 2012. *Econometric Analysis*. New York: Prentice Hall.

Greve, Jane. 2011. "New Results on the Effect of Maternal Work Hours on Children's Overweight Status: Does the Quality of Child Care Matter?" *Labour Economics* 18 (5): 579-590.

Herbst, Chris M., and Erdal Tekin. 2011. "Child Care Subsidies and Childhood Obesity." *Review of Economics of the Household* 9(3): 349-378.

Huang, Jikun, Huayong Zhi, Zhurong Huang, Scott Rozelle, and John Giles. 2011. "The Impact of the Global Financial Crisis on Off-farm Employment and Earnings in Rural China." *World Development* 39 (5): 797-807.

Ji, CY and TJ Chen. 2013. "Empirical Changes in the Prevalence of Overweight and Obesity among Chinese Students from 1985 to 2010 and Corresponding Preventive Strategies." *Biomedical and Environmental Sciences: BES* 26 (1): 1-12.

Kilburn, M. Rebecca and Ashlesha Datar. 2002. *The Availability of Child Care Centers in China and its Impact on Child Care and Maternal Work Decisions.* RAND.

Knight, John and Ramani Gunatilaka. 2010. "Great Expectations? The Subjective Well-being of Rural–urban Migrants in China." *World Development* 38 (1): 113-124.

Koenker, R. and G. Bassett. 1982. "Robust Tests for Heteroscedasticity Based on Regression Quantiles." *Econometrica* 50: 43-61.

Li, H. 2008. "A National Epidemiological Survey on Obesity of Children Under 7 Years of Age in Nine Cities of China, 2006." *Zhonghua Er Ke Za Zhi* 46 (3): 174-178.

Li, M. 2013. "Childhood Obesity: What is Happening in China." *China Express* Online Magazine (4).

Li, Yanping, Fengying Zhai, Xiaoguang Yang, Evert G. Schouten, Xiaoqi Hu, Yuna He, D. Luan, and G. Ma. 2007. "Determinants of Childhood Overweight and Obesity in China." *British Journal of Nutrition* 97 (1): 210-215.

Liu, Jin. 2008. "Effects of Maternal Labor Supply on children's Health Outcomes in Rural China." *Chinese Journal of Economic Study* 9: 120-128.

Mashberg, Tom. 1999. "Childhood Obesity Reaches Epidemic Proportions." *Boston Herald* 23:1.

Maurer-Fazio, Margaret, Rachel Connelly, Lan Chen, and Lixin Tang. 2011. "Childcare, Eldercare, and Labor Force Participation of Married Women in Urban China, 1982–2000." *Journal of Human Resources* 46 (2): 261-294.

McGuire, Judith S. and Barry M. Popkin. 1990. *Helping Women Improve Nutrition in the Developing World: Beating the Zero Sum Game.* World Bank - Technical Paper:114.

Ministry of Education. 1995-2006. *Educational Statistics Yearbook of China*. Beijing: Department of Development and Planning, Ministry of Education.

Morrissey, Taryn W., Rachel E. Dunifon, and Ariel Kalil. 2011. "Maternal Employment, Work Schedules, and Children's Body Mass Index." *Child Development* 82 (1): 66-81.

Ogden, Cynthia L., Margaret D. Carroll, Brian K. Kit, and Katherine M. Flegal. 2012. "Prevalence of Obesity and Trends in Body Mass Index among US Children and Adolescents, 1999-2010." *JAMA: The Journal of the American Medical Association* 307 (5): 483-490.

Parzen, Emanuel. 1962. "On Estimation of a Probability Density Function and Mode." *The Annals of Mathematical Statistics* 33 (3): 1065-1076.

Patrick, Heather and Theresa A. Nicklas. 2005. "A Review of Family and Social Determinants of children's Eating Patterns and Diet Quality." *Journal of the American College of Nutrition* 24 (2): 83-92.

Pearce, A., L. Li, J. Abbas, B. Ferguson, H. Graham, and C. Law. 2010. "Is Childcare Associated with the Risk of Overweight and Obesity in the Early Years: Findings from the UK Millennium Cohort Study." *International Journal of Obesity* 34 (7): 1160-1168.

Phipps, Shelley A., Lynn Lethbridge, and Peter Burton. 2006. "Long-Run Consequences of Parental Paid Work Hours for Child Overweight Status in Canada." *Social Science & Medicine* 62 (4): 977-986.

Popkin, Barry M., Ge Keyou, Fengying Zhai, Xuguang Guo, Haijiang Ma, and Namvar Zohoori. 1993. "The Nutrition Transition in China: A Cross-sectional Analysis." *European Journal of Clinical Nutrition* 47(5): 333-346.

Popkin, Barry M., Shufa Du, Fengying Zhai, and Bing Zhang. 2010. "Cohort Profile: The China Health and Nutrition Survey - Monitoring and Understanding Socio-economic and Health Change in China, 1989–2011." *International Journal of Epidemiology* 39(6): 1435-1440.

Rosenblatt, Murray. 1956. "Remarks on some Nonparametric Estimates of a Density Function." *The Annals of Mathematical Statistics*: 832-837.

Ruhm, Christopher J. 2004. "Parental Employment and Child Cognitive Development." *Journal of Human Resources* 39(1): 155-192.

Ruhm, Christopher J. 2008. "Maternal Employment and Adolescent Development." *Labour Economics* 15 (5): 958-983.

Short, Susan E., Feinian Chen, Barbara Entwisle, and Zhai Fengying. 2002. "Maternal Work and Child Care in China: a Multi-method Analysis." *Population and Development Review* 28(1): 31-57.

Song, Y., H-J Wang, J. Ma, and Z. Wang. 2013. "Secular Trends of Obesity Prevalence in Urban Chinese Children from 1985 to 2010: Gender Disparity." *PLoS One* 8 (1): e53069.

Stewart, Jay. 2009. "*Tobit or Not Tobit?"* IZA Discussion Papers No. 4588.

Strom, R. D., S. K. Strom, and Q. Xie. 1995."The Small Family in China." *International Journal of Early Childhood* 27 (2): 37-45.

Taveras, Elsie M., Sheryl L. Rifas-Shiman, Catherine S. Berkey, Helaine RH Rockett, Alison E. Field, A. Lindsay Frazier, Graham A. Colditz, and Matthew W. Gillman. 2005. "Family Dinner and Adolescent Overweight." *Obesity Research* 13 (5): 900-906.

Thomas, Duncan, Elizabeth Frankenberg, and James P. Smith. 2001. "Lost but Not Forgotten: Attrition and Follow-up in the Indonesia Family Life Survey." *Journal of Human Resources* 36(3): 556-592.

von Hinke Kessler Scholder, Stephanie. 2008. "Maternal Employment and Overweight Children: Does Timing Matter?" *Health Economics* 17 (8): 889-906.

Wang, Youfa. 2001. "Cross-national Comparison of Childhood Obesity: the Epidemic and the Relationship between Obesity and Socioeconomic Status." *International Journal of Epidemiology* 30(5): 1129-1136.

Yao, J. 2011. "*Maternal Employment Type, Maternal Care and Child Health in Rural China: Policy and Behavior."* Unpublished Manuscript.

Yao, Xianguo and Tan, Lan. 2005. "Family Income and Labor Force Participation of Married Women in Urban China." *Economic Research Journal* 7: 001.

Yu, Z., S. Han, J. Chu, Z. Xu, C. Zhu, and X. Guo. 2012. "Trends in Overweight and Obesity among Children and Adolescents in China from 1981 to 2010: A Meta-analysis." *PLoS One* 7 (12): e51949.

Zhang, Linxiu, Alan de Brauw, and Scott Rozelle. 2004. "China's Rural Labor Market Development and its Gender Implications." *China Economic Review* 15 (2): 230-247.

Zhang, Jing. 2012. "The Impact of Water Quality on Health: Evidence from the Drinking Water Infrastructure Program in Rural China." *Journal of Health Economics* 31(1): 122-134.

Zhu, Anna. 2007. *The Effect of Maternal Employment on the Likelihood of A Child Being Overweight.* School of Economics, The University of New South Wales. Discussion Papers 2007-17.