ADOLESCENT FOOD CONSUMPTION IN URBAN CHINA: FACTORS INFLUENCING BMI AND SCHOOL MEALS

A Thesis
Submitted to the Graduate Faculty
of the
North Dakota State University
of Agriculture and Applied Science

By

Carl Allen Anfinson

In Partial Fulfillment
for the Degree of
MASTER OF SCIENCE

Major Department:
Agribusiness and Applied Economics

April 2013

Fargo, North Dakota

North Dakota State University
Graduate School

Title

Adolescent Food Consumption in Urban China: Factors Influencing BMI and School Meals

By

Carl Allen Anfinson

The Supervisory Committee certifies that this ***disquisition*** complies with North Dakota State University's regulations and meets the accepted standards for the degree of

MASTER OF SCIENCE

SUPERVISORY COMMITTEE:

Dr. Thomas I. Wahl
Chair

Dr. Won Koo

Dr. Saleem Shaik

Dr. Jin Li

Approved:

April 4, 2013
Date

Dr. William Nganje
Department Chair

ABSTRACT

China's food consumption patterns are changing as the population becomes wealthier and more urban. As the country ages, today's adolescents will be tomorrow's consumers. Few studies have focused on this important demographic.

This study intended to investigate what might be influencing adolescent BMI by examining what adolescents are eating at home and away from home along with socioeconomic factors. An increase in a mother's education was found to have a positive influence on BMI. Another section focuses on what adolescents consume at school compared to at home and also examines their parent's perception of these school meals by developing an ordered logit model. Compared to preschool, the likelihood of a parent being satisfied with all aspects of a school meal decreased for higher levels of the student's education. Almost three times as many lunch meals were consumed at school, proving how important this often forgotten meal is.

ACKNOWLEDGMENTS

First off, I would like to thank the Agribusiness and Applied Economics Department faculty and staff for all they have done throughout my undergraduate and graduate studies at NDSU. I appreciate the enormous opportunity and many life lessons learned throughout my academic career from many of you.

I would especially like to thank my major advisor, Dr. Thomas I. Wahl for his patience and continued support throughout my academic career at NDSU. Dr. Wahl not only convinced me to further my education, but has also helped me obtain a great internship that has sparked my interest in international trade. I would also like to thank my committee, Dr. Won Koo, Dr. Saleem Shaik, and Dr. Jin Li for their patience, time, and comments.

Last but most certainly not least, I'd like to thank Caitlin, my classmates, friends, and family all along the way who pushed me to complete my graduate studies. You know who you are. I am forever grateful to you all.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIX TABLES

LIST OF APPENDIX FIGURES

CHAPTER 1. INTRODUCTION

Problem Statement

In a time span of less than a single generation, China has been able to considerably improve its socioeconomic development and change the lives of its citizens (Guo *et al.* 2000). Transformation has been a key theme throughout China's growth to a more consumer-oriented economy. In this period of economic growth, consumer's income has been steadily increasing. This enhanced transformation is particularly noticeable throughout many urban areas. For instance, urban annual per capita disposable income has drastically risen from a 2011 real value of 3,593 Yuan in 1978 to 21,809 Yuan in 2011 (Figure 1.1.). The rural per capita annual disposable income has also risen. It grew from a 2011 real value of 1,420 Yuan in 1978 to 6,977 Yuan in 2011(Figure 1.2.). The annual per capita expenditure on food has also experienced a visible surge. In 1990 urban Chinese consumers spent approximately 693 Yuan on their food expenses compared with 5,506 Yuan in 2011. Food expenses make up around 36 percent of their per capita annual cash consumption in 2011 (China Statistical Yearbook, 2012).

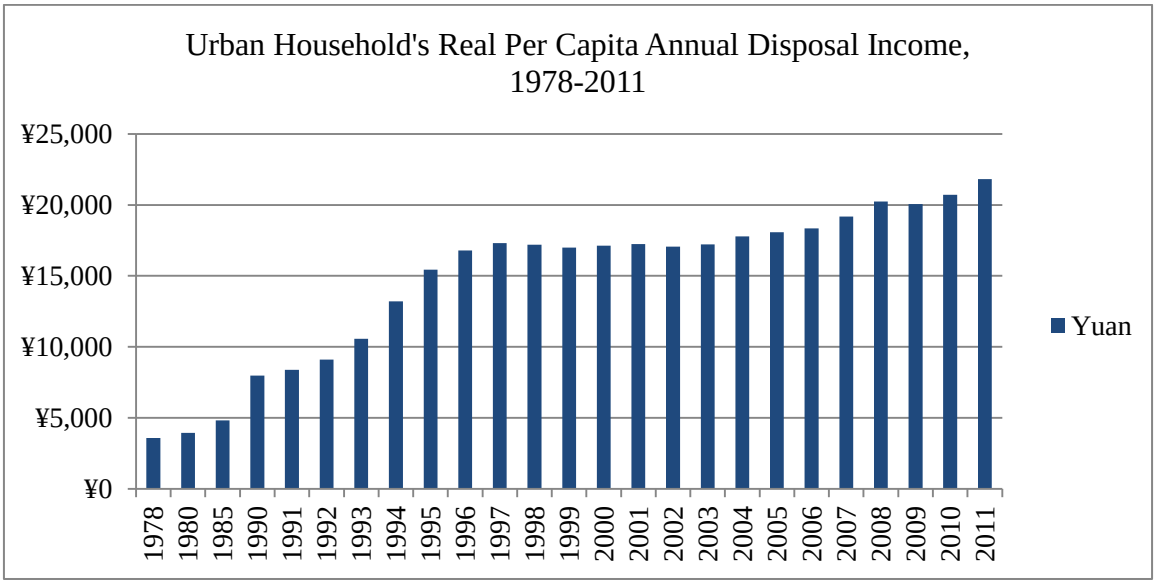

Figure 1.1. Urban Household's Per Capita Annual Disposal Income, 1978-2011
Source: China Statistical Yearbook, 2012. The National Bureau of Statistics, P. R. China

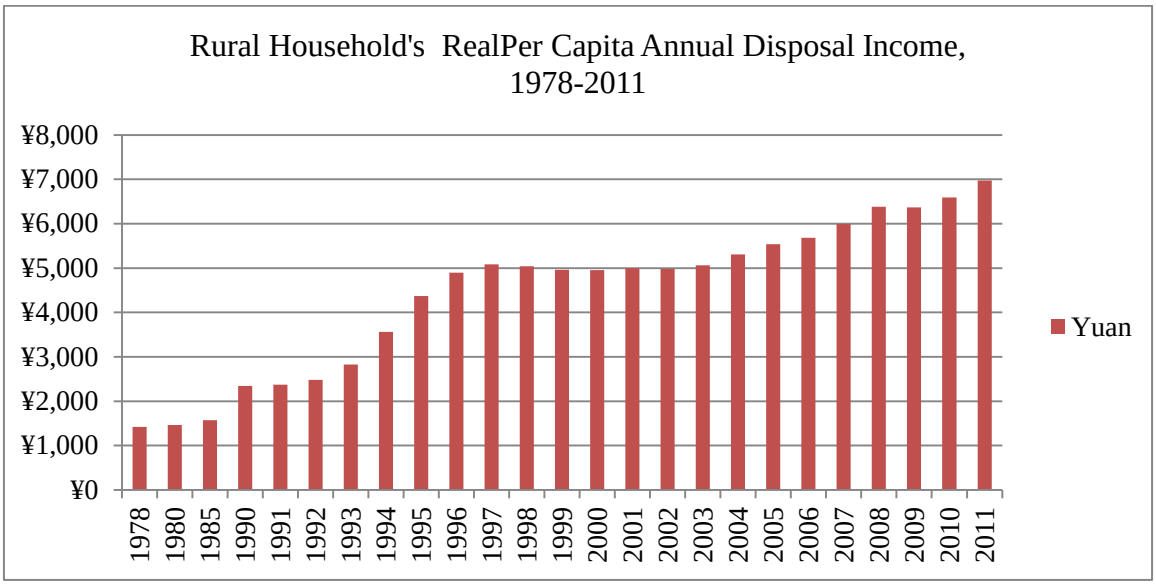

Figure 1.2. Rural Household's Per Capita Annual Disposal Income, 1978-2011
Source: China Statistical Yearbook, 2012. The National Bureau of Statistics, P. R. China

China's population continues to grow although it is growing slower than it has in the past. The current population is around 1.34 billion. This population is increasingly becoming more urban. In 2010, the urban population in China was estimated to be 665 million (Bloomberg, 2011). This is almost more than twice the population of the United States. China is officially on the verge of having more residents in urban regions than rural for the first time in its long history. According to the Chinese National Bureau of Statistics urban population makes up 49.7 percent of the total, 13.5 percentage points higher than just a decade ago (Bloomberg, 2011). As we have seen, not only are there more people heading towards the urban areas, these people also tend to have a higher disposable income when compared with their rural counterparts. Along with this increase in urban population and disposable income, there has been a noticeable change in the consumption patterns of food. Urban China is expanding into uncharted territory with the expansive population and the changing preferences of its consumers.

The changing preferences in these urban Chinese consumers may perhaps be the most interesting and applicable to the rest of the globalized economies and more specifically their food markets. Numerous studies have documented China's food and nutritional transition (Du *et al.*, 2002; Curtis *et al.*, 2007; Huang and Gale, 2009; Mendez and Popkin, 2001; Popkin *et al.*, 1993; Veeck and Veeck, 2000; Zheng and Henneberry, 2009; amongst others). These studies note several changes but the vast majority agree that many consumer's diets have transitioned from a subsistence low-fat traditional diet (focused on grains, vegetables, and more traditional foods) to one that could be labeled as increasingly more "Western" (centered on animal products, edible oils, and processed foods). Higher incomes, busier lifestyles, and an increase in choices have all proved significant in altering the diets of Chinese consumers. This thesis focuses on adolescent food consumption and body mass index in various cities throughout urban China. It also looks into an often forgotten food away from home; the school meal. In conclusion, this thesis brings forth the opportunities North Dakota exports have from analyzing this important demographic.

Adolescents in China

According to the World Health Organization (WHO, 2008), adolescence pertains to a key developmental period in a person's life. More specifically, the WHO defines children aged 10 to 19 years as adolescents. Lifestyle habits are formed during this important developmental period. There are estimated to be around 1.2 billion adolescents, close to one out of every five people, throughout the world today. Of these total adolescents, nearly 85 percent live in developing countries (WHO, 2008). In 2010 there were approximately 201 million, or about 14.75 percent of the total population, adolescent children living in China (United Nations, 2011). Adolescent consumers are particularity in need of more studies focusing on potential health concerns due to diet and socioeconomic factors.

The changing patterns in food consumption in China mentioned before have raised some legitimate health concerns. There has been a dramatic increase in the occurrence of overweight and obesity among preschool children in urban areas of China. Past studies have indicated that the occurrence of being overweight in China has increased from 14.6 percent in 1989 to 28.6 percent in 1997 and obesity increased from 1.5 percent in 1989 to 12.6 percent in 1997 (Luo and Hu, 2002). It was also found from the years of 1992 to 2002, the prevalence of overweight and obesity in Chinese people aged 0 to 6 and 7 to 17 years increased by 31.7 percent and 17.9 percent respectively (Ma *et al.*, 2005). This study looks at if the current trend of overweight and obesity is still continuing at these increasing levels. During the 1990s the problem of under-nutrition shifted to over-nutrition throughout older children and adolescents in China. The shift was noted to be more dramatic in urban regions than compared to rural (Wang *et al.*, 2002). Further research has found that more attention should focus on the increase of dietary fat and the problem of obesity in Chinese adolescents. This is especially true among urban family groups with higher incomes (Wang *et al.*, 1998).

When evaluating the results and implications associated with this and several other studies, it is important to note the cultural shift of the new generation. Improved living standards, growing up with few or no siblings under the one child policy, that results in a typical family of four grandparents and two parents for one child, have all likely contributed to the new generation being label as “little emperors”(Jing, 2000). Children in this generation have grown in a time where they have an increase in the amount of food choices and also an increase in the influence in what their parents feed them compared with past generations. Younger people in Urban China, aged 20 or less, have been found to consume more food away from home (FAFH) than compared with people aged 50 and over. These younger people also tend to eat more meat when they are

dining out (Ma *et al.*, 2006). While most evidence of an adolescent having a substantial influence on household expenditure is anecdotal rather than empirical (McNeal and Yeh, 1997), it is crucial to emphasize how influential this demographic has become.

North Dakota Exports

In addition, given the future importance of this demographic, better understanding adolescent Chinese food consumption patterns is of great interest to not only domestic producers, marketers, consumers, and policy makers, but it is also essential to the continuing growth of international trade. This is especially true for exporting states with significant agricultural surpluses like North Dakota. In particular, the accession of China to the World Trade Organization (WTO) in 2001 has accelerated the openness of China's agricultural trade and allowed more imports. Studies have shown that China's main trading partners will benefit along with overall trade in the world (Martin and Ianchovichina, 2001). Entering the WTO has been a catalyst for China, making it much easier to gain greater access to world markets. It also has provided a better opportunity for states like North Dakota. The following section will begin to discuss these changes. In addition, this thesis will develop some empirical analyses to assess the new preference of Chinese adolescent consumers on food consumption.

The United States exported a record $110.5 billion dollars to China in 2012 up a significant amount from the $16.1 billion in 2000. China currently ranks 3rd in total dollars of exports for the U.S. According to the official government export statistics, North Dakota ranks 49th, only ahead of Wyoming, in the dollar amount exported to China (U.S. Census Bureau, 2012). However, North Dakota's exports to China have increased from around $5 million in 2000 to nearly $25 million dollars in 2010 (Figure 1.3.). This is a near 400 percent increase in the course of ten years. The opportunities for North Dakota to increase exports to china are

immense. In 2010, the top three exports to China were agricultural related and the top two, edible peas and chickpeas, accounted for over half of all exports (Figure 1.4.). The data from 2010 were based on the worldwide classification of export codes (the harmonized tariff schedule or HTS code).

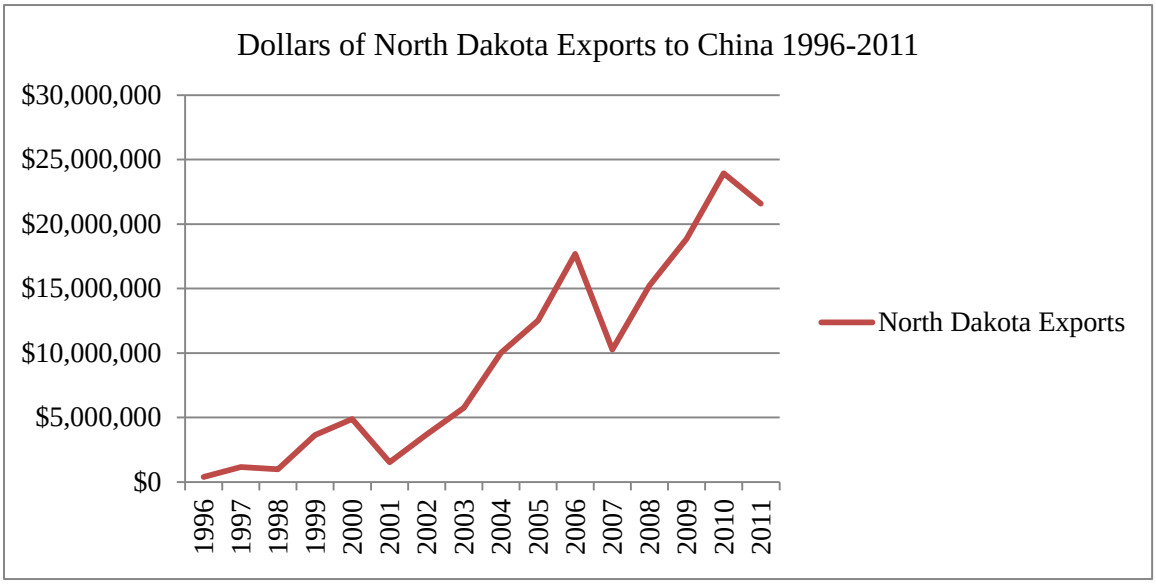

Figure 1.3. Dollars of North Dakota Exports to China, 1996-2011
Source: United States International Trade Commission; United States Census Bureau 2012.

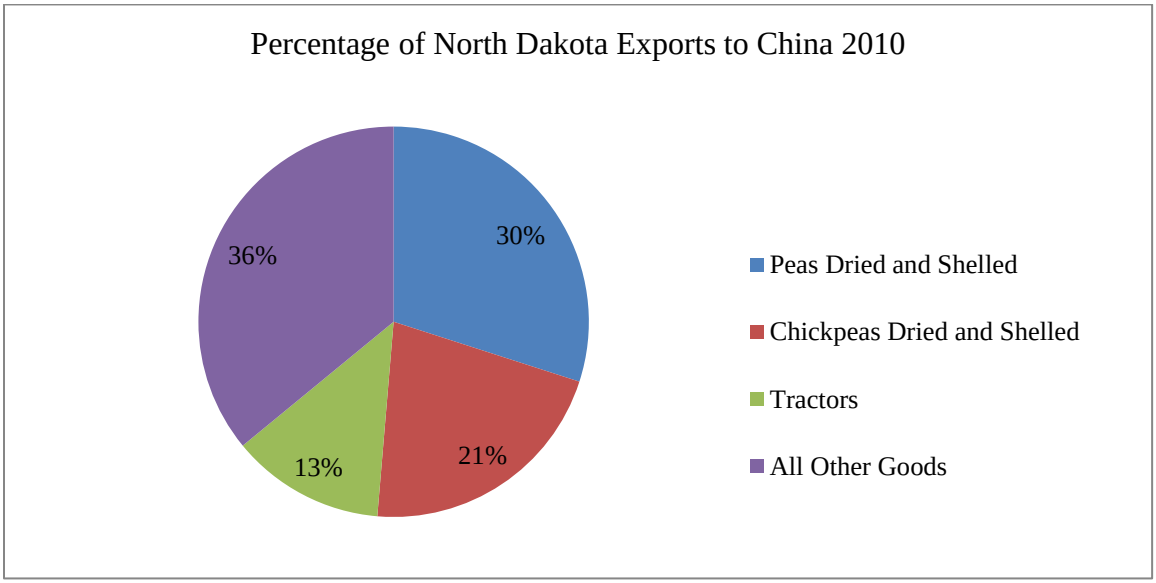

Figure 1.4. Percentage of North Dakota Exports to China, 2010
Source: Trade Stats Express International Trade Administration; U.S. Dept. of Commerce 2012.

Historically North Dakota has been a state with a solid agriculture economy. In 2010, agriculture made up 23.1 percent of the states booming economic activity (Coon *et al.,* 2012). Although data on a specific year may fluctuate, it is evident that agriculture is a linking factor in international trade between China and North Dakota. As noted in Koo and Kennedy (2005), agricultural trade can be dictated by the differences countries have in resource endowments. One country may have a particular advantage in producing a commodity over another. Countries would increase their welfare by producing the commodities they have an advantage in and engage in trade for others that they need or want.

Overall, China is experiencing many changes in the key areas of its society. More disposable income is available and numerous food preferences have changed. In the future, the demographics are expected to change and the makeup of the country is projected to be older than it is today. Now is an important time to focus on the adolescent consumers who in the near future will be the consumer's driving demand. These urban adolescent consumers are unique in that they are growing up in a time that is much different when one compares it to their parents and grandparents. This study is intended to investigate what might be influencing adolescent BMI (body mass index) by descriptively explaining what adolescents are eating at home and away from home along with applying empirical methods. Another important section in this study is focusing on what adolescents consume at school. School meals have become an important issue in countries like the United States, but not much information on these important meals exists for China. Providing information on school meals and what influences a parent's perception of these meals will greatly extend the gap of literature in this area. In the end, this study hopes to update the current literature on adolescent food consumption in urban China, which hopefully will be useful for policy makers, nutrition experts, and food exporting states like North Dakota.

Objectives

First, the changing preferences of urban adolescent Chinese consumers along with specific socioeconomic influences are analyzed from recent surveys throughout urban China. This section attempts to determine what factors are influencing adolescent BMI by separating nutritional factors of the food consumed from socio-economic and demographic variables. The nutritional factors included food calories consumed at home versus food calories consumed away from home.

Next, using a recent and unique consumer household survey throughout cities in China, data on food consumed at school by students is analyzed. The purpose of this study is to analyze what types of food students are consuming at school, the nutritional quality of that food and compare it to what they are eating with at home. Another important area of this study examines the influence of socio-demographic factors on a Chinese parent's perception of their children's meals at school. Their perception was based on asking the parent to rate their satisfaction on certain aspects such as the safety, price, and the nutritional content of the meals served. The results will hopefully provide insight into nutrition, behavior, and perceptions that are important to nutritionists, policymakers, and industry as they design, implement, and ultimately supply school lunch programs.

The overall objective of this research is to analyze food consumed by urban adolescents in contemporary urban China. This study is separated into two major studies. The first study focuses on adolescent food consumption at home and away from home and also what factors are influencing an adolescent's BMI. The second study investigates school meals and focuses on a student's consumption and their parent's perception. The specific objectives of this study are to do following works:

1) Descriptively analyze adolescent's BMI and what food they are consuming by highlighting the differences in nutrition and food consumed at home versus food consumed away from home. Also, empirically determine what is influencing an adolescent's BMI by developing a general linear regression model.
2) Examine the influences on a parent's perception of the school meals by developing a non-linear ordered logit model. Helping one understand what is or perhaps more importantly what is not perceived as an important aspect of a school meal. Another goal is to determine and explain the differences from food consumed at school and food consumed at home for the regions in the survey. Extending the literature and knowledge of school meals from parents and students is an important objective of this thesis.
3) Assess the opportunities for North Dakota exports that this increasing important demographic might currently have and also focusing on how this will impact the future.

Methods

First off, the data are descriptively analyzed and merged with nutritional information to determine the nutrient content and also what exactly is currently being consumed by urban adolescents. The descriptive statistics are very important and relay information from new and unique surveys. For the empirical side, two separate models are developed for this study. To help determine what is influencing an adolescent's BMI, a general linear equation model is applied. BMI is applied as the dependent variable and tests were performed on the data to insure its linear compatibility and can be found in Appendix A of this thesis. The tests help reassure that the

estimations from the liner equations are unbiased estimations and that it follows the Guass-Markov theorem explained in Pindyck and Rubinfeld (1997).

The second empirical model on determining a parent's perception of the many aspects of meals consumed at school based on a non-linear ordered logistic regression. This is due to the dependent variable being a qualitative response. The respondents (parent or guardian in charge of shopping for food in the household) were asked to rank from 1 to 10 (1 to 4 being less satisfied, 5 to 6 being neutral, and 7 to 10 being more satisfied) how satisfied they are with the nutrition, amount, variety, safety, and price of their children's school meal. The dependent variable is not continuous thus applying a linear regression may not be the correct model and therefore the model is usually estimated by maximum likelihood (ML). A vast body of literature recognizes that linear regression might be inappropriate when the dependent variable is categorical, especially when it is ordinal in nature (McKelvey and Zavoina 1975; Borooah 2001; Greene 2002). For example, if the dependent outcomes are ordinal and labeled in this case 1(e.g. being less satisfied), 2(e.g. neutral), or, 3(being more satisfied) a linear based regression would not be able to the treat the differenece between 3 and 2 "identically" from 2 and 1 (Borooah, 2001). In turn, there are some who choose to ignore the ordering of the categories of the dependent variable and treat it nominal, especially if the data is extensive and numerous categories are present (Menard, 2001). The ordered logit model was chosen over the order probit model due to the distribution of the error terms. Following Borooah (2001), an ordered logit model assumes the distribution of the error term is logistically distributed while the order probit model assumes the result is normally distributed. The logistic distribution, which is similar to the normal distribution, is better for our case because it puts more emphasis on the tails of the distribution. This better fits the data in that many more observations were found to happen in the neutral and

more satisfied region. This will be explained later on in the section concerning a parent's perception.

This study uses unique household survey data that was collected from 2009 to 2011. All the descriptive data and models were ran using STATA 12.0 statistical software and was compressed in several program files so models and descriptions from the author can easily be recreated (StataCorp., 2011).

Organization

This thesis is organized into five chapters. Past and related studies about adolescent food consumption, BMI, and school meals will be discussed in Chapter 2. This chapter will also include the background on the empirical modeling approach focusing on the ordered logit model. Chapter 3 is a separate study which focuses on what is influencing an adolescent's BMI. This chapter also includes a descriptive analysis on what foods adolescents consumed at home and also away from their home. Chapter 4 is also a separate study which focuses on what students consumed at their school meals in urban China and also carefully examining their parent's perception of these meals. Finally, Chapter 5 ties it all together and provides the overall summary, conclusions, as well as opportunities for North Dakota exports and also recommendations for further research.

CHAPTER 2. LITERATURE AND METHODLOGY REVIEW

Summary

The transitions and growths of the Chinese consumers and their economy has been a widely studied topic. From 1978 through the year 2005, on average the Chinese economy has sustained an annual growth rate of around 10 percent (Naughton, 2006). This has aided the Chinese economy to be labeled as the most consistent and rapid growing economy in the world. This label has also increased the extensive amount of literature one can find pertaining to Chinese food consumption and nutrition. These studies have helped develop a better comprehension of the current trends and patterns of Chinese food consumption. Ultimately, this chapter is devoted to understanding patterns in Chinese adolescent food consumption.

Literature Review

The studies are vast and range in topic from the broad focus of food demanded (Zheng and Henneberry, 2009; Gale and Huang, 2007) to topics that follow a trend such as food away from home consumption in Urban China (Ma *et al*., 2006).

Ma *et al*. (2004) focuses on consumption of meat. They consider the effects of food away from home on the consumption of meat in China. A large reason why their study is important is that it focuses on how omitting consumption away from home can lead to a misunderstanding of food consumption. An L/A AIDS model along with a Seemingly Unrelated Regression (SUR) is used for the main estimation technique. In the conclusion, Ma *et al.* point out that Chinese consumers will continue to increase the consumption of meat products, but their preference is shifting from pork to chicken and aquatic products. The results also show significant differences in meat consumption and preferences across regions in China.

Wu and Wu's (1997) study focuses directly on food consumption. The authors present an almost ideal demand system (AIDS) model to detect household grain consumption in China. The main objectives of this paper are to focus on the application of demand models, examination of consumption parameters, and estimation of the effects of price, income and urbanization on grain demand. They also pay attention on the regional grain demand in China. In this study, the authors also discuss how the effect of urbanization may play a negative role on the food grain consumption. Their reasoning is that in the mist of the massive migration that is occurring in China, people who move to the urban areas adopt an urban consumption pattern and tend to consume less food grains and more meat.

Adolescent Consumption

Typically the food demand studies tend to devote a small section to adolescent consumption. Some do not mention or separate adolescents at all. There is a large gap in the literature for adolescent food consumption throughout China. This thesis hopes to improve and expand the literature in this area.

Using a Box-Cox double hurdle regression model Bai *et al*. (2010) discusses how households with fewer children tend to dine out more and also spend more money when dining out relative to other households. Ma *et al.* (2006) also focuses on the consumption of food away from home (FAFH). In their study a system of multivariate Tobit equations is simultaneously estimated for separate age groups. They found that young people aged less than 20 consume more food away from home and tend to eat more meat when dining out than compared with people aged 50 and over.

Nutrition

Throughout the better part of the past century, most nutrition oriented research was directed at the developing world and mainly dealt with under-nutrition and poverty. Recently, the studies have shifted their focus to center in on the growing overweight and obesity problem (Wang *et al.*, 2002). Therefore, it is understandable that nutrition based literature tends to dominate the past studies on Chinese food consumption (Du *et al.*, 2002; Mei *et al.*,2002; Popkin *et al.*, 1993; Wang *et al.*, 1998; Zhai *et al.* 2002).

Some studies are more directly related to this study and focus on adolescent nutrition. In Li *et al.* (2007) the prevalence of overweight and obesity in China was compared with different dietary and physical activity patterns and parental body weight status. This study noted that limiting fat intake and overconsumption of cooking oil in China is an ongoing challenge due to the habits of consuming fried food. Li *et al.* (2007) also discusses how parental participation in low-activity exercise can have a positive effect on that child's health.

Another nutrition focused study is Li *et al.* (2010). This study focuses on the dietary habits and how they are associated with overweight and obesity in Xi'an City, China. Li *et al.* (2010) uses logistic regression analysis to identify dietary patterns associated with obesity and they also take into account the socio-demographic factors. Having breakfast away from home and consumption of soft drinks was associated with an increased risk in being overweight or obesity. The study recommends health programs to prevent excess weight gain from unhealthy eating habits.

Very few studies focus solely on the socioeconomic and nutritional factors associated with adolescent food consumption. Only one was found. In this study, Shi *et al.* (2005) uses

cross-sectional data from urban and rural middle schools in Jiangsu Province. A food preference and a food frequency questionnaire along with the socioeconomic variables such as parents' education were analyzed. A multivariate linear regression analysis was performed to model the association between the intake of food and socio-demographical factors. A higher socioeconomic status was associated with an increased consumption of higher-energy and more Westernized foods especially in the urban areas. The results suggest a need for nutritional education and more preservation of traditional Chinese food habits to promote healthy eating among adolescents and parents.

Body Mass Index

Studies modeling body mass index (BMI) are also widespread, and are mainly focused on the United States. Brinkley *et al.* (2000) uses a linear regression analysis to estimate the effect of food source, dietary, demographic, and different lifestyle variables on BMI. The main contribution of this study showed that trends in increased consumption of FAFH appear to have contributed to adult overweight in the U.S. Increased physical activity was also found to have contributed to a lower BMI.

Eales *et al.* (2002) also uses linear regressions to estimate the effect of eating FAFH on U.S. children and teenagers' BMI. A Logit analysis is also used to model the probability of being at risk of overweight. Like in adults, FAFH was found to increase BMI amongst children and teenagers in the U.S. but not as significantly as a lack of physical activity. In all the models created in Eales *et al.* (2002) the demographic variables of a mother's BMI and household income are significant throughout. The mother's BMI had a positive effect and the household income had a negative effect on BMI.

In the majority of the previous literature authors use linear or logistic based regressions to model the effects on BMI. This does have its limitations, therefore other methods such as quantile regression have been applied to various related BMI studies alongside the linear regressions (Beyerlein *et al.*,2008; Stifel and Averett, 2009). Popkin (2010), uses quantile regression and finds that between categories of children, BMIs for U.S. children at the top end of the distribution (95^{th} centile) are below those of children in China. This indicates a shift in BMI distribution and the U.S. is no longer alone at the top end of the distribution. In other words, obesity is increasingly becoming a global issue.

Chen and Tseng (2010) compare ordinary least squares (OLS) regressions with quantile regressions and conclude that quantile regressions provide more information on broader marginal effects of the explanatory variables on the entire distribution of an individual's BMI level. Quantile regression is useful in examining the separate BMI classes of underweight, healthy, overweight, and obese particularly in larger national based studies and did not apply well to this study. This is mainly due to the low number of observations at both the underweight and overweight categories in this study.

Review of Methodology

In this thesis, a general linear regression model and an ordered logit model are the main empirical estimations used. Due to the prevalence of the general linear regression, only the ordered logit model will be addressed in this section.

Ordered Logit Model

The ordered logit model is a variant of the ordered probit model developed by McElevy and Zavoina (1975). This model has been used in applied applications (e.g. surveys) in which the respondent will express a preference in the terms of an ordinal ranking. Furthermore, Han and Hausman (2006) also showed that the flexibility by proving that the orded logit model can be adapted for other reasons such as describing the duration of specific data. One can also think of the ordered logit model by adapting and labeling it as a nonlinear probability model.

The methodology and logic for both the ordered probit and ordered logit can be explained by the same equations. Following Borooah (2001) advice, an example from the study will be adapted. Suppose there are N parents who have students consuming meals at school (i =1,…,N) living throughout regions in urban China and that each household has a parent whose "degree of satisfaction" is measured for several aspects of a school meal. The value is represented by $S_i$in such that higher values of S_i represent ordinal "degrees of satisfaction." The degree of satisfaction depends on many different factors. For example the education, age, and gender of the respondent along with important variables like the student's education level and city level variables to adjust for regional and school differences. Suppose these factors can be labeled as K whose values, for individual i, are X_{ik}, $k = 1, \dots K$). Now the index of this can be represented by the following latent regression equation:

$$S_i = + \sum_{k=1}^{K} \beta_k X_{ik} + \varepsilon_i = Z_i + \varepsilon_i \qquad (2.1.)$$

where β_k is the coefficient associated with the k^{th} variable ($k = 1, \dots K$) and also $Z_i = \sum_{k=1}^{K} \beta_k X_{ik}$. Therefore, an increase in value of k^{th} factor for a particular parent will cause his or hers satisfactions score to rise if $\beta_k > 0$ and it will fall if $\beta_k < 0$. However, there is not an exact relationship (equal to 1) so the error term, ε_i, is included.

As noted above equation (2.1.) is a latent regression and is not observable. The parent's satisfaction donated as, Y_i, and is associated with levels of satisfaction. For example, $Y_i = 1$ if less satisfied, $Y_i = 2$ if rated as neutral, and $Y_i = 3$ if mostly satisfied. Where Y_i is an ordinal variable. The levels are associated with the latent variable S_i and are further associated with "threshold" or "cut" points denoted as δ_1 and δ_2 such that they represent:

$$Y_1 = 1, \ \ if\ S_i \leq \delta_1 \qquad (2.2.)$$

$$Y_2 = 1, \qquad if\ \delta_1 \leq S_i \leq \delta_2$$

$$Y_3 = 1, \qquad if\ S_i \geq \delta_2.$$

where δ_1 and $\delta_2 \geq 0$ of equation 2.2. are the unknown parameter ($\delta_1 < \delta_2$) that are to be estimated with β_k from equation 2.1. Whether or not a parent is classified in a certain level depends on if S_i crosses the "cut" point. Furthermore, the probabilities of Y_i take on the values of 1, 2, or 3 is defined as follows:

$$\Pr(Y_i = 1) = \Pr(Z_i + \varepsilon_i \leq \delta_1) = \Pr(\varepsilon_i \leq \delta_1 - Z_i) \qquad (2.3.)$$

$$\Pr(Y_i = 2) = \Pr(\delta_1 \leq Z_i + \varepsilon_i \leq \delta_2) = \Pr(\delta_{1_i} - Z_i < \varepsilon_i \leq \delta_2 - Z_i)$$

$$\Pr(Y_i = 3) = \Pr(Z_i + \varepsilon_i \geq \delta_2) = \Pr(\varepsilon_i \geq \delta_2 - Z_i)$$

Now the likelihood of observing the sample is computed by the following equation:

$$L = [\Pr(Y_i = 1)]^{N_1}[\ \Pr(Y_i = 2)]^{N_2}\ [\ \Pr(Y_i = 3)]^{N_3} \qquad (2.4)$$

$$= [\mathrm{F}(\delta_1 - Z_i)]^{N_1}[\mathrm{F}(\delta_2 - Z_i) - F(\delta_1 - Z_i)]^{N_2}$$

$$\times [1 - \mathrm{F}(\delta_1 - Z_i)]^{N_3}$$

where $\mathrm{F}(x) = \Pr(\varepsilon_i < x)$ is the cumulative probability distribution of the error terms. One can assume the error terms follow a certain distribution based on the appearance of the data.

Borooah (2001) further suggests that the main specification issue in the ordinal logit model is determining how appropriate the assumption that the categories of dependent variables are in fact, truly ordered. Following Brant (1990), the ordinal logit model may also be incorrectly specified for the following reasons. First, the set of explanatory variables has been specified wrong. Secondly, heterogeneity in the error terms variance may be present. Finally, the link function may be specified wrong. All three of these misspecifications lead to violation of the parallel slopes property which is the underlying assumption of the model. The tests developed by Brant not only take into account the extremes which can happen, but they also focus in on the possibilities in between.

CHAPTER 3. FACTORS INFLUENCING ADOLESCENT BMI

Summary

Chapter 3, intended to stand on its own, attempts to determine what factors are influencing adolescent BMI by separating nutritional factors of the food consumed from socio-economic and demographic variables. A general linear equation is utilized to model the results empirically. A descriptive analysis is also created to determine what adolescents are currently consuming. Key results discovered that adolescents tend to eat substantially less fruit when they eat away from home and females tend to consume more pork than males when eating away from home. The empirical results found that FAFH and FAH calories have a relatively similar positive influence on BMI. It also brought forth evidence that a mother's weight contributes more to an increased BMI than a father's weight. Increasing a mother's education was also found to increase the BMI.

Introduction and Background

It is well known that food-related health problems have become an important public concern in many advanced countries. At the center of the food-related health issues is that of overconsumption which may lead to the increasing problem of being overweight or obese. An alarming trend in the obesity issue is the percentage of children that are becoming involved. The percentage of obese children in the U.S. doubled and even tripled for some age groups from 1976 to 2008. During this time period children ages 6 to 11 almost tripled their rates of obesity from 7 percent to 20 percent. Even more concerning are the adolescent children ages 12 to 19 whose obesity rates more than tripled from 5 percent to 18 percent (Ogden and Carroll, 2010). A recent study by Cawley and Meyerhoefer (2011) also found the annual United States estimated cost of public health expenditure on obesity to be in the hundreds of billions of dollars. Recent studies

like this have shown that the past literature has greatly underestimated the potential costs to society obesity has.

Despite conventional thought, concern over food-related health problems is rising rapidly in many developing countries. In fact, the prevalence of childhood obesity is increasing rapidly worldwide (Dehghan *et al.*, 2005). In the year 2000 it was found that overweight and obesity in Chinese children is very similar to the conditions of the United Kingdom and the United States had in the early 1980s (Liu *et al.*, 2007). China has always maintained high self-sufficiency and ensuring food security has been a high priority.

China has about 1/5 of the total world's population. It has experienced a massive migration to its urban areas and has had unbalanced economic growth over the last 30 years (Gong *et al.*, 2012). With this recent massive transformation, health problems have emerged as a major public concern. For example, Cui *et al.* (2010) found that the prevalence of overweight and obesity in Chinese children aged 7-17 went from 5.2 percent in 1991 to 13.2 percent in 2006. The study went further to describe that the greatest increase occurred among male children and adolescents. Their excess body weight tripled from 4.8 percent in 1991 to 15.4 percent in 2006, compared with 5.4 percent and 11.0 percent in females. Perhaps the most related to this study is that Cui *et al.* (2010) describes how the most notable increase was in children from urban areas and those in households with higher disposable incomes. Understanding the rising health problems due to food consumption in China will be important to the Chinese food policy and the rest of the globalized economies as well as their food markets. Still, little is known about the rising health problems in China and its socioeconomic and demographic drivers.

This paper attempts to analyze what urban Chinese adolescents are currently consuming and also what factors might be influencing their Body Mass Index[1](BMI). Certain health risks (diabetes, hypertension, cardiovascular diseases, stroke, sleep apnea, respiratory problems amongst many others) have been found to be associated with a heightened level of BMI (CDC, 2012). BMI has the ability to show if a person is at a risk of being underweight, overweight, or obese. It does however need to be used with caution. For example, the BMI scale may prove to misidentify people who are serious athletes or weight trainers due to a presence of more muscle than fat (Fahey *et al.*, 2007). Nestle and Nesheim (2012) note that the BMI works well as an indicator of body fat content. Body fat content can also be measured by skinfold thickness, but it is not a very reliable method and has not been used in research. Other methods noted in Nestle and Nesheim (2012) include underwater weighing, bioelectrical impedance, dual-energy x-ray absorption, and isotope dilution. All of these methods are more accurate than solely measuring BMI but they remain difficult to interpret, conduct, and happen to be very expensive. Therefore, BMI is widely accepted as a suitable substitute.

Adolescent BMI

Past studies have found that children with a higher BMI are much more likely to have adverse health effects and they also have an increased chance of becoming obese adults (Freedman and Sherry, 2009). BMI at the adolescent stage has also been found as one of the most important predictors of the BMI during one's adult life (Laitinen *et al.*, 2001). However, defining a child as obese is a difficult task.

[1] BMI is calculated by dividing the weight of a person measured in kilograms by the height squared measured in meters (BMI=weight in kg/ (height in m^2))

Measuring BMI in children is complex. BMI amongst adolescents needs to account for the differences in age and sex. This is because adolescents are still growing and that the amount of body fat changes with age and tends to differ between boys and girls (CDC, 2011). Only until recently has there been a widely accepted BMI based reference that could be used to identify an adolescent underweight, overweight, or obese. To determine if an adolescent is underweight, normal, overweight, or obese, a growth chart to obtain a correct percentile rating must be used. A popular growth chart used throughout the U.S. was developed by the Center for Disease Control and Prevention (CDC). The CDC (2011) defines adolescents as being underweight if they lie below the 5th percentile, a healthy weight if between the 5th and the 85th percentiles, overweight if between the 85th to 95th percentile, and obese if the adolescent is in the 95th percentile or greater. This might work well for Western societies but the growth rate of Chinese students to some extent differs from Westerners. Other studies have recognized this and have worked on developing a more relative growth chart that pertains to Chinese adolescents. A recent study (Ma *et al.*, 2010) focused on developing a current BMI percentile chart for Chinese adolescents. The new percentile curve is different when compared with the CDC and other internationally recognized charts. It was found that the BMI percentiles associated with Chinese girls and older Chinese boys (ages 15-18) were substantially lower than when compared with the CDC information. Another study by Ji (2005) was recommended by the Working Group on Obesity in China for use as a nationwide reference for screening overweight and obesity of school-age children and adolescents in China.

Table 3.1. asses the BMI from adolescents in this study using the charts developed from previous studies to develop statistics for our sample. One can see that using the CDC chart does result in less overweight and obesity when compared to the percentiles from Ma *et al.* (2010) and

Ji (2005). Compared with the other Western societies this study's overweight numbers, on a surface level, do not seem very alarming. As a previous study by Ji and Cheng (2009) noted that there are large disparities in the changes of obesity for different regions of China. Ji and Cheng (2009) found that in 2005 national estimates found that 7.73 percent of Chinese youth aged 7-18 are overweight and only 3.71 percent of them are obese. For this study the averages may be a bit higher due to the reason that this study focuses on urban middle to upper class families in key provinces throughout China.

Table 3.1. Adolescent BMI Classifications from Data

Source	**Overweight**	**Obese**
CDC	8.47%	2.97%
Ma *et al.* 2010	10.59%	6.78%
Ji 2005	10.17%	5.08%

The World Health Organization (WHO) refers to adolescence as the key developmental period in a person's life ranging in age from 10 to 19 years. This paper uses their age range as defined by the WHO. Adolescent consumers are particularity in need of more studies focusing on potential health concerns due to diet and socioeconomic factors.

This paper utilizes unique survey data. The data is focused on the urban areas of China and was administered throughout 5 different cities from 2009 to 2011. The data was obtained by a randomly selected household survey that used a diary-based method for a period of one week to gather information on how much and what types of foods people consumed. Key information used from the survey in this study included the height and weight of the individual along with the socioeconomic household factors such as income, mother's education, parents' height and

weight, health insurance, along with the consumption of various food groups. To obtain the nutrition information, data was intersected with a nutrient conversion for 79 different commodity classifications from the survey with the food based on information from the China Food Composition book from 2002 and 2004 (China Food Composition, 2009). A weighted share for consumption was created to distinguish how many grams a person ate if there were more than one person consuming the meal.[2]

The remainder of this paper is structured as follows. First, it begins by reviewing relevant studies. Next, the methodology used throughout the paper is discussed along with a statistical description of the data. Finally, the estimated results and the implications associated within the findings are reported.

Relevant Studies

The transition and growth of Chinese consumers and their economy has been a widely studied topic. From 1978 through the year 2005, the Chinese economy on average has sustained an annual growth rate of around 10 percent (Naughton, 2006) helping their economy to be labeled as the most consistent and rapid growing in the world. This label has also increased the extensive amount of literature one can find pertaining to Chinese food consumption and nutrition. These studies have helped develop a better comprehension of the current trends and patterns of Chinese food consumption. The implications from the studies do not focus solely on the interest of domestic producers, marketers, consumers or policy makers; they also provide a firmer understanding to the continuing development of international trade.

[2] Weighted consumption share =(weight of individual/total weight of consumers) this is then multiplied by the total grams consumed at the meal which develops a weighted consumption

Few studies focus solely on the socioeconomic and nutritional factors associated with adolescent food consumption. Shi *et al.* (2005) uses cross-sectional data from urban and rural middle schools in Jiangsu Province. A food preference and a food frequency questionnaire along with the socioeconomic variables such as parent's education were analyzed. A multivariate linear regression analysis was performed to model the association between the intake of food and socio-demographical factors. A higher socioeconomic status was associated with an increased consumption of higher-energy and more Westernized foods. The results suggest a need for nutritional education and more preservation of traditional Chinese food habits to promote healthy eating among adolescents and parents.

Studies modeling BMI are also widespread and focus mainly on the U.S. Brinkley *et al.* (2000) uses a linear regression analysis to estimate the effect of food source, dietary, demographic, and different lifestyle variables on BMI. The main contribution of this study showed that trends in increased consumption of FAFH appear to have contributed to overweight problems in the U.S. Increased physical activity was also found to have contributed to a lower BMI. Eales *et al.* (2002) also uses linear regressions to estimate the effect of eating FAFH on U.S. children's and teenagers BMI. A Logit analysis is also used to model the probability of being at risk of overweight. Like in adults, FAFH was found to increase BMI amongst children and teenagers in the U.S. but not as significantly as a lack of physical activity. This study's results significantly showed that a mother's BMI had a positive effect while the household income had a negative effect on children and teenagers BMI.

The majority of the previous literature tends to use linear or logistic based regressions to model the effects on BMI (O'Dea and Wilson 2006; Beyerlein *et al.*, 2008). This does have its

limitations, therefore other methods such as quantile regression have been applied to various related BMI studies alongside the linear regressions have been used (Beyerlein *et al.*, 2008; Stifel and Averett, 2009). Popkin (2010), uses quantile regression and finds that between categories of children, BMIs for U.S. children at the top end of the distribution (95^{th} centile) are below those of children in China. This indicates a shift in BMI distribution and that the U.S. is no longer alone at the top. In other words, obesity is increasingly becoming a global issue. Chen and Tseng (2010) furthermore compare ordinary least squares (OLS) regressions with quantile regressions and conclude that quantile regressions provides more information on broader marginal effects of the explanatory variables on the entire distribution of an individual's BMI level. Quantile regression is useful in examining the separate BMI classes of underweight, healthy, overweight, and obese particularly in larger national based studies. This paper is focusing a limited number of households in specified regions in urban China, thus modeling using quantile regression would be inappropriate for this study. This paper also introduces new and current data that is unique .

Methodology

The basic equation (3.1.), seen below, provided a general linear model for testing the impact each variable has on an adolescent's BMI throughout a week in urban China. Using linear regression allows for certain factors to be controlled while an effect on BMI for an adolescent is determined. A description of the variables is also given in table 3.2.

$$BMI_i = \propto + \beta_1 fafhcal_{d_i} + \beta_2 fahcal_{d_i} + \beta_3 educ_{mother} + \beta_4 weight_{mother_i} + \quad (3.1.)$$

$$\beta_5 height_{mother_i} + \beta_6 height_{father_i} + \beta_7 weight_{father_i} + \beta_8 insur_i + \beta_9 incins_i +$$

$$+ \beta_{10} gender_i + \beta_{11} age_i + \beta_{12} qhhinc_i \ \beta_{13} district_{2_i} \ldots \ \beta_{38} district_{27i} + \mu$$

Table 3.2. Description of Variables

Variable	Description
Dependent	
BMI	The body mass index recorded at beginning of week
Independent	
Nutrition	
fafhcal_d	Total calories consumed away from home per day
fahcal_d	Total calories consumed at home per day
Demographic	
edu_mother	Ranges (1) preschool to (6) college and advanced
weight_mother	Weight measured in kilograms at beginning of week
height_mother	Height measured in centimeters
weight_father	Weight measured in kilograms at beginning of week
height_father	Height measured in centimeters
insur	Indicates health insurance yes (1) no (0)
incinsur	Interaction term between household income and insurance
gender	Gender of the adolescent (1) female (0) Male
age	Age of the adolescent (10-19)
qhhinc	Quantiles of household income divided by household size in each city (1) Lowest 20% to (5) Highest 20% for all the households in the survey
City_dist2-City_dist27	Dummy district variables throughout regions in the survey

The dependent variable BMI_i is the BMI recorded with the height and weight at the beginning of the week by the ith individual. The explanatory variables to test our hypothesis include the nutrition variables of the total amount of calories consumed away from home per day,$fafhcal\_d_i$, and the total amount of calories consumed at home per day, $fahcal\_d_i$, as

determined by the total weighted share of food consumed in a week. The next sets of variables included are socioeconomic based. The education of the mother, $educ_{mother_i}$, which includes six different groups that range in ascending order from preschool (1), primary (2), middle school(3), high school (4), vocational school (5), and advanced which contains college(6). Next is the height and weight of each parent. Ideally these variables would help control any genetic variation in the model. Following that is a binary variable, insur_i, (1 indicating Yes) whether or not they have health insurance. Next there is the interaction term between household income and insurance, incins_i, and the monthly disposable income,$qhhinc_i$, based on five quantiles of household income divided by household size to develop lower and higher echelon for each specific city. Finally included in the model are the various districts throughout the regions. This will hopefully act as a placeholder for the different regions. As noted before, China is a very large country and it is important to account for the different changes throughout regions. In all there were 27 districts. 26 will be used when running the model. The Nanjing district of Baixia is the base. This analysis, albeit simple, can provide direct and clear information concerning adolescent BMI in urban China.

Data

As stated before, this paper brings forth a unique dataset to further extend the literature. The paper is based on a combination of five similar surveys with a total of 1,025 households throughout regional districts in urban China. The first survey contains 246 and covers the area of Nanjing. The second contains 208 households from Chengdu. The third has 215 households from Xi'an. The fourth is from Shenyang and has 149 total household and the last has 207 households and is from Xiamen. In total, 236 households were found to have both a mother and a father and also an adolescent between the ages of 10 and 19. Only families with that had both a mother and

a father were taken into consideration to focus on the typical middle class household that has one child and two parents. The adolescent data consists of 131 (56%) males and (44%) 105 females with an average age of 14.33. The distribution of adolescents from each city is displayed below (Figure 3.1.).

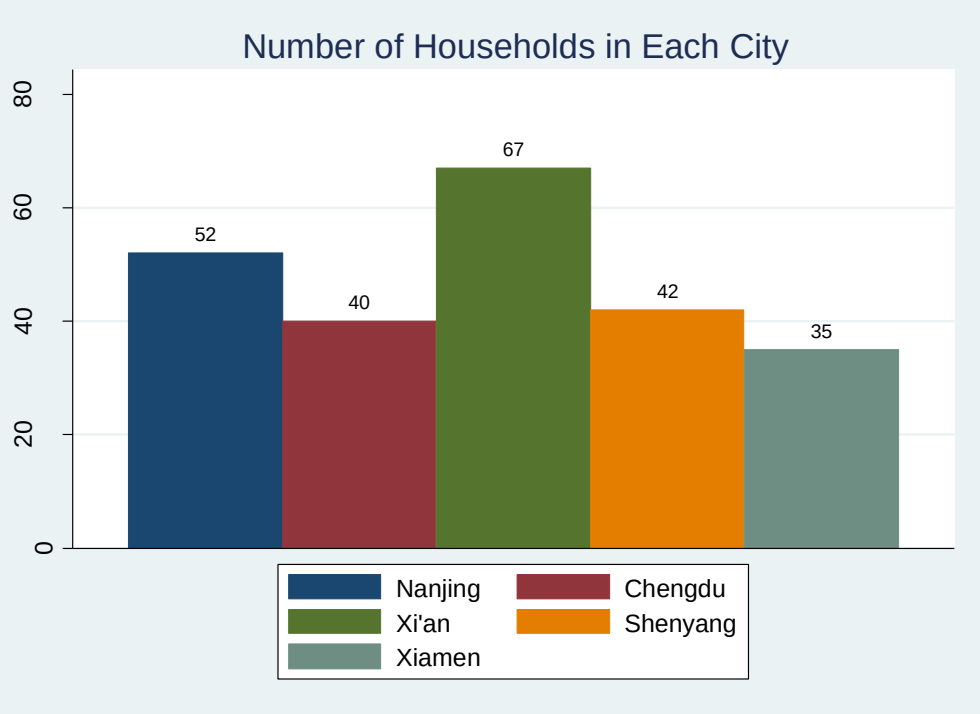

Figure 3.1. Number of Households Containing Adolescents by City
Source: Calculated by Author, 2013

Despite this study being based on household surveys in several large cities in China, it is still able to provide important insights for understanding what adolescents are eating and what is influencing their BMI throughout the nation. First off, sample cities have been located in different provincial areas. For example Sichuan (Chengdu) and Shaanxi (Xi'an) are more inland where Jiangsu (Nanjing) and Liaoning (Shenyang) are located near the Northeastern coast and Fujian (Xiamen) is on the coast in southern China. Next, the total population in these five provinces in 2010 accounted for around 20% of the total population in the country (China Statistical Yearbook 2011). Finally, all cities except for Xiamen are provincial capitals. In China

provincial capitals are usually the center of the culture and economy for the province and they also tend to have influence throughout their respective regions.

The survey in this study used the some of the same sample households that were also part of a previous urban household income and expenditure survey. Therefore, this new survey includes the same reliable household respondents. The previous household income and expenditure survey has been used by prominent authors in research and cited in several papers on urban food consumption in China (Gale and Huang, 2007). This unique survey used in this study differed in that it used a random sampling approach to select representative regional districts. The survey was also separated into two separate but complementing parts. Table 3.3., shown below, displays how this survey compares with the national and regional based surveys. It appears to be very representative.

Table 3.3. Household's Average Annual Per Capita Disposable Income in RMB

Source	Mean	Year
China Statistical Yearbook	20,953	2011
*Survey Adolescent Households	20,498	2011

*Survey from this study

The first part of the household survey was conducted by enumerators that preformed a face-to-face interview with the heads of the household. It collected detailed information on demographics of the individuals. The second part of the survey is focused on the consumption of food. This section separated the food away from home data from the food consumed at home. During the first part of the survey the enumerators explained how to properly record data to ensure the participants correctly recorded their consumption. The second part of the survey was

then left with the participants for a period of one week. In this one week period they would record all their data in a diary based format.

Descriptive Analysis

The data from the survey are extensive. Figure 3.2. shows the average BMI for males and females based on their mother's education. From this figure, one can see that on average adolescent males have a slightly higher BMI than compared with females. It is important to focus on education. Education, especially a woman's education, may represent not only her taste differences but also the efficiency of the household (Wolfe and Behrman, 1983). Mother's education will be discussed in greater detail in the empirical results. The majority of the meals were consumed at home than compared with meals away from home (Table 3.4.). This should be taken into consideration when the two are being compared.

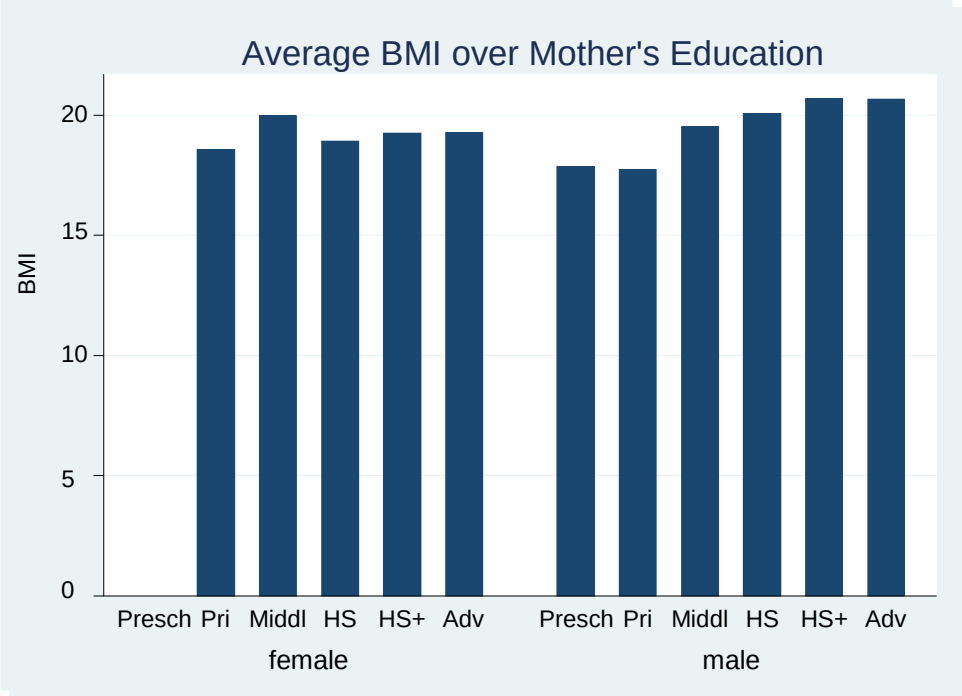

Figure 3.2. Average BMI by Mother's Education Level
Source: Calculated by Author, 2013

Table 3.4. Food at Home Compared with Food Away From Home by Meal

	FAH	FAFH
Breakfast	1,005	159
Lunch	617	356
Dinner(Last meal of day)	1,229	77
Total Number of Meals	2,851	592

Figure 3.3. shows the overall weekly at home food consumption separated into nine different food groups. This is contrasted by figure 3.4. which shows the overall weekly away from home food consumption separated into the same nine different food groups. Upon first notice one should realize that due to it being a direct sum of grams consumed and with more observations being consumed at home there is a noticeable difference in the total sum of grams consumed. These graphs are provided for a relative measurement of total grams consumed. For a major difference, one can look at the overall fruit consumption between the two venues. When an adolescent ate away from their homes there was a large drop in fruit consumed. Another difference was in the drinks consumed. When an adolescent ate away from home, they tend to buy more drink products (including fruit juice, tea drinks, and soft drinks). The other categories (grains, meat, and vegetables) appear to be consumed around the same relative rate whether and individual is at home or if they eat away.

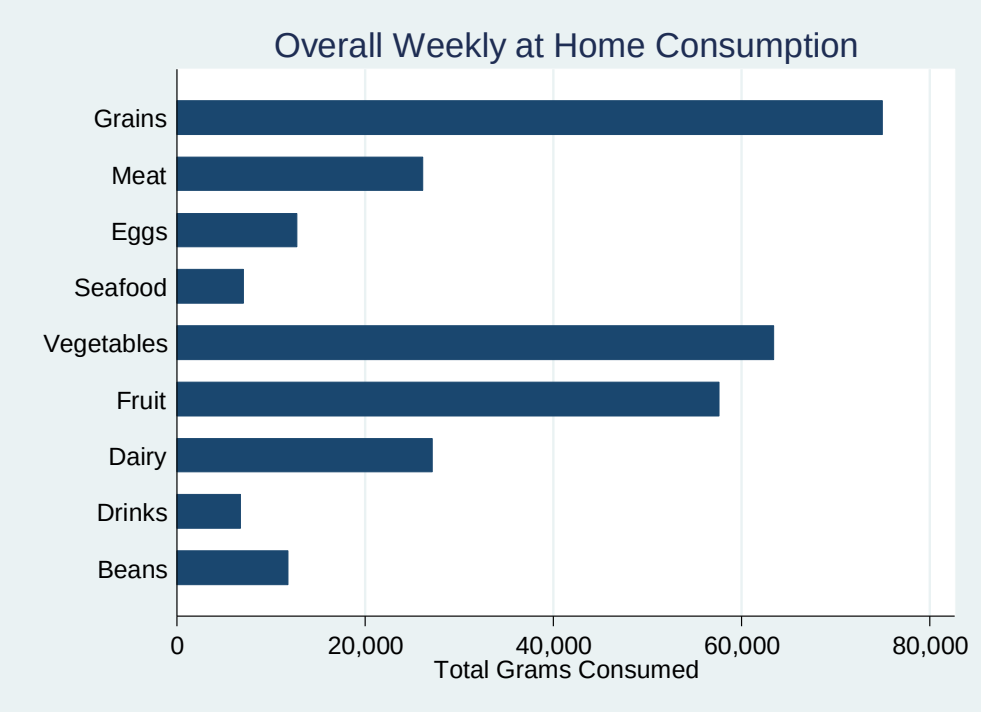

Figure 3.3. Overall Weekly at Home Food Consumption in Total Grams
Source: Calculated by Author, 2013

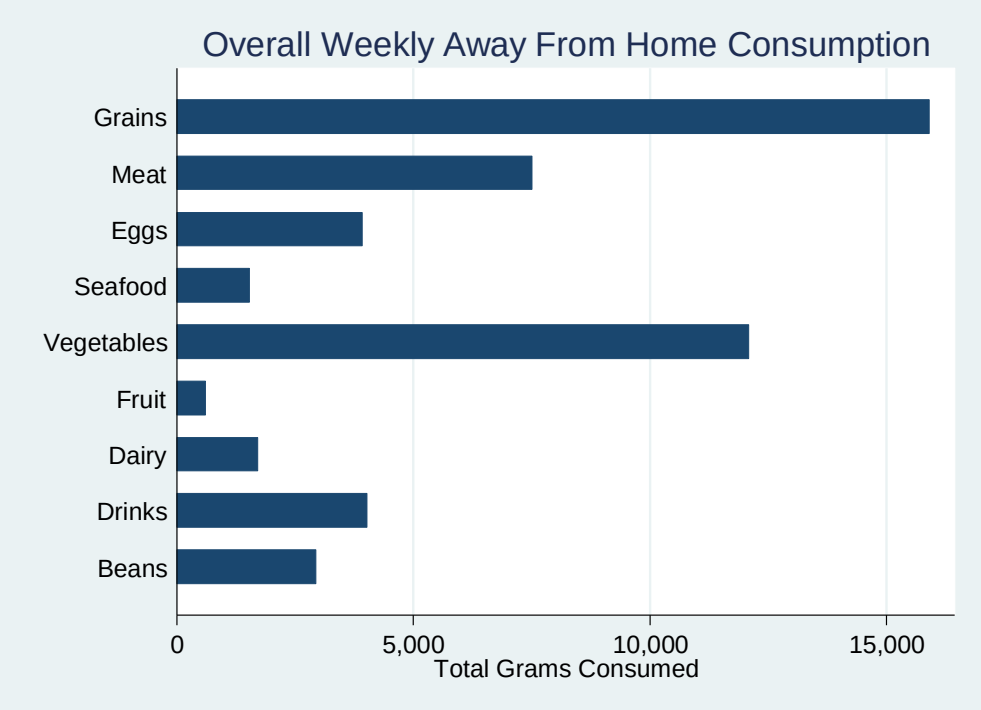

Figure 3.4. Overall Weekly Away from Home Food Consumption in Total Grams
Source: Calculated by Author, 2013

Being that meat appeared to have the same pattern when consumed at home or away from the household, further information was needed to determine if there was anything further to add. An interesting story emerged when meat consumption was analyzed and separated from females and males concerning food consumed at home and food consumed away from home. Figures 3.5. and 3.6. show a more in-depth look at how females and males consumed meat at home and away from home respectively. As expected, pork dominates the amount of meat consumed. However, what was not expected was the difference females have in meat consumption, pork especially, when compared to eating at home versus away from home. One can see that adolescent females tend to eat more meat when dining out and they prefer to eat more pork than their male counterparts.

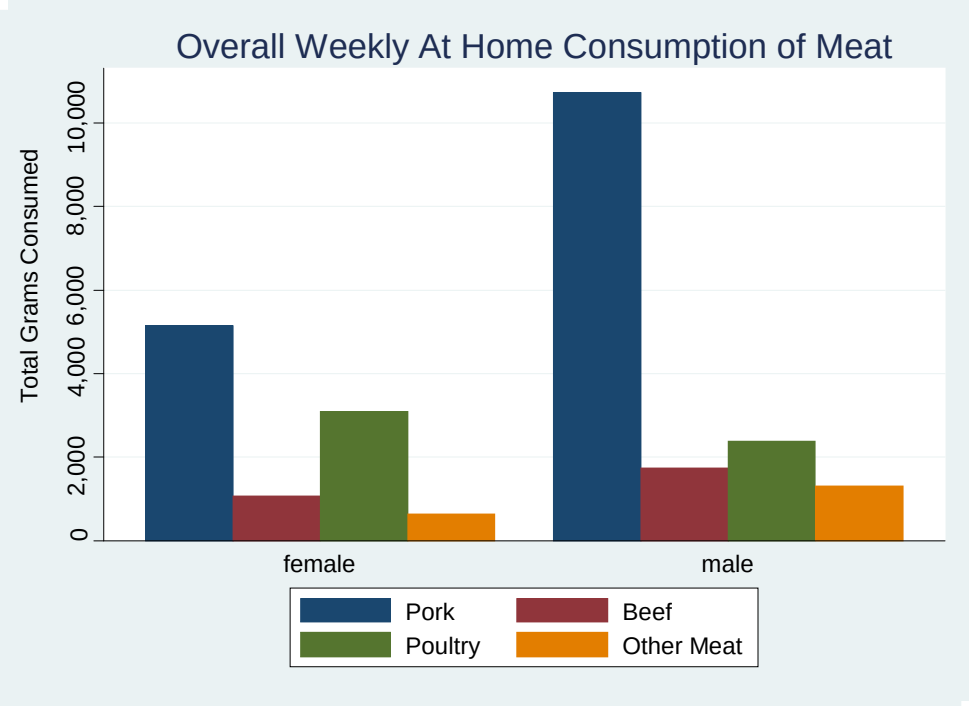

Figure 3.5. Overall Weekly at Home Consumption of Meat by Gender
Source: Calculated by Author, 2013

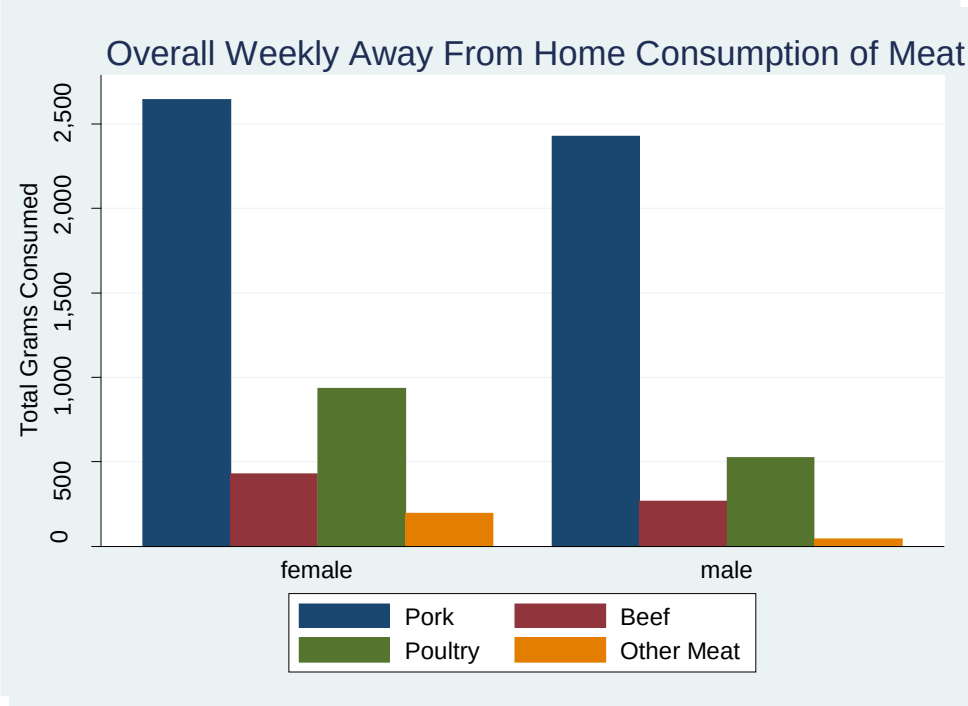

Figure 3.6. Overall Weekly Away from Home Consumption of Meat by Gender
Source: Calculated by Author, 2013

Utilizing the food composition book made it possible to analyze the calories consumed and also the overall average nutrients consumed from the meals. Figure 3.7. shows the average calories consumed in a day from both food at home and food away from home based on the education of an adolescent's mother. There is a clear upwards trend of eating away from home as ones mother increases her education. This might be associated with the mother earning more money and having enough so the child can eat out to not having the time to make something for the child at home due to being preoccupied from a career outside of the household. Also notice how the lowest education level tends to eat all their meals at home. Figure 3.8. depicts average daily nutrients consumed separated by males and females for both food at home and food away from home are included in this figure. Following intuition, males eat on average substantially more carbohydrates than females. Adolescent males also tend to get more protein in their meals.

Average daily fiber intake appears to be low. It is important to note that cooking oil information was not recorded in the diaries and which may underestimate the true value of fat consumed.

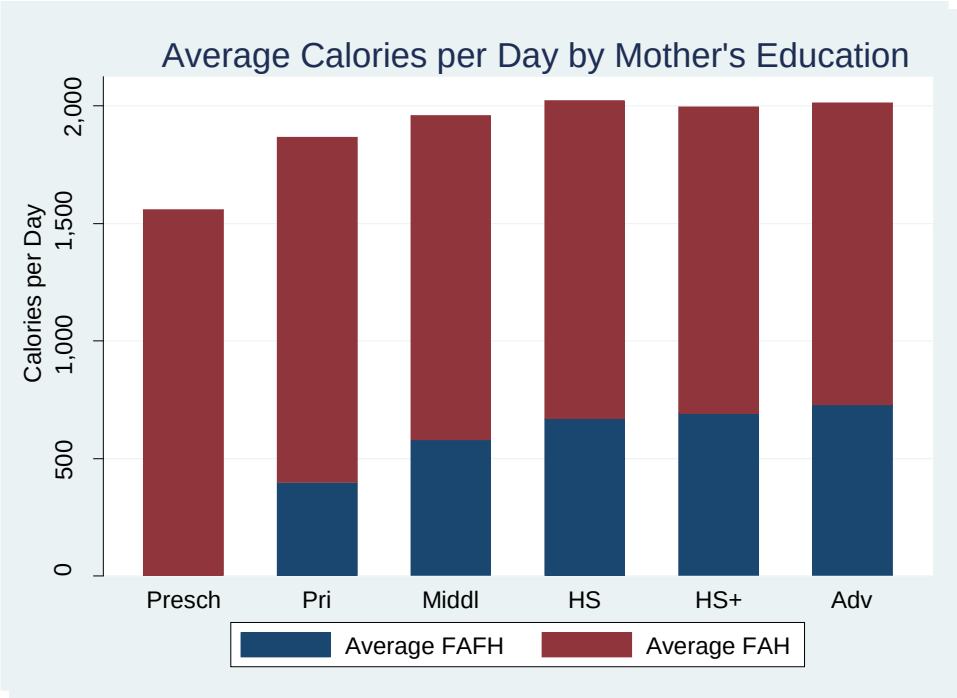

Figure 3.7. Average Calories Consumed per Day by Mother's Education
Source: Calculated by Author, 2013

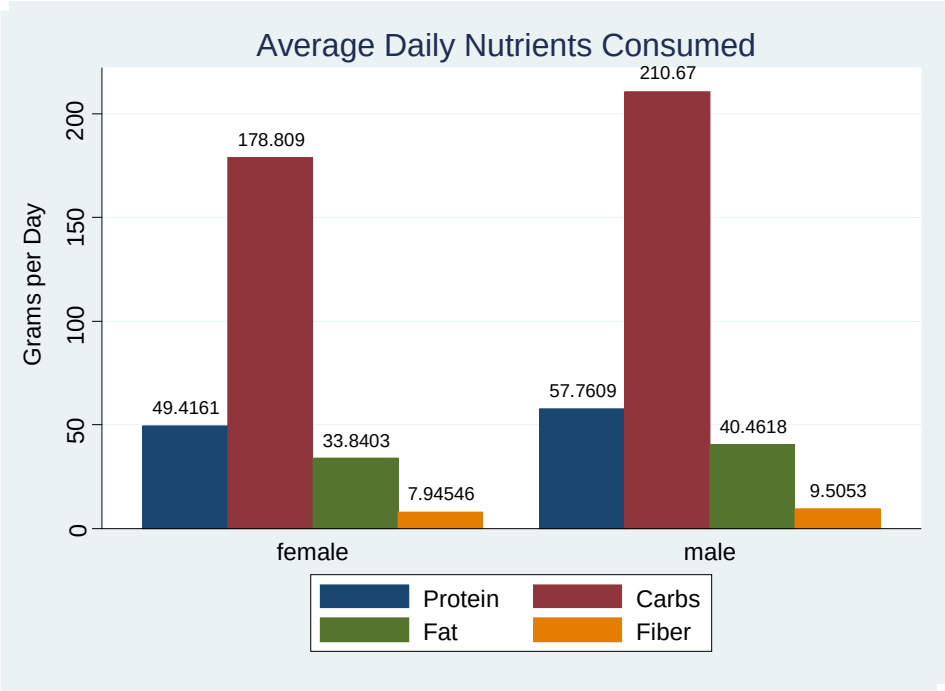

Figure 3.8. Daily Nutrients Consumed by Gender
Source: Calculated by Author, 2013
* Oil used in cooking was not available

Empirical Results and Implications

The data analysis and estimation was conducted in STATA 12.0 (StataCorp. 2011). Many variables in the model proved to be statistically significant up to the 5 percent level. Tests for normality of the data, if heteroskedasticity is present, and model specification amongst others were performed and were found to be in order with general linear equation assumptions. Due to multicollinarity reasons the first Nanjing district of Baixia was dropped. Below are the summary statistics, (table 3.5.) followed by the estimation results (table 3.6.).

Table 3.5. Summary Statistics

Variable	Mean	Std.Dev	Min	Max
BMI	19.73	3.24	12.44	31.31
fafhcal_d	647.72	690.84	0	3863.64
fahcal_d	1342.84	601.96	0	2955.73
edu_mother	4.20	1.12	1	6
weight_mother (*kgs*)	56.50	7.51	40	80
height_mother (*cm)*	159.72	6.07	112	180
weight_father (*kgs)*	68.59	9.23	32	98
height_father *(cm)*	170.94	5.93	140	192
insur	0.79	0.40	0	1
gender	0.44	0.49	0	1
age	14.31	2.72	10	19
qhhinc	2.97	1.44	0	5

Table 3.6. Estimates from BMI General Linear Regression

BMI	Coef.	Std. Errors
fafhcal_d	0.0010***	(0.0003)
fahcal_d	0.0010***	(0.0004)
edu_mother	0.5451***	(0.2244)
weight_mother	0.1193***	(0.0313)
height_mother	-0.0764**	(0.0403)
weight_father	0.0990***	(0.0265)
height_father	-0.1029***	(0.0421)
insur	-0.4756	(0.7331)
incinsur	0.0001	(0.0001)
gender	-0.4630	(0.4067)
age	0.1815**	(0.0843)
qhhinc	-0.4843**	(0.2359)
nanjing_dist2	0.6418	(1.7174)
nanjing_dist3	-1.2548	(1.2328)
nanjing_dist4	-1.7898	(1.2346)
nanjing_dist5	-0.0939	(1.4731)
nanjing_dist6	-1.2445	(1.3484)
chengdu_dist7	-1.1083	(1.3133)
chengdu_dist8	-2.6989**	(1.2272)
chengdu_dist9	-2.1525	(1.4249)
chengdu_dist10	-2.0543*	(1.1725)
xian_dist11	-4.1318***	(1.2617)
xian_dist12	-1.3336	(1.1450)
xian_dist13	-1.7196	(1.0822)
xian_dist14	-2.8735*	(1.7124)
xian_dist15	-3.1729	(2.2792)
xian_dist16	-2.9148***	(1.1023)
shenyang_dist17	-0.8734	(1.2845)
shenyang_dist18	-2.0633	(1.3973)
shenyang_dist19	-1.2598	(1.9064)
shenyang_dist20	-2.2024**	(1.1366)
xiamen_dist21	-0.3586	(1.3942)
xiamen_dist22	-3.9152**	(1.8876)
xiamen_dist23	-4.6616***	(1.6787)
xiamen_dist24	-1.5716	(2.2186)
xiamen_dist25	-3.5063***	(1.1656)
xiamen_dist26	0.33566	(1.4828)
xiamen_dist27	-1.2879	(1.3629)
Constant	32.1292***	(7.8020)

(Continued)

Table 3.6. Estimates from BMI General Linear Regression (Continued)

BMI	Coef.	Std. Errors
R^2	0.3380	
Adjusted R^2	0.2103	
F(37,198)	2.65	
Prob >F	0.0000	
Number of observations	236	

Note: 1. * significant at the 10% level; ** at 5% level; *** at 1% level
Base Case: Male without health insurance living in Nanjing district of Baixia

FAFH calories were found to have a positive effect on the BMI. FAFH tends to contain higher calories per meal than when food is consumed at home (Lin *et al.*, 1999) so one would expect an increase of total calories of FAFH to increase their BMI. FAH calories were also found to have a positive influence on the BMI. The coefficients on both of these variables are relatively small and appear to be very similar. This might mean that adding one more calorie per day whether it comes from FAFH or FAH may not have a large influence on BMI. Previous studies focused on the shifting trend of more FAFH being consumed puts adolescents at an increased risk of health and should be of concern. This was not a major finding in this study. Also as past literature have noted, the trend of increasing FAFH along with decreasing FAH is expected to continue for the adolescent age group. A ratio to test the difference between FAFH calories and FAH calories per day was found insignificant when added to the model.

Next is the socioeconomic factors and how they influenced BMI. In comparing the weight of each parent both were found to be highly significant. Analyzing the coefficient one might conclude that a mother's weight has a higher positive impact on a child's BMI than a fathers. Concerning the height of the parents the exact opposite is true. While both are statistically significant, it is the father's height which has a greater negative impact on the BMI. Logically the taller the parents the more likely an adolescent will in the normal BMI range.

Having insurance was not found to influence BMI. Also, the quantiles of household income was significant at the five percent level indicating that as per capita quantile income rises the BMI of an adolescent will fall. As expected, as one increases in age so too does there BMI. This is due to adolescents still being in the developmental stages of their lives. Statistically significant regional differences appeared in every city included in the survey.

Perhaps one of the more important variables is the education of the mother. From previous studies a mother's education appeared to have strong positive effects on health and nutrition (Behrman and Wolfe, 1987). The elasticity for a women's education was also found to be higher than compared with income or household size causing the belief that in developing economies the education of women is often undervalued (Behrman and Wolfe, 1984). The results from this study indicate that as the education level of a mother increases then an adolescent's BMI will increase. This might be due to the fact that the mean of the BMI was already in the normal range and may also be to as reasons discussed before that the mother might be too busy in her career to teach her child about nutrition. Also, the mother's schooling education may not be a good proxy for determining nutrition education.

In a past study of an area experiencing a nutritional transition, it was found that adolescents were reportedly more likely to be influenced by and obtain nutrition information from family members rather than friends or others (Doyle and Feldman, 1997). An increase in nutritional information not only for adolescents themselves, but also for the mother would be an effective way to assuring the BMI would be in a healthy range. Overall, more nutritional education would be beneficial.

Conclusion

There is no doubt that food is a central part of the Chinese culture and in all likelihood will continue to be in the future. Eating plays a vital role in all people's lives. The main reason for this study is to investigate which factors influence BMI in urban Chinese adolescents and what foods are they current consuming. To achieve the empirical results, a general linear model was developed. The model found that FAFH and FAH have a relatively similar positive influence on BMI. It also brought forth evidence that a mother's weight contributes more to an increased BMI than a father's weight and also a father's height decreases BMI greater than the height of the mother. Also, as a mother's education increases so too does the BMI of an adolescent. Some interesting descriptive analysis discovered that adolescents tend to eat substantially more fruit when they eat at home than compared to when they eat outside the household. Also adolescent girls eat more meat when they eat outside of their household and in this instance they ate more than their male counterparts. Overall, the results offer insight on what factors may be attributed to the recent transition and concern over BMI in contemporary urban China.

Like any combination of survey data it would have been beneficial to have more information. For example, in the survey this study uses the degree of how processed a food was captured for food at home but not for food away from home so it could not be used in the analysis. Furthermore, interesting demographic variables such as how many minutes in traffic does a mother spends in a one way commute to work, the frequency an adolescent has had a physical examination from a doctor within the last two years, and how many visits was made to a Western fast food outlet were asked in the some but not all surveys. It would have been interesting to see the effect of these three, especially the mother's travel time to work. The

number of children in the family has been found to have a positive effect on how food is consumed and evaluated (Maguire et al., 2004). As stated before in Yen *et al*. (2004), larger Chinese families place a greater emphasis on convenience based foods and may not be focused on the different varieties associated with a meal, however adding household size did not improve this model. Another interesting aspect not covered would be how concerned a parent is with the air quality outside. Also there were no variables on physical exercise which has been found in previous studies to have a great influence on BMI and would have made a great contribution to the model.

The paper expands the body of literature on Chinese adolescent BMI and food consumption. It is important to acknowledge the unique and current dataset used in this study. Future studies should focus more on exactly what foods adolescents are consuming along with their daily exercise activities to find out more about this important demographic. Future studies should also focus on this demographic and follow their consumption patterns as they age.

CHAPTER 4. SCHOOL MEALS IN URBAN CHINA: STUDENTS' CONSUMPTION AND PARENTS' PERCEPTION

Summary

School meal consumption has not been widely studied throughout China. The importance of school meals and their nutrition content has been a major concern in the U.K. and the U.S. for decades. School meals, often forgotten about, are an important factor in an adolescent's food consumption. This study attempts to focus on school meals in urban China in hopes to further extend the literature pertaining to what students are consuming. The main point of this study is to investigate what children are eating in schools compared to at home. The results will provide insights into nutrition, behavior, and perceptions that are important to nutritionists, policymakers, and industry as they design, implement, and supply school lunch programs. An ordered logistic regression is created to help examine what influences parent's view of these meals. The likelihood of a parent being satisfied with all aspects of a school meal decreased as their child entered higher levels in their education. On average, it was found that students get more calories and fat in their school meals versus meals at home. Almost three times as many lunch meals were consumed at school than at home, proving how important school meals are. It was also found that a considerable amount of calories come from grains, meat, eggs, dairy, fruit, and drinks when a student is at school where as bean products (including soybeans) are consumed more at home.

Introduction and Background

With the world's largest population[3] and the world's second largest economy (Tabuchi 2011), China is quickly heading to the global forefront in influential economic and social development. An important part of this growth and higher stature amongst other nations has been the dramatic development of education. Around the time when the People's Republic of China (PRC) was founded in 1949, enrollment of school aged children was around 20 percent and an estimated 80 percent of the population was still illiterate. Since then, China has developed the largest education system in the world and has ensured free compulsory education for every child in the nation for up to 9 years. In 2009 China had an enrollment of over 260 million students with around 14 million full-time teachers at various levels throughout its education system. Additionally, China has increased its gross enrollment rate in primary school (starting at age 7) to 99.4 percent, junior high school (ages 12-14) to 99 percent, and in senior high schools (ages 15-17) to 79.2 percent which is on par with medium-income based countries and also is expected to rise (Ministry of Education, 2010). Education remains fundamentally important for China's long-term development and future success.

However, differences in basic education between rural and urban areas exist. According to the 2010 Chinese national census, 665.5 million people, or 49.68 percent of the total population, reside in urban areas (China Statistical Yearbook, 2012). Park (2008) points out the China Health and Nutrition Survey found that the average years of schooling for urban workers was 11 compared with an average of 6.6 years for rural workers. Furthermore, the enrollment rates for all school-aged children in urban areas were between 93 and 95 percent and rural enrollment rates were 84 to 90 percent in the 2000 census (Hannum *et al,* 2011). Some studies

[3] Estimated to be 1.34 billion people by National Bureau of Statistics of China 2011

have also indicated quality differences in the education received (Tsang 1994, 2002) which may be attributed to the lower paying salary rural school teachers receive compared to their urban counterparts. Although there have been discrepancies between the rural-urban divide in education, overall China has put forth the commitment to ensure that all students will receive an education. Equal access to education has played an important role dating back to the Chinese philosopher Confucius who championed education for all people without discrimination (Ministry of education, 2010).

An important issue that is often not taken into consideration but has an effect on everyday life and education is answering the question of what exactly are the students fed at school. This paper attempts to answer this question along with what influences their parents or guardians satisfaction with these meals consumed at school.

It has been documented that changing preferences in food choices, especially among young urban Chinese consumers, has entered China into a nutritional transition (Du *et al.*, 2002; Curtis *et al.*, 2007; Huang and Gale, 2009; Mendez and Popkin, 2001; Popkin *et al.*, 1993). Some studies in particular suggest that the changing demographics in China will have an important impact on the future of food demand. Yen *et al.* (2004) further explains that younger households are found to consume more meat and fruit but less staple foods like grain and vegetables. Additionally, the study finds that smaller families consume more convenience or easy-to-fix foods and less of the time-consuming foods like meat and fish when they were compared with larger families. China's nutritional patterns are on course to change considerably as the younger generation begins to be a larger proportion of society and also as the overall population becomes wealthier and more educated.

These changing nutritional food patterns have raised some legitimate health concerns. For example, there has been a dramatic increase in the occurrence of overweight and obesity among preschool children in urban areas of China. One survey conducted in eight Chinese cities found that obesity among 7 to 18 year old students increased from 3.4 percent in 1985 to 7.2 percent in 1996 (Chen, 1999). Another notable study found that the occurrence of being overweight increased from 14.6 percent in 1989 to 28.6 percent in 1997 and obesity increased from 1.5 percent in 1989 to 12.6 percent in 1997 (Lu and Han, 2002). It was also found from the years of 1992 to 2002, the prevalence of overweight and obesity in Chinese people aged 0 to 6 and 7 to 17 years increased by 31.7 percent and 17.9 percent, respectively (Ma et al., 2005). There appears to be a definite trend which has been well noted throughout various studies. During the 1990s the problem of under-nutrition shifted to over-nutrition amongst younger children and adolescents in China. The shift was noted as more dramatic in urban regions than compared to rural (Wang et al., 2002). This might be attributed to the finding that urban children on average receive less physical activity than rural children and are also more likely to be inundated with the constant pressures to excel scholastically, which leads to more time spent on schoolwork (Tudor-Locke *et al.*, 2003). All of these reasons may add to a higher risk of over-nutrition for urban children than compared to their rural counterparts. Also, according to Chunming (2000) urban boys consume more fat in their diet, around 23 to 30 percent, than rural boys who were found to consume around 16 to 20 percent. This over-nutrition trend appears to take root in how rapid the Chinese diet has changed. In 1970 the average Chinese diet consisted of around 10 percent fat. It has been recently estimated that around 40 percent of the Chinese population consumes a diet that is 30 percent fat and the majority of people take in around 400

percent more eggs, meat, and edible oils than they did just a generation ago (United Nations Children Fund, 2004).

School Meals in China

The current status of nutrition in Chinese urban children is clearly a cause for concern. Studies have shown that children prefer foods to which they have already been exposed (Birch, 1999) and that eating habits formed during childhood can carry on into adulthood (Kelder et al., 1994). It has also been found that proper diet and eating habits can prevent or delay premature onset of a number of chronic diseases (Ness and Powles, 1997). Cheng (2006) believes one of the most effective ways to improve overall nutritional quality of this demographic is to focus on school feeding practices. Organized school meal programs have had a short history in China. They formed in the early 1980's and were found primarily in the Eastern coastal regions. In 1988, the Chinese Students Nutrition Promoting Association was formed. This is an independent association that wants public and private groups to work on feeding every student enrolled in school. Progress has been made and since 2005 the Chinese Students Nutrition Promoting Association has been working with the government run National Institute of Child and Adolescent Health (Cheng, 2006). School meals can play a vital role in helping children to increase their intake of foods that are more likely to have health benefits. School meals can also help in limiting the intake of foods that are not recommended as part of a healthy diet (Condon *et al.*, 2009).

School meals are regarded as a very important social safety net in China, but they have not received national backing in funding and policy the same way the free compulsory education has. Current developmental research has found that school meals with good nutritional status increase student's enrollment and attendance, reduces the dropout rate, and have been linked to

improved academic performance and retention (Bundy *et al.*, 2009; Vince-Whitman *et al.*, 2001). Some interesting studies in China have been done. For example, the World Health Organization developed a project in Zhejiang Province that targeted improving the nutrition and health status by developing health promoting schools in China. The study found that developing health promoting schools is a good concept for China and it was likely to improve the dietary knowledge, attitudes, and behaviors of both students and parents (Shi-Chang *et al.*, 2004).

However, few studies have directly focused on the content of the food consumed by children in urban China let alone what they consume at school. Shi et al. (2005) use cross-sectional data from urban and rural middle schools in Jiangsu Province. In their study, they use a food preference and a food frequency questionnaire along with specific socioeconomic variables such as parent's education. A multivariate linear regression is also utilized to model the association between the intake of food and socio-demographical factors. A higher socioeconomic status and urban residence is found to be associated with an increased consumption of higher-energy and more Westernized foods. The key results for this study suggest a need for nutritional education and to preserve traditional Chinese food habits that promote healthy eating among adolescents and parents. The study is limited in that individual portions of food consumed by each adolescent could not be identified due to the frequency based method of the questionnaire.

To the author's knowledge, no studies have currently focused solely on what school-aged children eat at school compared with what they consume at home and also what factors contribute to their parent's perceived satisfaction with these school meals. The purpose of this study is to fill the gap in the current literature. It will do so by analyzing what types of food students are consuming at school determining the nutritional quality of that food versus the food

they consume at home. A separate section will evaluate what influences the satisfaction parents or guardians have with certain aspects of the school meal such as the amount, variety, safety, price, and the nutritional content of the food served. The results will hopefully provide insights into nutrition, behavior, and perceptions that are important to nutritionists, policymakers, and industry as they design, implement, and supply school lunch programs.

The remainder of this paper is organized as follows. First, it begins by discussing the methodology used throughout the paper. Next, an in-depth description of the survey and the data is covered followed by a descriptive analysis. Finally, the estimation results and the implications associated within the findings are reported.

Methodology

The ordered logit model is a variant of the ordered probit model developed by McKelvey and Zavoina (1975). This model has been used in applied applications (e.g. surveys) in which the respondent will express a preference in the terms of an ordinal ranking. The model has been adapted for use in a wide variety of studies. There have been studies conducted on modeling the perception business firms have in regards to labor legislation (Pierre and Scarpetta, 2006). Others focus on the influence of interviewers' race on the classification on skin color for white and African Americans (Hill, 2002). Another used an ordered logistic regression to examine the influence of socio-demographic factors on Americans' perceptions of their weight appropriateness (Chang and Christakis, 2003). The ordered logit model has many applications but to the author's knowledge has not yet been applied to examine the perception a parent has on its child's school meals.

The methodology and logic for both the ordered probit and ordered logit can be explained by the same equations. Following Borooah (2001) advice, an example from the study will be adapted. Suppose there are N parents who have students consuming meals at school (i =1,…,N) living throughout regions in urban China and that each household has a parent whose "degree of satisfaction" is measured for several aspects of a school meal. The value is represented by $S_i$in such that higher values of S_i represent ordinal "degrees of satisfaction." The degree of satisfaction depends on many different factors. For example the education, age, and gender of the respondent along with important variables like the student's education level and city level variables to adjust for regional and school differences. Suppose these factors can be labeled as K whose values, for individual$i$, are X_{ik}, $k = 1, \dots K$). Now the index of this can be represented by the following latent regression equation:

$$S_i = + \sum_{k=1}^{K} \beta_k X_{ik} + \varepsilon_i = Z_i + \varepsilon_i \qquad (4.1.)$$

where β_k is the coefficient associated with the k^{th} variable ($k = 1, \dots K$) and also $Z_i = \sum_{k=1}^{K} \beta_k X_{ik}$. Therefore, an increase in value of k^{th} factor for a particular parent will cause his or hers satisfactions score to rise if $\beta_k > 0$ and it will fall if $\beta_k < 0$. However, there is not an exact relationship (equal to 1) so the error term, ε_i, is included.

As noted above equation (4.1.) is a latent regression and is not observable. The parent's satisfaction donated as, Y_i, and is associated with levels of satisfaction. For example, $Y_i = 1$ if less satisfied, $Y_i = 2$ if rated as neutral, and $Y_i = 3$ if mostly satisfied. Where Y_i is an ordinal variable. The levels are associated with the latent variable S_i and are further associated with "threshold" or "cut" points denoted as δ_1 and δ_2 such that they represent:

$$Y_1 = 1, \ \ if\ S_i \leq \delta_1 \qquad (4.2.)$$

$$Y_2 = 1, \qquad if\ \delta_1 \leq S_i \leq \delta_2$$

$$Y_3 = 1, \qquad if\ S_i \geq \delta_2.$$

where δ_1 and $\delta_2 \ \geq 0$ of equation 4.2. are the unknown parameter ($\delta_1 < \delta_2$) that are to be estimated with β_k from equation 4.1. Whether or not a parent is classified in a certain level depends on if S_i crosses the "cut" point. Furthermore, the probabilities of Y_i take on the values of 1, 2, or 3 is defined as follows:

$$\Pr(Y_i = 1) = \Pr(Z_i + \ \varepsilon_i \leq \delta_1) = \Pr(\varepsilon_i \leq \delta_1 - Z_i) \qquad (4.3.)$$

$$\Pr(Y_i = 2) = \Pr(\delta_1 \leq Z_i + \ \varepsilon_i \leq \delta_2) = \Pr(\delta_{1_i} - Z_i < \varepsilon_i \leq \delta_2 - Z_i)$$

$$\Pr(Y_i = 3) = \Pr(Z_i + \ \varepsilon_i \geq \delta_2) = \Pr(\varepsilon_i \geq \delta_2 - Z_i)$$

Now the likelihood of observing the sample is computed by the following equation:

$$L = [\Pr(Y_i = 1)]^{N_1}[\ \Pr(Y_i = 2)]^{N_2}\ [\ \Pr(Y_i = 3)]^{N_3} \qquad (4.4.)$$

$$= [\mathrm{F}(\delta_1 - Z_i)]^{N_1}[\mathrm{F}(\delta_2 - Z_i) - F(\delta_1 - Z_i)]^{N_2}$$

$$\times [1 - \mathrm{F}(\delta_1 - Z_i)]^{N_3}$$

where $\mathrm{F}(x) = \Pr(\varepsilon_i < x)$ is the cumulative probability distribution of the error terms. One can assume the error terms follow a certain distribution based on the appearance of the data.

Survey Description

The survey for this study was collected by interviewing the household members who are most familiar with the food shopping and food consumption in each randomly selected household (Zhang *et al.,* 2010). This survey is separated into two separate parts. The first part includes socioeconomic and demographic information, which was collected in face-to-face interviews by enumerators. The second part includes food consumption information collected using a diary record method in which the selected households are asked to record detailed information such as quantity consumed, price, and the dining place for every meal in a week. The diary based method is preferred by the U.S Department of Labor (2012) in their Consumer Expenditure Survey.

Additionally, the second part can be yet again divided up into two distinct sections. The first section records the information regarding at-home food consumption, and the second section records food away from home consumption. Additionally, the selected households are required to record their daily dishes and expenditures on food which is consumed away from home and other related information, such as who paid for each meal, the type of food facility, the dining place, etc. (Bai *et al*., 2010).

The survey in this study utilizes the same sample households that were part of a previous urban household survey but it was based on a unique questionnaire. Therefore, this new survey includes the same reliable household respondents. The sample in this particular survey differs from others due to the fact that it uses a random sampling approach to select representative regional districts. Finally, the survey is also separated into two separate but complementing parts. A key point to this survey is that it allowed the authors to tract where and what the student ate. This was very crucial for this paper to determine which foods were consumed at school

compared to what was consumed at home. The following section will discuss the data in greater detail and also the important variables that were utilized in this study.

Data

The data used in this study are from a unique consumer survey that was conducted from 2009 to 2011 and consists of 1,025 households throughout 5 cities and 27 different urban districts in China. It is displayed in the table (4.1.) below. The first survey was conducted in 2009 and covers Nanjing (246 households). The second contains was conducted in 2010 and covers Chengdu (208 households). The last there cities were all conducted in 2011 and they were in Xi'an (215 households), Shenyang (207 households), and lastly in Xiamen (149 households). The survey data in this study specifically interviewed the person who was the most familiar with shopping and food consumption in their household. Thus making the respondent more likely to be knowledgeable in food consumed not only at their household but with what their children ate at school. The population in each city was estimated by the Economist Intelligence Unit (2012) using data from the China Statistical Information and Consultancy Centre and is from 2011.

Table 4.1. Total Number of Households in Each City Surveyed

	Nanjing	**Chengdu**	**Xi'an**	**Shenyang**	**Xiamen**	**Total**
Households	246	208	215	207	149	1,025
Population	8,900,000	15,300,000	10,300,000	7,800,000	3,300,000	45,600,000

In order for the perception of the parent or guardian to be analyzed specific question on the aspects of a school meal were asked. For instance, to determine the satisfaction of a particular aspect (e.g. nutrition) of their children's school meals, the respondents are asked to rank from 1 to 10 (1 to 4 being less satisfied, 5 to 6 being neutral, and 7 to 10 being more satisfied) how satisfied they are. The amount of food consumed, measure in grams at school along with exactly

what specific types of food consumed is also collected. Nine food categories which included grain, meat, eggs, seafood, vegetables, fruit, dairy, drinks, and bean products are analyzed. To obtain the nutrition information, data were intersected with a nutrient conversion for each kind of food based on information from the China Food Composition book (Institute of Nutrition and Food Safety, 2009). The China Food Composition book is utilized for conversion in past nutritional based studies on food consumption.

Students' Consumption

For currently analyzing what students consumed at school a descriptive analysis of the data is presented. 224 households are found to have school-aged children who consume school meals. 98 (44%) are females and 126 (56%) are males. The total number of school meals consumed by children in these households is 1,331. Of these school meals, 206 are consumed at breakfast, 961 at lunch, and 164 at dinner or the latest meal of the day. The total number of household that consumed school meals by each city is displayed in table 4.2. and the total school meals consumed by city and type of meal is shown in table 4.3. The adolescent population (ages 10-19) in each city was estimated by the Economist Intelligence Unit (2012) using data from the China Statistical Information and Consultancy Centre and is from 2011.

Table 4.2. Total Number of Households that Consumed School Meals

	Nanjing	**Chengdu**	**Xi'an**	**Shenyang**	**Xiamen**	**Total**
Households	67	57	32	43	25	224
Adolescent Population	762,000	1,493,000	1,103,000	630,000	288,000	4,276,000

Table 4.3. Total Number of School Meals by City

	Nanjing	Chengdu	Xi'an	Shenyang	Xiamen	Total
School Meals						
Breakfast	17	65	71	41	12	206
Lunch	304	243	106	197	111	961
Dinner(Last meal of day)	5	58	46	47	8	164
Total Meals	326	366	223	285	131	1,331

In order to compare food consumed at school versus food consumed at home the differences in the data need to be displayed. The differences are shown below in Table 4.4. As expected, more breakfast (206 meals at school versus 1,054 meals at home) and dinner (164 meals at school compared to 1,127 meals at home) meals were consumed at home. However concerning lunch meals 961 were eaten at school while only 375 were eaten at home. This solidifies how important school meals are during the course of a week. Without this, crucial consumption information would be lost.

Table 4.4. Total Number of Meals Consumed at Home by Each City

	Nanjing	Chengdu	Xi'an	Shenyang	Xiamen	Total
Meals at Home						
Breakfast	346	308	83	189	128	1,054
Lunch	87	104	65	60	59	375
Dinner(Last meal of day)	362	300	127	211	127	1,127

On average, more calories are consumed at breakfast and dinner when the student consumes the meal at school (Figure 4.1. and 4.2.). Having breakfast outside of the home was also found to increase the risk of being overweight or obese in Li et al. (2010). The few observations for breakfast and dinner consumed at school might play a part in how big the difference is.

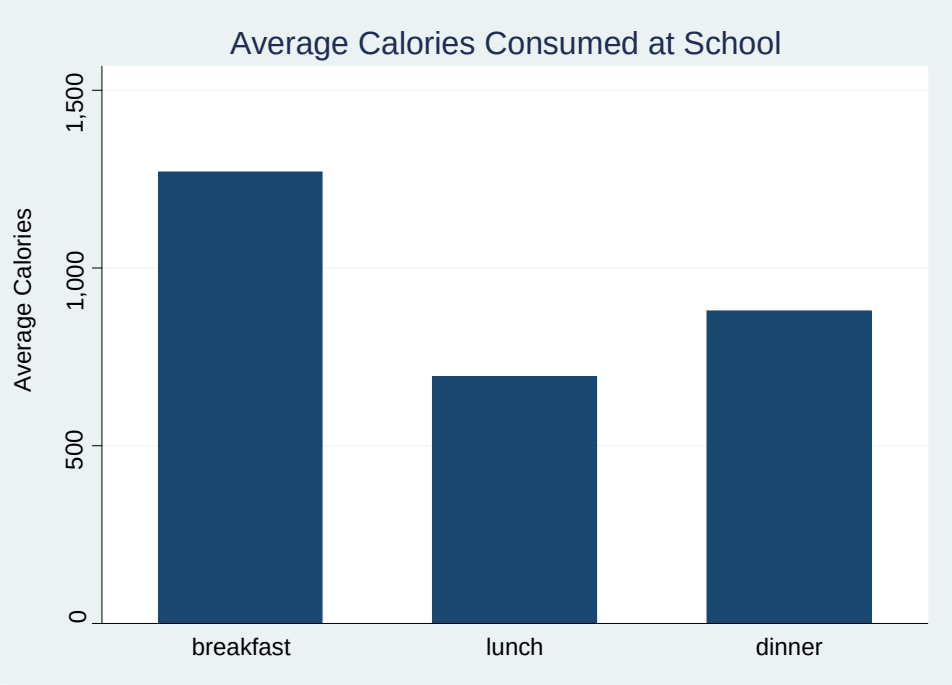

Figure 4.1. Average Calories Consumed at School by Meal
Source: Calculated by Author, 2013

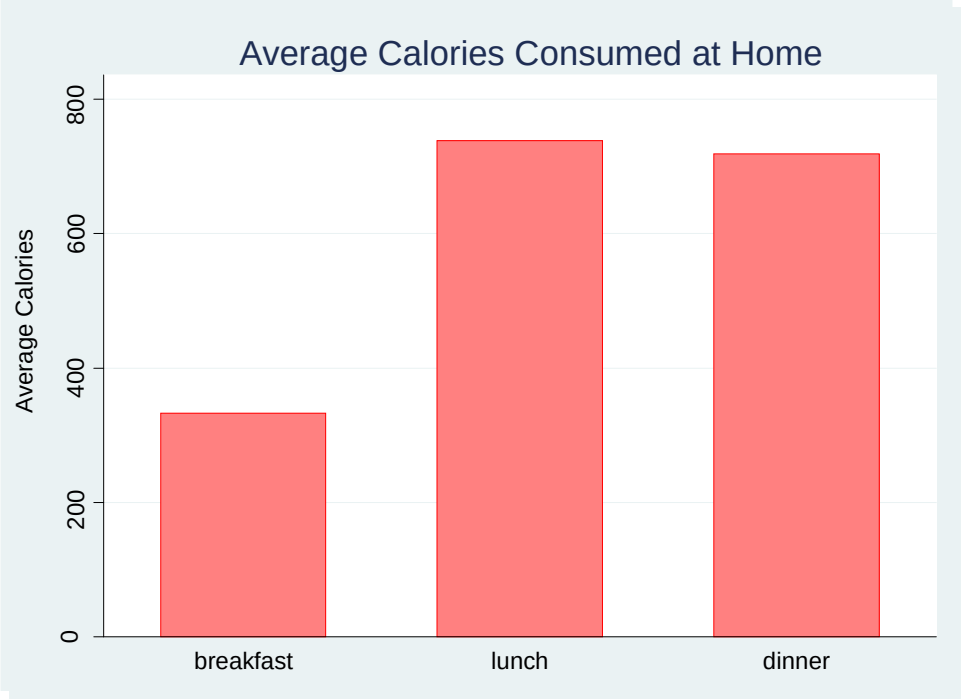

Figure 4.2. Average Calories Consumed at Home by Meal
Source: Calculated by Author, 2013

Also, from Figure (4.3. and 4.4.) considerable more calories come from grains, meat, eggs, dairy, fruit, and drinks when a student is at school. Bean products, such as soybeans however, appear to be consumed in greater number at home. Calories from seafood and vegetables were around the same. This implies more food, on average, is being consumed at school.

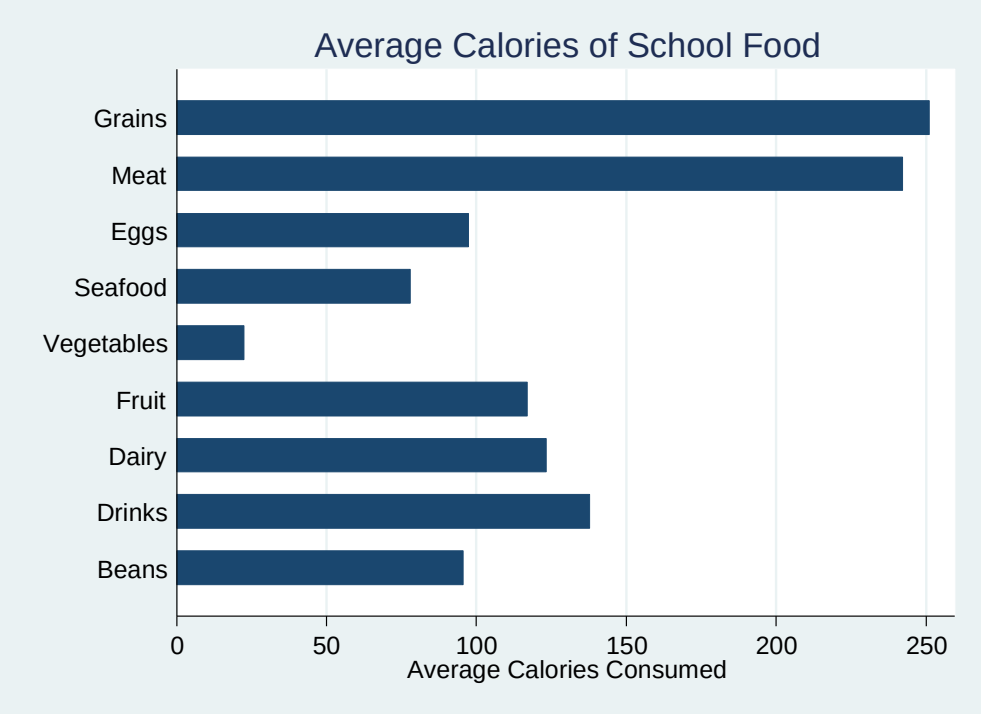

Figure 4.3. Average Calories Consumed at School by Types of Food Categories
Source: Calculated by Author, 2013

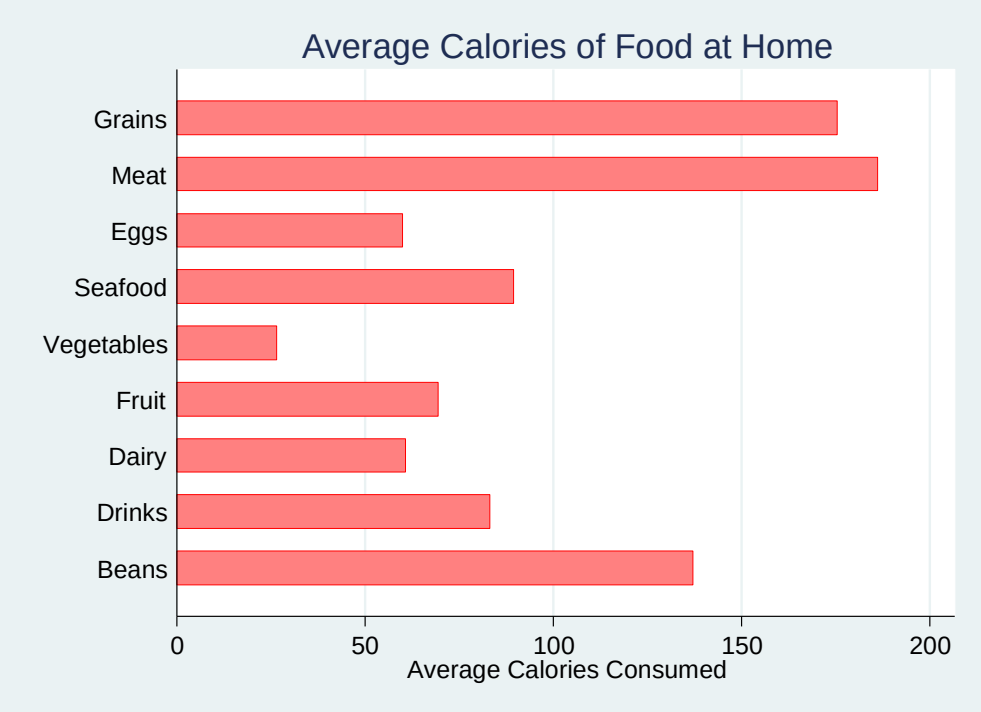

Figure 4.4. Average Calories Consumed at Home by Types of Food Categories
Source: Calculated by Author, 2013

School meals and food at home are converted first to ingredient content from the diary method and then to each meals nutrient content in terms of average calories, protein, carbohydrates, and fat. Table 4.5. compares the nutrients for lunches consumed at school and at home. The focus was drawn to lunch due to how close their average consumed calories were. More calories, protein, and carbohydrates were consumed at home but the interesting nutritional information here was that on average more fat was consumed at school for lunch even though less calories were consumed. Students get less fat along with more protein and carbohydrates and only roughly around 40 more calories for lunch at home.

Table 4.5. Nutrient Intake for Lunch: School Meals Compared with Meals at Home

	School Lunch (n=961) Mean	**Lunch at Home** (n=375) Mean
Energy(kcal)	694	738
Protein	28	33
Carbohydrates(g)	79	98
Fat (g)	28	23

Parents' Perception: Empirical Results and Discussion

The ordered logistic regression model is estimated with the satisfaction rating of 5 different school meal categories (amount, variety, nutrition, safety and price) by using STATA 12.0 (Stata corp., 2011). The education of the household respondent is included in our model to capture the variation in the respondent's awareness of quality, safety, health and nutritional information related to school meal consumption. The education level of the respondent is also an

important factor not only in the determining the satisfaction of a school meal but also in shaping the knowledge of a child when she goes to choose what to eat during a school meal. In a past study of an area experiencing a nutritional transition, it was found that adolescents are reportedly more likely to be influenced by and obtain nutrition information from family members rather than friends or others (Doyle and Feldman, 1997). Separating the household income in quantiles helps give a better idea of an income effect. Gale and Huang (2007) argue that Chinese consumers who have high household income levels are willing to pay more for food products and brands that guarantee safety and dependability. For a full description of the response (dependent) variables and explanatory (independent) variables, refer below to tables 4.6. and 4.7., respectively.

Table 4.6. Parent's Satisfaction with School Meals

Variables	Definition	Mean	Std dev.
Dependent			
Schoolamount	Degree of satisfaction with the amount; 1 less, 2 neutral, 3 more	2.59	0.61
Schoolhvariety	Degree of satisfaction with the variety; 1 less, 2 neutral, 3 more	2.45	0.66
Schoolnutrition	Degree of satisfaction with the nutrition; 1 less, 2 neutral, 3 more	2.49	0.65
Schoolsafety	Degree of satisfaction with the safety; 1 less, 2 neutral, 3 more	2.70	0.52
Schoolprice	Degree of satisfaction with the price; 1 less, 2 neutral, 3 more	2.41	0.67

Table 4.7. Explanatory Variables for Ordered Logistic Regression

Variables N=(283)	Definition	Mean	Std dev.
Independent			
qhhinc	Quantiles of household income divided by household size (1) Lowest 20% to (5) Highest 20% for all the households in the survey	3.09	1.41
edu_r	Education of respondent; 1 pre-school to 7 graduate/advanced professional	4.51	1.20
gender_r	Gender of the respondent; =1 if male; =0 if female	0.22	0.42
age_r	Age of the respondent	44.38	11.69
food_sub	=1 if respondent is receiving a food subsidy; =0 otherwise	0.26	0.44
preschool	=1 if student in preschool; =0 otherwise	0.27	0.44
primary	=1 if student in primary school; =0 otherwise	0.31	0.47
middlesch	=1 if student in middle school; =0 otherwise	0.23	0.42
highsch	=1 if student in high school; =0 otherwise	0.18	0.39
City1	=1 if located in Nanjing; =0 otherwise	0.30	0.46
City2	=1 if located in Chengdu; =0 otherwise	0.21	0.40
City3	=1if located in Xi'an; =0 otherwise	0.19	0.39
City4	=1 if located in Shenyang; =0 otherwise	0.19	0.40
City5	=1 if located in Xiamen; =0 otherwise	0.11	0.31

All five models are estimated with a total of 283[4] observations. The base case for comparison is an unmarried female who does not get a food subsidy and lives in Nanjing. Nanjing was found to have the highest monthly average per capita income in comparison with the other cities. The base case also is relative to a respondent who has a student in preschool. The summary statistics of each one of these aspects can be found above in tables 4.6. and 4.7. On average parents and guardians are generally satisfied with the aspects of school meals except they tend to be neutral on the issue concerning price. In order to analyze the regression results, separate focuses for the five aspects of a school meal will be discussed. Following the review of methodology five equations were created. The results are displayed at the end in table 4.8. That is for a one unit increase in the predictor, while the dependent variable is expected to change by its respective regression in the ordered log odds scale will all other variables are held equal. The cut variables are the estimated cutpoints or thresholds. For example, cut1 is used to differentiate low satisfaction from neutral and high satisfaction when the values of the predictor variables are evaluated at zero (UCLA, 2012). Also the odds ratio results are given in Appendix table B1 and are interpreted differently. These are the proportional odds ratio. Percentage or factor changes in the odds are better for interpretations than marginal effects and discrete changes for ordinal logit models (Long, 1997). They are displayed throughout Appendix B as well.

Amount

To confirm that students have the opportunity to help meet their recommended dietary allowances for a day, the amount of food served is important. Parents should be aware of the fact that the quality and amount of food and beverages consumed while in the school have an

[4] The total number of households is greater due to that fact that in modeling the perception, the total number of households that rated were taken into consideration not just the households who consumed meals during the week.

enormous and potential impact on the health and well-being of their children (Pe´rez-Rodrigo et al., 2001). Examining the amount, as the age of the parent increases the likelihood of them being satisfied will also increase. The negative and statistically significant coefficient on high school implies that compared with preschool there is a less likelihood that a respondent would be satisfied with the amount provided at school. There is also a noted regional difference when compared with Xi'an.

Variety

For the variety of a school meal, the greater the household size the more the respondent is satisfied with the variety. Having a variety of different foods to choose from is important. However, it was found in the United States National School Lunch Program (NSLP), which gives students the opportunity of a wide variety of food choices at lunch and varies greatly amongst school, students still consumed, on average, meals that had similar fat and sodium content (Burghardt *et al.,* 1995). From the ordered log odds it was found that males are more likely to have less satisfaction when compared with females on the aspect of variety. Also the likelihood of having a satisfied response decreases with the different levels of education a student is in. Having a food subsidy increases the likelihood of the parent being satisfied and is highly significant.

Nutrition

This study found that as the education level of the student increases, the likelihood nutrition satisfaction of the meal declines. This is an important theme throughout modeling the perception of the parent. It appears that female respondents are not satisfied with the school meals as their child changes in education levels and institutions. This is a key distinction that must be made when looking at school meals in urban China.

Safety

Food safety may perhaps be one of the most important aspects of not just school meals but of any meals consumed. Food safety has become a top priority in China and is treated as a very serious matter. This may be attributed with the recent cases of several food-related illnesses and deaths being frequently reported by media outlets. It was in 2008 when infant formula is found to be contaminated with melamine that resulted in many illnesses and six reported deaths which led to a lack of trust from the domestic consumers and ultimately global criticisms of how safe food in China actually is (Zhe, 2009). As Chinese consumers incomes are increasing they are also becoming more discriminating in their food preferences. Consumers are demanding greater quality, convenience, and safety in their food (Gale and Huang, 2007). Currently, China has put in place a domestic certification system for food quality and safety standards. According to Zhang *et al.* (2010), the Chinese government and other related authorities have invested large amounts of social, economic, and political resources to develop and implement quality or safety-related certification programs for food. The purpose of these labels is to help in terms of food safety and quality of the food. The results that were statistically significant in this case were found to be similar for the nutrition aspect of the school meal.

Price

According to Harris (1997), consumers may view and purchase foods with different characteristics and price levels, based on their needs and income level. It has been noted that households with higher incomes are less price sensitive to the cost of food. The results indicate that the likelihood of being less satisfied with the price of a school meal is greater in Chengdu and Xi'an than compared with Nanjing.

Table 4.8. Estimation Results Using Ordered Logistic Regression, Ordered Log Odds

Categories	Amount	Variety	Nutrition	Safety	Price
qhhinc	0.230**	0.063	-0.056	0.102	0.049
	(0.104)	(0.968)	(0.099)	(0.110)	(0.0957)
edu_r	0.024	-0.129	-0.115	-0.052	0.042
	(0.135)	(0.124)	(0.126)	(0.142)	(0.118)
gend_r	-0.365	-1.029***	-0.555*	-0.211	-0.020
	(0.318)	(0.300)	(0.301)	(0.343)	(0.300)
age_r	0.024*	0.015	0.014	0.020	-0.03
	(0.013)	(0.011)	(0.012)	(0.014)	(0.011)
foodsub_r	-0.113	0.688***	0.337	0.608*	0.225
	(0.325)	(0.309)	(0.315)	(0.369)	(0.304)
primary	-0.287	-1.226***	-1.569***	-0.790**	-0.792**
	(0.370)	(0.343)	(0.339)	(0.406)	(0.327)
middlesch	-0.460	-1.120***	-1.122***	-0.757*	-0.548
	(0.386)	(0.369)	(0.389)	(0.430)	(0.353)
highsch	-1.158***	-1.264***	-1.411***	-1.200***	-0.922***
	(0.404)	(0.388)	(0.407)	(0.429)	(0.373)
Chengdu (City2)	-0.432	-0.328	-0.764**	-0.406	-0.747**
	(0.409)	(0.362)	(0.372)	(0.440)	(0.47)
Xi'An (City3)	-1.865***	-0.716**	-0.900**	-1.153***	-1.136***
	(0.399)	(0.368)	(0.381)	(0.425)	(0.366)
Shenyang (City4)	-0.646	-0.468	-0.564	-0.623	-0.428
	(0.398)	(0.361)	(0.371)	(0.438)	(0.351)
Xiamen (City5)	-0.348	-0.437	-0.445	-0.712	0.009
	(0.499)	(0.433)	(0.457)	(0.515)	(0.451)
Cut1	-2.261	-3.436	-4.164	-3.684	-3.073
Cut2	0.038	-1.158	-2.027	-1.18	-0.879
Log Likelihood	-207.14	-241.66	-234.94	-179.40	-252.79
LR chi(12)	42.32	35.61	35.31	23.51	29.16
Prob > chi2	0.000	0.000	0.000	0.023	0.003
Pseudo R^2	0.096	0.068	0.069	0.061	0.054
Number of observations	283	283	283	283	283

Note: 1. The standard errors are in parentheses.

2.* significant at the 10% level; ** at 5% level; *** at 1% level.

Base case: Female who lives in Nanjing and does not receive a food subsidy and has a child in preschool

The area of focus and appearing to be a common theme throughout is how the perception of school meals diminishes with the different levels of education a student is in. Compared to preschool meals, parents perceived primary, middle school, and high school to all to be worse in two of the most important aspects; safety and nutrition. Parents are less likely to be satisfied with high school meals. High school meals were found to be statistically significant at the 1 percent level for all aspects of a school meal and so was the city variable Xian. Xian was the least developed out of the five cities surveyed. Education level of the respondent was not found to have an influence. Surprisingly, more of the demographic variables of the respondent did not appear to have an influence on how satisfied they were with school meals.

Conclusion

Food consumption in China is a broad and challenging topic. Food plays an important role in Chinese people's daily life. This study attempts to narrow the focus by studying urban school meals in China. The main point of this study is to investigate what children are eating in schools compared to at home and what influences their parent's view of these meals.

The descriptive results show that school meals are important and differ from food consumed at home, especially in the case of lunch. In this particular study, almost three times more lunch meals were consumed at school throughout the course of a week. It was found that more calories are consumed if a student eats breakfast or dinner at school. A considerable amount of more calories come from grains, meat, eggs, dairy, fruit, and drinks when a student is at school where as only bean products are greater for at home consumption.

To achieve the empirical results, an ordered logistic regression model is introduced into the estimation. This estimation brought on an interesting story. Compared to preschool meals,

parents perceived primary, middle school, and high school to all to be worse in safety and nutrition. This indicates a unique distinction that perception of school meals in China tend to get worse as the child moves into their high schools. This might be due to the base being preschool. Preschool in China is usually private and high schools are usually public.

Finally, it is important to recognize the issue concerning the limitation of sample size of meals consumed at school. Future studies should look to combine more cities in China in order to increase the sample size on this topic and perhaps add rural counterparts for a more complete discussion. School meals are often forgotten about when talking about adolescent food consumption. This study showed that more emphasis needs to be put on school meals especially in the case of lunch. More information to help further explain food consumption patterns for this complex and ever important demographic are needed.

CHAPTER 5. SUMMARY AND CONCLUSION

Opportunities for North Dakota Exports

Studying the changing preferences of Chinese urban adolescents is important to agricultural exporting states like North Dakota. In near future, these adolescent consumers will soon be driving the demand for households in China. Adolescents are unique from their parent's generation. They have undergone a rapid cultural shift. However, eating still remains a vital role in everyday life and culture in China. Understanding food consumption and the types of food consumed in a country is a great way of understand their culture. Eating out is increasing being more common throughout urban China. This study found that more meat, especially pork, was found to be consumed more when adolescents were eating outside of the home. Demand for gain commodities like bean products, which North Dakota is a net exporter of, were still to being widely consumed but more so when the meal was at home.

In summary, food quality and safety issues have been abundant throughout China. North Dakota is in a unique position. It is a state with a booming economy along with a healthy agricultural sector that has seen its exports to China increase exponentially over the past decade. Future success can be improved by further understanding the adolescent demographic. North Dakota has a great opportunity to grow its exports to China.

Conclusion

One objective of this study was to analyze adolescent's BMI by what food they are consuming and also find out what is influencing an adolescent's BMI by developing a general linear regression model. The model found that FAFH and FAH have a relatively similar positive influence on BMI, which is different from other studies that found FAFH to have a greater effect. It also brought forth evidence that a mother's weight contributes more to an increased BMI than

a father's weight and as a mother's education increases so too does the BMI of an adolescent. Analyzing food consumption showed that adolescents tend to eat substantially more fruit when they eat at home than compared to when they eat outside the household. Also adolescent girls eat more meat when they eat outside of their household and in this instance they ate more than their male counterparts.

Another objective was to examine influences on a parent's perception of the school meals by developing a non-linear ordered logit model and also determine and explain the differences from food consumed at school and food consumed at home. The likelihood of a parent being satisfied with all aspects of a school meal decreased as their child entered higher levels in their education. On average, it was found that students get more calories and fat in their school meals versus meals at home. Almost three times as many lunch meals were consumed at school than at home, proving how important school meals are. It was also found that a considerable amount of more calories come from grains, meat, eggs, dairy, fruit, and drinks when a student is at school where as only bean products are greater for at home consumption.

Few studies about China's food consumption focus on adolescents. Some additional areas of research may be expanded for the future studies. Focusing on how this demographic changes overtime would be useful. Future studies should consider following this important demographic as they age and become the main consumers of China. It would be interesting to compare consumption over a time period rather than a snapshot. Also, there were many limitations to this study. Future studies may look at more complex models to examine the overall consumption of food and also food demanded.

REFERENCES

Bai, J., T. I. Wahl, B. T. Lohmar, and J. Huang. 2010. Food away from home in Beijing: effect of wealth, time and free meal. *China Economic Review* 21(2010) 432-441.

Behrman, J., B. Wolfe. 1987 "How does mother schooling affect family health, nutrition, medical care usage, and household sanitation?" *Journal of Econometrics* 36.

—. 1984. "More evidence on nutrition demand: income seems overrated and women's schooling underemphasized." *Journal of Development Economics* 14(1): 105-128.

Beyerlein A, Fahrmeir L, Mansmann U, Toschke AM 2008. "Alternative regression models to assess increase in childhood BMI." *BMC Med Res Methodology* 8:59.

Bloomberg 2011. "China Declares Victory Over Rapid Population Rise as Focus Shifts to Aging" Retrieved from: http://www.bloomberg.com/news/2011-04-28/china-s-urban-population-climbs-to-49-7-of-total-nbs-says.html (Accessed March 12, 2012)

Binkley JK, Eales J, Jekanowski M. 2000. "The relation between dietary change and rising US obesity." Int J Obesity 24: 1032–39.

Birch LL. 1999. Development of food preferences. *Annu. Rev. Nutr*. 19, 41–62.

Borooah, V. K. 2001. Logit and probit: Ordered and multinomial models. Vol. 138. Sage Publications, Incorporated.

Brant, R. 1990. "Assessing proportionality in the proportional odds model for ordinal logistic regression." *Biometrics*, 1171-1178.

Bundy DAP., Burbano C., Grosh M., Gelli A., Jukes M., Drake L. 2009. Rethinking school feeding: social safety nets, child development and the education sector. directions in development, World Bank, Washington, DC.

Burghardt, J. A., Devaney, B. L. & Gordon, A. R. 1995. the school nutrition dietary assessment study: summary and discussion. *American Journal of Clinical Nutrition.*

Cawley J, Meyerhoefer, C 2011. "The medical care costs of obesity: an instrumental variables approach." *Journal of Health Economics.*

Centers for Disease Control and Prevention (CDC) 2012. "Overweight and obesity: health consequences Retrieved from: www.cdc.gov/obseity/causes/health.html (Accessed January 3, 2013).

Centers for Disease Control and Prevention (CDC). 2011 "About BMI for Children and Teens". Retrieved from: http://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html (Accessed August 8, 2012).

Chang, V. W., and Christakis, N. A. 2003. "Self-perception of weight appropriateness in the United States." *American Journal of Preventive Medicine*, 24(4), 332-339.

Chen, X. C. 1999. Research progress of Children's nutrition in China. *China Journal of Preventive Medicine,* 33, 134–136.

Chen S.N., Tseng J., 2010. "Body mass index, nutrient intakes, health behaviours and nutrition knowledge: A quantile regression application in Taiwan." *Health Education Journal* vol. 69 no. 4 409-426.

Cheng, Y.J. 2006. School feeding practices in China. Presented at the Global Child Nutrition Forum, Los Angeles, CA, USA.

China Food Composition 2009. Institute of Nutrition and Food Safety China CDC, Beijing 2009 393 pp (Chinese).

China Statistical Yearbook. 2012. China Statistical Press. National Bureau of Statistics of China.

Chunming C. 2000. Fat intake and nutritional status of children in China. *Am. J. Clin. Nutr.* 72 (Suppl.): 1368S–72S.

Condon E.M., Crepinsek M.K., Fox M.K. 2009. School meals: types of foods offered to and consumed by children at lunch and breakfast. *Journal of the American Dietetic Association* 109(suppl 1):S67-S78.

Coon, R. C., Bangsund, D. A., and Hodur, N. M. 2012. The Economic Base of North Dakota (No. 121763). North Dakota State University, Department of Agribusiness and Applied Economics.

Cui, Z., Huxley, R., Wu, Y., & Dibley, M. J. 2010. "Temporal trends in overweight and obesity of children and adolescents from nine Provinces in China from 1991–2006." *International Journal of Pediatric Obesity*, *5*(5), 365-374.

Curtis, K.R., McCluskey J.J., Wahl T.I., 2007. "Consumer preferences for western-style convenience foods in China." *China Economic review* **18**, pp. 1–14.

Dehghan M, Akhtar-Danesh N & Merchant AT, 2005. "Childhood obesity, prevalence and prevention. *Nutr J* 4, 24.

Doyle, E, Feldman R. 1997. “Factors affecting nutrition behavior among middle-class adolescents in urban area of Northern region of Brazil.” *Rev. Saúde Pública* vol.31, n.4, pp. 342-350.

Du, S., Lu, B., Zhai, F., & Popkin, B. M. 2002.“A new stage of the nutrition transition in China.” *Public Health Nutrition* 5(1A), 169–174.

Eales, J., Brinkley J., Jekanowski M. 2002. “Determinants of U.S. Children's and Teenagers' Body Mass Index.” Selected Paper paper prepared for presentation at the American Agricultural Economics Association 2002 Annual Meeting, July 28-31, Long Beach, California.

Economist Intelligence Unit. 2012. *EIU China Country Data*. Retrieved November 22, 2012, from EIU Country Commerece database.

Fahey, T., Insel, P., and Roth, W. 2007. *Fit and well: Core concepts and labs in physical fitness and wellness* (7th ed.). Boston: McGraw Hill.

Freedman, D.S., Sherry B. 2009. “The validity of BMI as an indicator of body fatness and risk among children.” Pediatrics.124 Suppl 1:S23-34.

Gale, F., Huang K. 2007. *Demand for Food Quantity and Quality in China* Washington DC: U.S. Department of Agriculture, Economic Research Rep. 32.

Gong P., Liang S, Carlton E J, Jiang Q, Wu J, Wang L, Remais J V, 2012. “Urbanisation and health in China.” *The Lancet, Volume 379, Issue 9818*, Pages 843-852.

Greene, W. H. 2002. Econometric Analysis (5th edition.).

Guo, X, Mroz TA, Popkin BM, and Zhai F. 2000. “Structural changes in the impact of income on food consumption in China, 1989–93.” Econ Dev Cult 48: 737–760.

Han, A and Hausman J. A. 2006. "Flexible parametric estimation of duration and competing risk models." *Journal of applied Econometrics* 5.1: 1-28.

Hannum, E., Wang, M., & Adams, J. 2011. Urban–rural disparities in access to primary and secondary education under market reform. In M. K. Whyte (Ed.), One country, two societies? rural–urban inequality in contemporary China. Harvard University Press (Forthcoming).

Harris J. M. 1997. “The impact of food product characteristics on consumer purchasing behavior: the case of frankfurters.” *Journal of Food Distribution Research* 1997(Feb): 92-97.

Hill, M. E. 2002. “Race of the interviewer and perception of skin color: Evidence from the multi-city study of urban inequality.” *American Sociological Review*, 99-108.

Huang, K. S. and Gale F. 2009. “Food Demand in China: income, quality, and nutrient effects.” *China Agricultural Economic Review* 1(4): 395-409.

Institute of Nutrition and Food Safety China. 2009. China food composition 2009. CDC, Beijing, 393 pp (Chinese).

Ji CY. 2005. “Report on childhood obesity in China (1)--body mass index reference for screening overweight and obesity in Chinese school-age children.” Biomed Environ Sci.18:390-400 Working Group on Obesity in China.

Ji, CY., Cheng, T. O. 2009." Epidemic increase in overweight and obesity in Chinese children from 1985 to 2005." *International journal of cardiology*, 132(1), 1.

Jing, J. (Ed.). 2000. *Feeding China's little emperors: Food, children, and social change*. Stanford, CA: Stanford University Press.

Kelder SH, Perry CL, Klepp KI & Lytle LL. 1994. "Longitudinal tracking of adolescent smoking, physical activity, and food choice behaviors." *Am. J. Public Health* 84, 1121–1126.

Koo, W., and P. Kennedy. 2005. *International Trade and Agriculture: Theories and Practices*. Wiley-Blackwell.

Laitinen, J, Power C, Jarvelin MR. 2001. "Family social class, maternal body mass index, childhood body mass index and age at menarche as predictors of adult obesity." *AmJ Clin Nutr* 74: 287–94.

Li M, Dibley MJ, Sibbritt DW, Yan H. 2010. "Dietary habits and overweight/obesity in adolescents in Xi'an City,China." *Asia Pac J Clin Nutr* 19(1):76–82.

Li, Y., Zhai F., Yang X, Schouten EG, Hu X, He Y, Luan D, Ma G. 2007. "Determinants of childhood overweight and obesity in China." *Br J Nutr*; **97**: 210–215.

Lin, B.H., J. Guthrie,E. Frazao. 1999. "Nutrient Contribution of Food Eaten away from Home." Frazao E, Ed. America's Eating Habits: Changes and Consequences." Washington DC: U.S. Department of Agriculture, Economic Research Service 1999: 213–42.

Liu, J. M., Ye, R., Li, S., Ren, A., Li, Z., and Liu, Y. (2007). "Prevalence of overweight/obesity in Chinese children." *Archives of medical research*, *38*(8), 882.

Long, J. Scott. 1997. *Regression Models for Categorical and Limited Dependent Variables: Advanced Quantitative Techniques in the Social Sciences*. Sage Publications.

Luo J, Hu F.B. 2002. "Time trends of obesity in preschool children in China from 1989 to 1997." Int J Obes Relat Metab Disord.;26:553-558.

Ma, J., Wang Z., Song Y., Hu P. and Zhang, B. 2010. "BMI percentile curves for Chinese children aged 7-18 years, in comparison with the WHO and the US Centers for Disease Control and Prevention references." *Public Health Nutrition* 13 12: 1990-1996.

Ma, H.Y., Huang, J.K., Fuller, F. and Rozelle, S. 2006. "Getting Rich and Eating Out: Consumption of Food Away from Home in Urban China." *Canadian Journal of Agricultural Economics* **54**, 1, 101-119.

Ma, H., A. Rae, J. Huang, and S. Rozelle. 2004. Chinese Animal Product Consumption in the 1990s. The Australian Journal of Agricultural and Resource Economics (48:4): 569-590.

Ma G.S., Li Y.P., Wu Y.F., Zhai F.Y., Chi Z., Hu X. 2005. "The prevalence of overweight and obesity and its changes among Chinese people during 1992–2002." *Chin J Prev Med*; 39: 311–316.

Maguire, K. B., N. Owens, and N. B. Simon. 2004. "The price premium for organic babyfood: a hedonic analysis." *Journal of Agricultural and Resource Economics* 29 (1): 132-149.

Martin, W., and Ianchovichina, E. 2001. "Implications of China's Accession to the World Trade Organisation for China and the WTO." *The World Economy*, *24*(9), 1205-1219.

McKelvey, R. D., and Zavoina, W. 1975. A statistical model for the analysis of ordinal level dependent variables. Journal of Mathematical Sociology, 4(1), 103-120.

McNeal, J.U., Yeh, C.H. 1997. "Development of consumer behavior patterns among Chinese children." *Journal of Consumer Marketing* Vol. 14 No. 1, pp. 45-57.

Mei Z, Grummer-Strawn LM., Pietrobelli A., Goulding A., Goran MI., Dietz WH. 2002. "Validity of body mass index compared with other body-composition screening indexes for the assessment of body fatness in children and adolescents." *American Journal of Clinical Nutrition* 7597–985.

Menard, S. 2001. Applied logistic regression analysis. Vol. 106. Sage Publications, Incorporated.

Mendez MA., Popkin, B.M. 2001. "Globalization, Urbanization and Nutritional Change in the Developing World". *Electronic Journal of Agricultural and Development Economics* Vol. 1, No. 2, 2004, pp. 220-241.

Ministry of Education, People's Republic of China. 2010. Education as a long-term priority. Retrieved from: http://www.moe.gov.cn/publicfiles/business/htmlfiles/moe/moe_2862/201010/109030.html (Accessed March 8, 2012).

The National Bureau of Statistics, People's Republic of China. 2010. China Statistical Yearbook 2010. China Statistic Press, Beijing.

Naughton, B. 2006. *The Chinese economy: transitions and growth* MIT Press, Cambridge, Mass.; London, England.

Ness AR., and Powles JW (1997): Fruit and vegetables, and cardiovascular disease: a review. *Int. J. Epidemiol*. 26, 1–13.

Nestle, M., and Nesheim, M. 2012. Why Calories Count: From Science to Politics (Vol. 33). Univ of California Press.

O'Dea J.A., Wilson R. 2006. "Socio-cognitive and nutritional factors associated with body mass index in children and adolescents: possibilities for childhood obesity prevention." *Health Education Research* **21** (6), 796–806.

Ogden C, Carroll M. 2010. NCHS Health E-Stat: Prevalence of obesity among children and adolescents: United States, trends 1963-1965 through 2007-2008, updated June 2010 www.cdc.gov/nch/data/hestat/obseity_child_07_08/obseity_child_07_08.html (Accessed January 15, 2012).

Park, A. 2008. Rural-urban inequality in China. In S. Yusuf & S. Nabeshima (Eds.), China urbanizes. Washington DC: World Bank.

Pe´rez-Rodrigo C, Klepp KI, Yngve A, Sjo¨strom M, Stockley L & Aranceta J. 2001. "The school setting: an opportunity for the implementation of dietary guidelines." *Public Health Nutrition* 4, 717–724.

Pierre, G., and Scarpetta, S. 2006. "Employment protection: Do firms' perceptions match with legislation?." *Economics Letters*, 90(3), 328-334.

Pindyck, R. S., and D. L. Rubinfeld, 1997. "Econometric models and economic forecasts." 4th edition. Irwin McGrw-Hill, New York.

Popkin B.M. 2010. “Recent dynamics suggest selected countries catching up to US obesity.” Am J Clin Nutr 91(suppl):284S–8S.

Popkin B.M., Ge K., Zhai Z., Guo X., Ma H., and Zohoori N. 1993 “The nutrition transition in China: a cross sectional analysis.” Eur J Clin Nutr. 47:333–46.

Shankar B. 2010. “Socio-economic drivers of overnutrition in China.” *Journal of Human Nutrition and Dietetics* Vol. 23, No. 5, pp. 471–479.

Shi, Z., Lien, N., Kumar, B.N., Holmboe-Ottesen, G. 2005. “Socio-demographic differences in food habits and preferences of school adolescents in Jiangsu Province, China.” *Eur. J. Clin. Nutr* 59, 1439–1448.

Shi-Chang, X., Xin-Wei, Z., Shui-Yang, X., Shu-Ming, T., Sen-Hai, Y., Aldinger, C., and Glasauer, P. 2004.“Creating health-promoting schools in China with a focus on nutrition. Health Promotion International.” 19(4), 409-418.

StataCorp. 2011. Stata Statistical Software: Release 12. College Station, TX: StataCorp LP.

Stifel DC, Averett SL. 2009. “Childhood overweight in the United States: a quantile regression approach.” *Econ Hum Biol* 7:387–397.

Tabuchi H. 2011. China replaced Japan in 2010 as no.2 economy. Feb 13, 2011. The New York Times. Retrieved from: http://www.nytimes.com/2011/02/14/business/global/14yen.html?_r=1&scp=2&sq=China%20GDP%202010%20surpass%20Japan&st=cse (Accessed August 12, 2012).

Tsang, Mun. 1994.“The financial reform of basic education in China.” *Economics of Education Review* 15 (4): 423–44.

———. 2002. “Intergovernmental grants and the financing of compulsory education in China.” Teachers College, Columbia University, New York.

Tudor-Locke, C., Ainsworth, B.E., Adair, L.S., Du, S., Popkin, B.M. 2003. Physical activity and inactivity in Chinese school-aged youth: the China health and nutrition survey. *International Journal of Obesity* 27, 1093–1099.

UCLA: Statistical Consulting Group. 2012. Stata Annotated Output Ordered Logistic Regression. Retrieved from:http://www.ats.ucla.edu/stat/stata/output/stata_ologit_output.htm

United Nations, Department of Economic and Social Affairs, Population Division 2011. World Population Prospects: The 2010 Revision, CD-ROM Edition.

United Nations Children Fund. 2004. China. The Children. New York
Retrieved from: http://www.unicef.org/china/children_877.html (Accessed August 9, 2012).

U.S. Census Bureau. 2012. Foreign Trade with China.
Retrieved from: http://www.census.gov/foreign-trade/balance/c5700.html (Accessed March 5, 2013).

U.S. Department of Labor 2012. Bureau of Labor Statistics. *Consumer Expenditure Survey*.
Retrieved from: http://www.bls.gov/cex/home.htm (Accessed March 5, 2013).

Veeck, A., and Veeck, G. 2000. “Consumer segmentation and changing food purchase patterns in Nanjing, PRC.” WorldDevelopment, 28(3), 457−471.

Vince-Whitman, C., Aldinger, C., Levinger, B. and Birdthistle, I. (2001) Thematic studies: school health and nutrition. UNESCO, Paris.

Wang Y., Monteiro C., Popkin B.M. 2002. “Trends of obesity and underweight in older children and adolescents in the United States, Brazil, China, and Russia.” Am J Clin Nutr.;75:971-977.

Wang Y., Popkin B., Zhai F. 1998. “The nutritional status and dietary pattern of Chinese adolescents, 1991 and 1993.” *Eur J Clin Nutr* 52, 908–916.

Wolfe B. L. and J. R. Behrman 1983. “is income overrated in determining adequate nutrition”, *Economic Development and Cultural Change,* Vol. 31(3):525-549.

World Health Organization (WHO). 2009 “10 facts on adolescent health”. WHO Fact sheet. Retrieved from: http://www.who.int/features/factfiles/adolescent_health/en/index.html (Accessed June 5, 2012).

Wu, Y., and H. X. Wu. 1997. Household Grain Consumption in China: Effects of Income, Price and Urbanization. Asian Economic Journal 11(3): 325-342.

Yen, S. T., Fang, C. and Su, S. 2004. “Household food demand in urban China: a censored system approach.” *Journal of Comparative Economics* 32: 564–585.

Zhang, C., J. Bai, B. T. Lohmar, and J. Huang. 2010. “How do consumers determine the safety of milk in Beijing, China?” *China Economic Review* 21 (2010): 45-54.

Zhang, Z. and S. R. Henneberry. 2010. "The impact of changes in income distribution on current and future food demand in urban China." *Journal of Agricultural and Resource Economics* 35(1): 51-71.

Zhai F., Fu D., Du S., Ge K., Chen C., Popkin BM. 2002. "What is China doing in policy-making to push back the negative aspects of the nutrition transition?" *Public Health Nutr* 5: 269—273.

Zheng Z., Henneberry S.R. 2009. "An analysis of food demand in China: A case study of urban households in Jiangsu province." *Review of Agricultural Economics* 31 (4), pp. 873-893.

APPENDIX A. FACTORS INFLUENCING ADOLESCENT BMI

Displayed are the tests done on data from Chapter 3 pertaining to factors that influence an adolescents BMI. All tests were performed in STATA 12.0. Below is a histogram of dependent variable BMI. The dependent variable fits into the normal distribution. Also, the hetroskedascitiy tests reveals that hetroskedascticity is not present. Finally a correlation matrix is presented.

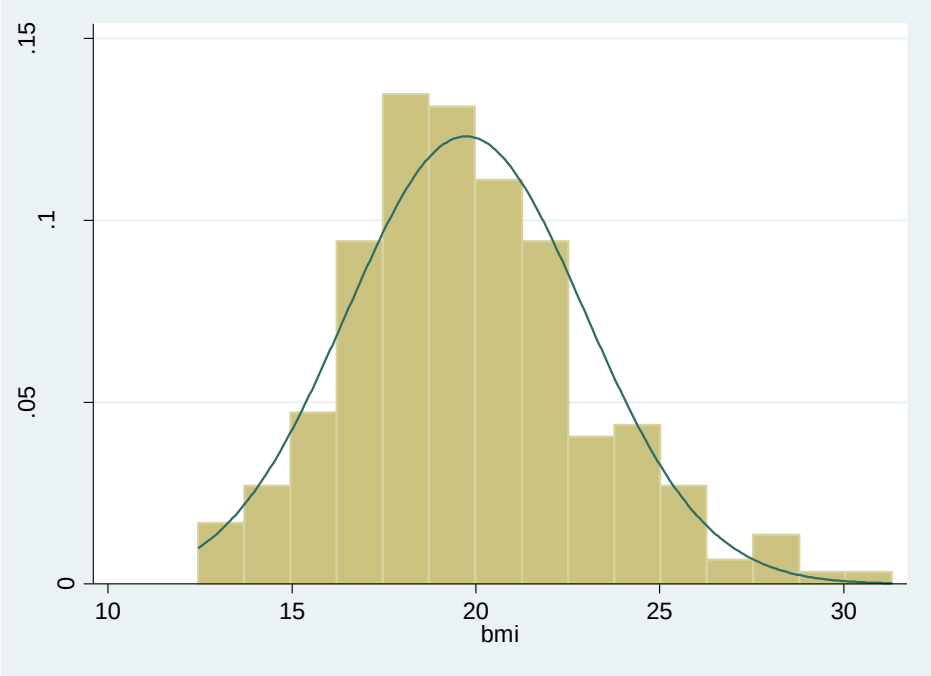

Figure A.1. Histogram of Body Mass Index (Dependent Variable)
Source: Calculated by author 2013

Table A.1. Cameron and Trivedi's Decomposition of IM-Test

Source	Chi^2	df	p value
Heteroskedasticity	236.00	235	0.4694
Skewness	37.70	37	0.4369
Kurtosis	1.67	1	0.1968
Total	275.37	273	0.4484

Table A.2. Correlation Matrix

	BMI	fafh cal_d	fah cal_d	edu_ mother	weight_ mother	height_ mother	weight_ father	height_ father	isur	inc insur	gender	age	qhhinc
BMI	1.00												
fafhcal_d	0.13	1.00											
fahcal_d	0.09	-0.42	1.00										
edu_ mother	0.11	0.10	-0.07	1.00									
weight_ mother	0.25	-0.02	0.07	0.05	1.00								
height_ mother	0.05	0.04	0.08	0.17	0.44	1.00							
weight_ father	0.21	0.12	-0.02	0.07	0.16	0.29	1.00						
height_ father	0.00	0.04	0.07	0.13	0.11	0.30	0.50	1.00					
isur	0.04	-0.04	0.07	0.12	-0.04	-0.08	0.06	0.06	1.00				
incinsur	0.01	-0.09	0.06	0.24	-0.16	-0.09	0.09	0.13	0.62	1.00			
gender	-0.12	0.09	-0.17	-0.05	-0.02	0.01	-0.09	-0.01	-0.05	-0.05	1.00		
age	0.22	0.32	0.14	0.03	0.04	0.11	0.06	-0.01	-0.09	-0.16	0.10	1.00	
qhhinc	-0.06	0.05	-0.03	0.50	-0.12	0.05	0.06	0.14	0.14	0.64	0.02	-0.09	1.00

APPENDIX B. SCHOOL MEALS IN URBAN CHINA: STUDENTS' CONSUMPTION AND PARENTS' PERCEPTION

Table B.1. Estimation Results Using Ordered Logistic Regression, Odds Ratios

Categories	Amount	Variety	Nutrition	Safety	Price
qhhinc	1.259**	1.065	0.945	1.107	1.050
	(0.131)	(0.103)	(0.094)	(0.122)	(0.100)
edu_r	1.024	0.878	0.890	0.948	1.043
	(0.139)	(0.109)	(0.122)	(0.135)	(0.123)
gend_r	0.694	0.357***	0.573*	0.809	0.979
	(0.221)	(0.107)	(0.172)	(0.277)	(0.294)
age_r	1.024*	1.016	1.014	1.020	0.996
	(0.014)	(0.011)	(0.012)	(0.014)	(0.011)
foodsub_r	0.892	1.991***	1.104	1.838*	1.253
	(0.290)	(0.616)	(0.441)	(0.679)	(0.381)
primary	0.750	0.293***	0.203***	0.453**	0.481**
	(0.277)	(0.100)	(0.073)	(0.184)	(0.157)
middlesch	0.631	0.326***	0.325***	0.468*	0.577
	(0.243)	(0.120)	(0.126)	(0.201)	(0.203)
highsch	0.314***	0.282***	0.243***	0.301***	0.397***
	(0.127)	(0.109)	(0.099)	(0.133)	(0.148)
Chengdu (City2)	0.648	0.719	0.465**	0.666	0.473**
	(0.265)	(0.260)	(0173)	(0.293)	(0.164)
Xi'An (City3)	0.154***	0.488**	0.406**	0.315***	0.254***
	(0.061)	(0.179)	(0.155)	(0.134)	(0.093)
Shenyang (City4)	0.523	0.626	0.568	0.535	0.651
	(0.208)	(0.226)	(0.210)	(0.235)	(0.228)
Xiamen (City5)	0.706	0.645	0.640	0.490	1.009
	(0.352)	(0.279)	(0.293)	(0.252)	(0.456)
Cut1	-2.261	-3.436	-4.164	-3.684	-3.073
Cut2	0.038	-1.158	-2.027	-1.18	-0.879
Log Likelihood	-207.14	-241.66	-234.94	-179.40	-252.79
LR chi(12)	42.32	35.61	35.31	23.51	29.16
Prob > chi2	0.000	0.000	0.000	0.023	0.003
Pseudo R^2	0.096	0.068	0.069	0.061	0.054
Number of observations	283	283	283	283	283

Note: 1. The standard errors are in parentheses.

2.* significant at the 10% level; ** at 5% level; *** at 1% level.

Base case: Female who lives in Nanjing and does not receive a food subsidy and has a child in preschool

Table B.2. School Amount Percentage Factor Change in Odds: Higher Compared to Lower

Schoolamount	b	Z	P>|z|	%	%StdX	SDofX
qhhinc	0.230	2.207	0.027	25.9	38.4	1.408
edu_r	0.024	0.177	0.859	2.4	3.0	1.206
gend_r	-0.365	-1.147	0.251	-30.6	-14.3	0.421
age_r	0.024	1.765	0.078	2.4	32.7	11.6909
foodsub_r	-0.113	-0.348	0.728	-10.7	-4.9	0.444
primary	-0.287	-0.776	0.438	-25.0	-12.5	0.465
middlesch	-0.460	-1.191	0.234	-36.9	-17.7	0.423
highsch	-1.158	-2.861	0.004	-68.6	-36.0	0.385
Chengdu (City2)	-0.432	-1.055	0.291	-35.1	-16.1	0.406
Xi'An (City3)	-1.865	-4.666	0.000	-84.5	-51.8	0.390
Shenyang (City4)	-0.646	-1.623	0.105	-47.6	-22.6	0.396
Xiamen (City5)	-0.348	-0.697	0.486	-29.4	-10.5	0.317

Note:

1. Odds of: >m vs <=m
2. b = raw coefficient
3. z = z-score for test of b=0
4. P>|z| = p-value for z-test
5. % = percent change in odds for unit increase in X
6. %StdX = percent change in odds for SD increase in X
7. SDofX = standard deviation of X

Table B.3. School Amount Percentage Factor Change in Odds: Lower Compared to Higher

Schoolamount	b	Z	P>|z|	%	%StdX	SDofX
qhhinc	0.231	2.207	0.027	-20.6	-27.7	1.408
edu_r	0.024	0.177	0.859	-2.4	-2.9	1.207
gend_r	-0.365	-1.147	0.251	44.1	16.6	0.421
age_r	0.024	1.765	0.078	-2.4	-24.6	11.691
foodsub_r	-0.113	-0.348	0.728	12.0	5.2	0.444
primary	-0.287	-0.776	0.438	33.3	14.3	0.465
middlesch	-0.460	-1.191	0.234	58.5	21.5	0.424
highsch	-1.158	-2.861	0.004	218.4	56.2	0.385
Chengdu (City2)	-0.433	-1.055	0.291	54.1	19.3	0.407
Xi'An (City3)	-1.866	-4.666	0.000	545.9	107.3	0.391
Shenyang (City4)	-0.647	-1.623	0.105	90.9	29.2	0.396
Xiamen (City5)	-0.348	-0.697	0.486	41.6	11.7	0.317

Note:

1. Odds of: <=m vs >m
2. b = raw coefficient
3. z = z-score for test of b=0
4. P>|z| = p-value for z-test
5. % = percent change in odds for unit increase in X
6. %StdX = percent change in odds for SD increase in X
7. SDofX = standard deviation of X

Table B.4. School Variety Percentage Factor Change in Odds: Higher Compared to Lower

Schoolvariety	b	Z	P>|z|	%	%StdX	SDofX
qhhinc	0.064	0.656	0.512	6.6	9.4	1.408
edu_r	-0.129	-1.038	0.299	-12.1	-14.4	1.207
gend_r	-1.030	-3.427	0.001	-64.3	-35.2	0.421
age_r	0.016	1.360	0.174	1.6	20.5	11.691
foodsub_r	0.689	2.225	0.026	99.2	35.8	0.444
primary	-1.226	-3.572	0.000	-70.7	-43.5	0.465
middlesch	-1.121	-3.033	0.002	-67.4	-37.8	0.424
highsch	-1.265	-3.253	0.001	-71.8	-38.6	0.385
Chengdu (City2)	-0.329	-0.906	0.365	-28.0	-12.5	0.407
Xi'An (City3)	-0.717	-1.947	0.052	-51.2	-24.4	0.391
Shenyang (City4)	-0.468	-1.293	0.196	-37.4	-16.9	0.396
Xiamen (City5)	-0.438	-1.010	0.313	-35.5	-13.0	0.317

Note:

1. Odds of: >m vs <=m
2. b = raw coefficient
3. z = z-score for test of b=0
4. P>|z| = p-value for z-test
5. % = percent change in odds for unit increase in X
6. %StdX = percent change in odds for SD increase in X
7. SDofX = standard deviation of X

Table B.5. School Variety Percentage Factor Change in Odds: Lower Compared to Higher

Schoolvariety	b	Z	P>|z|	%	%StdX	SDofX
qhhinc	0.064	0.656	0.512	-6.2	-8.6	1.408
edu_r	-0.129	-1.038	0.299	13.8	16.9	1.207
gend_r	-1.030	-3.427	0.001	180.1	54.3	0.421
age_r	0.016	1.360	0.174	-1.6	-17.0	11.691
foodsub_r	0.689	2.225	0.026	-49.8	-26.4	0.444
primary	-1.226	-3.572	0.000	240.8	76.9	0.465
middlesch	-1.121	-3.033	0.002	206.7	60.8	0.424
highsch	-1.265	-3.253	0.001	254.3	62.7	0.385
Chengdu (City2)	-0.329	-0.906	0.365	38.9	14.3	0.407
Xi'An (City3)	-0.717	-1.947	0.052	104.8	32.3	0.391
Shenyang (City4)	-0.468	-1.293	0.196	59.7	20.4	0.396
Xiamen (City5)	-0.438	-1.010	0.313	54.9	14.9	0.317

Note:

1. Odds of: <=m vs >m
2. b = raw coefficient
3. z = z-score for test of b=0
4. P>|z| = p-value for z-test
5. % = percent change in odds for unit increase in X
6. %StdX = percent change in odds for SD increase in X
7. SDofX = standard deviation of X

Table B.6. School Nutrition Percentage Factor Change in Odds: Higher Compared to Lower

Schoolnutrition	b	Z	P>|z|	%	%StdX	SDofX
qhhinc	-0.056	-0.563	0.573	-5.5	-7.6	1.408
edu_r	-0.116	-0.919	0.358	-10.9	-13.0	1.207
gend_r	-0.556	-1.847	0.065	-42.6	-20.9	0.421
age_r	0.014	1.180	0.238	1.4	18.2	11.691
foodsub_r	0.338	1.072	0.284	40.2	16.2	0.444
primary	-1.593	-4.426	0.000	-79.7	-52.3	0.465
middlesch	-1.123	-2.881	0.004	-67.5	-37.8	0.424
highsch	-1.412	-3.468	0.001	-75.6	-41.9	0.385
Chengdu (City2)	-0.764	-2.049	0.040	-53.4	-26.7	0.407
Xi'An (City3)	-0.900	-2.357	0.018	-59.3	-29.7	0.391
Shenyang (City4)	-0.565	-1.522	0.128	-43.2	-20.1	0.396
Xiamen (City5)	-0.446	-0.974	0.330	-36.0	-13.2	0.317

Note:

1. Odds of: >m vs <=m
2. b = raw coefficient
3. z = z-score for test of b=0
4. P>|z| = p-value for z-test
5. % = percent change in odds for unit increase in X
6. %StdX = percent change in odds for SD increase in X
7. SDofX = standard deviation of X

Table B.7. School Nutrition Percentage Factor Change in Odds: Lower Compared to Higher

Schoolnutrition	b	Z	P>|z|	%	%StdX	SDofX
qhhinc	-0.056	-0.563	0.573	5.8	8.2	1.408
edu_r	-0.116	-0.919	0.358	12.3	15.0	1.207
gend_r	-0.556	-1.847	0.065	74.4	26.4	0.421
age_r	0.014	1.180	0.238	-1.4	-15.4	11.691
foodsub_r	0.338	1.072	0.284	-28.7	-13.9	0.444
primary	-1.593	-4.426	0.000	391.9	109.8	0.465
middlesch	-1.123	-2.881	0.004	207.3	60.9	0.424
highsch	-1.412	-3.468	0.001	310.4	72.2	0.385
Chengdu (City2)	-0.764	-2.049	0.040	114.7	36.5	0.407
Xi'An (City3)	-0.900	-2.357	0.018	146.0	42.2	0.391
Shenyang (City4)	-0.565	-1.522	0.128	75.9	25.1	0.396
Xiamen (City5)	-0.446	-0.974	0.330	56.2	15.2	0.317

Note:

1. Odds of: <=m vs >m
2. b = raw coefficient
3. z = z-score for test of b=0
4. P>|z| = p-value for z-test
5. % = percent change in odds for unit increase in X
6. %StdX = percent change in odds for SD increase in X
7. SDofX = standard deviation of X

Table B.8. School Safety Percentage Factor Change in Odds: Higher Compared to Lower Outcome

Schoolsafety	b	Z	P>|z|	%	%StdX	SDofX
qhhinc	0.102	0.922	0.356	10.8	15.5	1.408
edu_r	-0.052	-0.366	0.714	-5.1	-6.1	1.207
gend_r	-0.212	-0.616	0.538	-19.1	-8.5	0.421
age_r	0.020	1.414	0.157	2.0	26.7	11.691
foodsub_r	0.609	1.647	0.100	83.8	31.0	0.444
primary	-0.790	-1.943	0.052	-54.6	-30.8	0.465
middlesch	-0.757	-1.765	0.078	-53.1	-27.4	0.424
highsch	-1.201	-2.710	0.007	-69.9	-37.0	0.385
Chengdu (City2)	-0.406	-0.922	0.357	-33.4	-15.2	0.407
Xi'An (City3)	-1.153	-2.713	0.007	-68.4	-36.3	0.391
Shenyang (City4)	-0.624	-1.422	0.155	-46.4	-21.9	0.396
Xiamen (City5)	-0.713	-1.383	0.167	-51.0	-20.2	0.317

Note:

1. Odds of: >m vs <=m
2. b = raw coefficient
3. z = z-score for test of b=0
4. P>|z| = p-value for z-test
5. % = percent change in odds for unit increase in X
6. %StdX = percent change in odds for SD increase in X
7. SDofX = standard deviation of X

Table B.9. School Safety Percentage Factor Change in Odds: Lower Compared to Higher

Schoolsafety	b	Z	P>|z|	%	%StdX	SDofX
qhhinc	0.102	0.922	0.356	-9.7	-13.4	1.408
edu_r	-0.052	-0.366	0.714	5.4	6.5	1.207
gend_r	-0.212	-0.616	0.538	23.6	9.3	0.421
age_r	0.020	1.414	0.157	-2.0	-21.1	11.691
foodsub_r	0.609	1.647	0.100	-45.6	-23.7	0.444
primary	-0.790	-1.943	0.052	120.4	44.4	0.465
middlesch	-0.757	-1.765	0.078	113.2	37.8	0.424
highsch	-1.201	-2.710	0.007	232.2	58.8	0.385
Chengdu (City2)	-0.406	-0.922	0.357	50.1	18.0	0.407
Xi'An (City3)	-1.153	-2.713	0.007	216.8	56.9	0.391
Shenyang (City4)	-0.624	-1.422	0.155	86.6	28.0	0.396
Xiamen (City5)	-0.713	-1.383	0.167	103.9	25.4	0.317

Note:

1. Odds of: <=m vs >m
2. b = raw coefficient
3. z = z-score for test of b=0
4. P>|z| = p-value for z-test
5. % = percent change in odds for unit increase in X
6. %StdX = percent change in odds for SD increase in X
7. SDofX = standard deviation of X

Table B.10. School Price Percentage Factor Change in Odds: Higher Compared to Lower

Schoolprice	b	Z	P>|z|	%	%StdX	SDofX
qhhinc	0.049	0.514	0.607	5.0	7.2	1.408
edu_r	0.043	0.363	0.717	4.4	5.3	1.207
gend_r	-0.021	-0.069	0.945	-2.0	-0.9	0.421
age_r	-0.004	-0.325	0.745	-0.4	-4.2	11.691
foodsub_r	0.226	0.741	0.459	25.3	10.5	0.444
primary	-0.730	-2.228	0.026	-51.8	-28.8	0.465
middlesch	-0.549	-1.555	0.120	-42.2	-20.8	0.424
highsch	-0.923	-2.468	0.014	-60.3	-29.9	0.385
Chengdu (City2)	-0.747	-2.154	0.031	-52.6	-26.2	0.407
Xi'An (City3)	-1.368	-3.729	0.000	-74.5	-41.4	0.391
Shenyang (City4)	-0.429	-1.220	0.222	-34.9	-15.6	0.396
Xiamen (City5)	0.010	0.022	0.983	1.0	0.3	0.317

Note:

1. Odds of: >m vs <=m
2. b = raw coefficient
3. z = z-score for test of b=0
4. P>|z| = p-value for z-test
5. % = percent change in odds for unit increase in X
6. %StdX = percent change in odds for SD increase in X
7. SDofX = standard deviation of X

Table B.11. School Price Percentage Factor Change in Odds: Lower Compared to Higher

Schoolprice	b	Z	P>|z|	%	%StdX	SDofX
qhhinc	0.049	0.514	0.607	-4.8	-6.7	1.408
edu_r	0.043	0.363	0.717	-4.2	-5.0	1.207
gend_r	-0.021	-0.069	0.945	2.1	0.9	0.421
age_r	-0.004	-0.325	0.745	0.4	4.4	11.691
foodsub_r	0.226	0.741	0.459	-20.2	-9.5	0.444
primary	-0.730	-2.228	0.026	107.5	40.4	0.465
middlesch	-0.549	-1.555	0.120	73.2	26.2	0.424
highsch	-0.923	-2.468	0.014	151.6	42.7	0.385
Chengdu (City2)	-0.747	-2.154	0.031	111.2	35.6	0.407
Xi'An (City3)	-1.368	-3.729	0.000	292.9	70.7	0.391
Shenyang (City4)	-0.429	-1.220	0.222	53.5	18.5	0.396
Xiamen (City5)	0.010	0.022	0.983	-1.0	-0.3	0.317

Note:

1. Odds of: <=m vs >m
2. b = raw coefficient
3. z = z-score for test of b=0
4. P>|z| = p-value for z-test
5. % = percent change in odds for unit increase in X
6. %StdX = percent change in odds for SD increase in X
7. SDofX = standard deviation of X