The Influence of Dining Location on Adult Overweight and Obesity in Urban China

Haiyan Liu, Thomas I. Wahl, Junfei Bai, and James Seale, Jr.[1]

Contact:
Thomas I. Wahl
Department of Agribusiness and Applied Economics
North Dakota State University
Fargo
701.231.9481
Tom.wahl@ndsu.edu

[1] Respectively, graduate student, North Dakota State University (NDSU); Professor, NDSU, Associate Professor, Chinese Academy of Sciences; Professor, University of Florida.

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Abstract

Chinese have been experiencing dramatic changes in their body weight in the last ten years. Food service sector is believed to have significant effect on the rise of obesity in China. This paper analyses Body Mass Index (BMI) and overweight issue of adults 18 years and above in urban China with respect to food eating locations and other socio-economic and demographic variables. The data are from household surveys in three representative Chinese cities: Xi'an, Shenyang, and Xiamen. OLS is used to estimate the relationship between continuous BMI and food eating outlets, and an ordered probit model is fit to the categorical BMI. Findings indicate that the number of meals eaten at cafeterias significantly increases the probability of being overweight and obese while decreasing the probability of staying underweight and normal. The probability that a person in Xi'an, Shenyang and Xiamen is underweight and normal decreases by 0.25 and 0.49 percentage point respectively if consuming one additional meal at a cafeteria. And one unit increase in the number of meals ate at a cafeteria increases the probability to become overweight and obese by 0.55 and 0.19 percentage point correspondingly. The number of meals consumed at full service restaurants and fast food outlets are found to be insignificant on the body weight of Chinese adults. Education, household income and employment status all have significant effects on body weight change, as well as smoking status and physical activity.

Key Words: BMI, Overweight and Obese, Food Eating Location, Dining Location, Socio-Economics, China

[2] Respectively, graduate student, North Dakota State University (NDSU);Professor, NDSU, Associate Professor, Chinese Academy of Sciences; Professor, University of Florida.

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Introduction

Obesity and being overweight [3] has become one of the most serious public health challenges of the 21st century and the problem is spreading rapidly. Globally, the age-standardized prevalence of being overweight increased from 24.6% in 1980 to 34.4% in 2008, and the prevalence of obesity increased from 6.4% to 12.0% during this period (Stevens et al. 2012). More than 1.4 billion adults, 20 and older, were overweight in 2008, with over 200 million men and nearly 300 million women being obese. Of all adults aged 20 and over, 35% were overweight in 2008, and 11% were obese(WHO Media Centre 2013). If current trends are unabated, the world's overweight and obese population could rise to a total of 2.16 billion and 1.12 billion, or 38% and 20% of the world's adult population by 2030, respectively(Kelly et al. 2008). Particularly, 43 million preschool children (under the age of five) were overweight or obese in 2010, and 35 million of these live in developing countries. If this trend continues, this number is expected to reach 60 million in 2020, which equals to 12.7% of the global population (De Onis et al. 2010).

Being overweight and obesity have also become serious problems in China which used to be one of the leanest populations worldwide. According to the World Health Organization's Global Info Database (Ono T et al. 2005), for those ages 15 and older, 45 percent of males in China and 32 percent of females were overweight. On average, 38.5 percent of the 2010 population has a BMI greater than or equal to 25. This is a sharp increase from the 2002 statistic of 25.1 percent and is estimated to continue increasing to 48.4 percent in 2015. Moreover, the overall obesity prevalence in 2015 is estimated to be double the 2010 rate.

The causes of obesity are multifactorial (Agurs-Collins and Bouchard 2008). Three causes for the rise of obesity were identified by Oliver and Lee (2005) – genetic factors (i.e. inherited from parents, born that way), environmental factors (i.e. poor food in restaurants, diets ineffective), and personal factors (i.e. lack willpower, obese don't care). But their study shows that most Americans still believe obesity is the individual failure to eat less and exercise more. A nationwide survey conducted by Lusk and Ellison (2013) reveals that Americans perceive individuals are primarily to blame for the rise of obesity, while parents are the next-most blameworthy group. Similar findings are also stated by (Tomer 2013; Wang and Coups 2010). A numberof specific demographic and socioeconomic factors have beenshown to be relevant to obesity as well, including marital status (Averett et al. 2008), education (Cai et al. 2013; Sadiq and Martin 2006), household income (Jolliffe 2011; Ljungvall and Gerdtham 2010), employment status (Mosca 2013), smoking status (Liu et al. 2010), and physical activity (Zick et al. 2009).

In addition to socioeconomic and demographic factors, food service sector and food eating locations have been shown to have important influences on nutrient intake and obesity. O'Dwyer et al. (2005) examined the nutrient intake of Irish adults between 1997 and 1999 at home, at work, and outside the home, and further compare diet quality outside the home by grouping the location as pub, deli and takeaways. They find intakes of energy, protein, fat and carbohydrate were significantly greater at home than at work or out. When people eat outside, alcohol contributed the greatest to total energy intake in pubs and fat had the largest contribution to total and food energy in takeaways. Fraser and Edwards (2010) find that in Leeds England, the

[3] The WHO definition is: BMI greater than or equal to 25 is overweight; BMI greater than or equal to 30 is obesity.

density of fast food outlets has a significant positive correlation with the likelihood that a child being overweight or obese, while the distance between a child's home and the nearest fast food restaurant does not significantly correlate with his/her weight status. However, Dunn et al. (2012) show that the distance to the nearest fast-food restaurant and the number of fast-food restaurants within 1 mile and 3 miles of a participant's residence is positively correlated with both the frequency of consuming and obesity risk for non-white rural residents in central Texas, although no significant relationship was found for whites. To address the endogeneity problem of fast-food availability, the distance between residence and the nearest major roadway connecting major metropolitan areas is used as an instrument, which was employed by (Dunn (2009); 2010) and Anderson and Matsa (2011) previously. Besides, a European study indicates that eating at restaurants and similar establishments which include cafeterias, bars or fast food outlets was positively associated with BMI and weight change (Naska et al. 2011). Overall, the bulk of existing research has documented that poor diet quality or high body mass indices (BMI) are associated with greater consumption of food away from home (FAFH) among Americans (Bezerra and Sichieri 2009; Binkley et al. 2000; Binkley 2008; Bowman and Vinyard 2004; Bowman et al. 2004; Clemens et al. 1999; Guthrie et al. 2002; Mancino et al. 2009; Paeratakul et al. 2003).

However, little attention has been paid to how food eating location affects adults' weight changes in China, although there are reports saying fast food expansion leads to the rise of obesity (Barnard 2012; Bruno 2013; Patterson 2011). However, the results suggest that not only eating at fast food outlets can cause obesity, but also other types of restaurants. Therefore, given the severity of obesity in China, the well-known harmful consequences to health, and the paucity of rigorous research on this topic, this paper analyzes adult overweight and obesity in urban China focusing on the effects of location when people dine away from home. Data used in the analysis were collected by the authors in recent surveys in urban China. Ordinary Least Squares and Ordered Probit models are fit to the data, coefficients are estimated, and the marginal effects are also calculated.

The structure of the paper is as follows. The methodology of the paper is briefly discussed and followed by a descriptive analysis of the data. Empirical results are presented in the next section. Finally, we discuss our major findings and the potential implications.

Methodology

Evidence has been found from longitudinal and cross-sectional studies that the WHO BMI cut-points to define overweight and obese ($BMI \geq 25$ and $BMI \geq 30$), which were developed from studies on mortality on Europids (World Health Organization 2000), underestimate the risk in Chinese and other Asian populations (Deurenberg-Yap et al. 1999; Ko et al. 1999; Pan et al. 2004; Zhou 2002a; Zhou 2002b). The Working Group on Obesity in China has recommended that a BMI of 18.5 to less than 24.0 should be considered as optimal, 24.0 to less than 28.0 as overweight, and 28.0 and above as obese (Zhou 2002a; Zhou 2002b). Therefore, the analysis in this paper is based on the Chinese criteria, while that on the WHO criteria is also provided.

Econometrically, OLS, binomial and multinomial models have been frequently used in obesity researches. Dunn (2010) used OLS to analyze the effect of fast food availability on obesity by geographic location, gender, and race/ethnicity. In 2012, their research was narrowed down to only rural residents in central Texas instead of whole United States, and probit and ordered logit regressions were employed (Dunn et al. 2012). Multinomial logit and quantile

regressions are utilized to examine the relationship between income and BMI (García Villar and Quintana-Domeque 2009; Jolliffe 2011; Schmeiser 2010). BMI in the current paper has a basic normal distribution (Figure 1); therefore, we use the OLS model to analyze the effect of food eating location on obesity where continuous BMI is the dependent variable. Further, an ordered probit model is used to examine the relationship by categorizing body weight as underweight, normal, overweight and obese according to Chinese criteria and WHO criteria respectively. The categorical dependent variable takes on value of 0 if the individual is underweight, 1 if normal weight, 2 if overweight and 3 if obese.

BMI increases for both men and women during marriage and in the course of a cohabiting relationship (Averett et al. 2008). And the study of Sobal et al. (2003) shows that marital change is predictive of the variation in weight changes in the US National Health and Nutrition Epidemiological Follow-up Survey (NHEFS).

The presence of children in a household affects adults' diet behaviors. Laroche et al. (2007) indicate that American adults in households with children tend to consume higher amount of total fat and saturated fat. Both men and women gained weight compared with those without children from a study on young Australian adults (Burke et al. 2004).

Education has been found to be negatively related to BMI. Sadiq and Martin (2006) find that young women between 18 and 34 years of age in Scania with low education are more likely to be overweight or obese, while students have a significantly higher odds to become underweight. A research based on the World Health Organization (WHO) MONICA (Monitoring Trends and Determinants in Cardiovascular Disease) Project shows the inverse relationship between education level and BMI. Lower education was associated with higher BMI in about half of the male and in almost all of the female populations (Molarius et al. 2000). Besides, Hjartaker et al. (2001) indicates that the more education a Norwegian woman between 45-69 years has, the more likely that she attempts to lose weight. And Wardle et al. (2002) show that obesity risk is greater among both men and women with fewer years of education in England. The negative relationship was also found in a Chinese study (Cai et al. 2013).

Income is related to many health outcomes. Based on distribution-sensitive measures of overweight, Jolliffe (2011) finds the severity of overweight has been higher for the poor than the non-poor throughout 1971 to 2006 for Americans. His results imply that increases in income are correlated with healthier BMI values for underweight and obese individuals. In both OLS and IV bootstrapped models, the probability of being obese decreases with mean income (Ljungvall and Gerdtham 2010). After decomposing household income into "own labor earnings" and "other household income", García Villar and Quintana-Domeque (2009) find that the negative association between household income and body mass index for European women appears to be driven by the negative relationship between BMI and "own labor earnings" for women. However, in a study on rural southwestern Chinese, yearly household income is found to be positively associated with the prevalence of central obesity, which is defined as a waist circumference (WC) >90 cm in men and >80 cm in women (Cai et al. 2013).

Sadiq and Martin (2006) show that young women in Scania who over worked have a higher chance to be underweight, while those unemployed are more likely to be overweight or obese. Data from old Irish adults indicates that employment status and obesity are negatively related, and the association is larger for women Mosca (2013).

Smoking cigarettes is associated with slightly lower body weights (Klesges et al. 1989). Liu et al. (2010) find a significant negative correlation between BMI/obesity and smoking status among American adults over 18 years old. Using data from a British Household Panel Survey in

2004 and 2006, Pieroni and Salmasi (2012) reveal the positive effect of quitting smoking on weight changes, which is also found to increase in the highest quantiles.

Physical activity is well-known to help people maintain a healthy body mass. Zick et al. (2009) study the relationship between neighborhood features that facilitates physical activity and obesity risk using a sample from Salt Lake County, Utah, U.S. They find neighborhoods where a higher fraction of the population walks to work have a lower BMI/obesity risk. And for individuals living in non-low income neighborhoods, the presence of one or more convenience stores, full-service restaurants, or fast food restaurants is associated with reduced BMI/obesity risk, compared to having no neighborhood food outlets.

Whether the family has members with dietary problems is also included in the model. People with hypertension, hyperglycemia, hyperlipidemia and other health issues usually have special diets compared with their counterparts; therefore, it may affect the BMI of themselves and even other household members. Finally, regional dummies are included to control for regional differences. The surveys in all three cities were done in 2011 and almost at the same time; therefore, a year dummy is not included.

Data

The household data used in this study are collected by surveying 1,340 households in six Chinese cities (Beijing, Nanjing, Chengdu, Xi'an, Shenyang and Xiamen). The survey year and number of households are 2007 and 315 households for Beijing, 2009 and 246 households for Nanjing, and 2010 and 208 households for Chengdu. The data in the other three cities are collected in 2011 with the number of households being 215 for Xi'an, 207 for Shenyang, and 149 for Xiamen. These cities are geographically dispersed in China, are relatively high income centers in their region, and have populations ranging from 2.52 million for Xiamen to 19.61 million for Beijing in 2010 (Hong Kong Trade Development Council 2011; NBSC 2011) . Because Beijing, Nanjing and Chengdu have data with missing weight, height and other information, only data from Xi'an, Shenyang and Xiamen is used. The current paper focuses on food consumption and health condition of adults in urban China; therefore, those younger than 18 years old are dropped further. Thus, the information of 1,381 Chinese adults is used in the analysis.

The households in our survey are selected by a stratified and random sampling approach from households participating in the Urban Household Income and Expenditure (UHIE) survey in each city. The UHIE survey is the primary official information on urban consumers' income and expenditures and is a primary data source of the published China Statistical Yearbooks. In our survey, selected households record each food item that is consumed by each household member, both at home and away from home, for seven consecutive days. A drop-off and pick-up approach is applied. Detailed information on demographics and socio-economics of the household are also collected in the survey. See Bai et al. (2012) and Bai et al. (2010) for detailed information of the survey.

Figure 1 shows that body mass indexes are normally distributed in Xi'an, Shenyang and Xiamen. Table 1 describes the BMI distribution in each city separately for men and women aged 18 to 91 in 2011. The overall average BMI for men (23.38) is higher than that for women (22.29), but with a smaller variation. Each city displays the similar pattern, but BMI for males in Xi'an has a larger variance than for females. For both men and women, Xiamen has a lowest mean BMI, particularly for women. On the other hand, Shenyang has a highest BMI for both

cohorts, and this holds for almost all the BMI percentiles. The median BMI for men (women) ranges from 23.03 (21.33) to 23.51 (22.50), both at healthy levels.

Table 2 shows the body weight categories and the prevalence of obesity. In total, seven percent of our sample individuals are underweight (BMI<18.5). Shenyang has the lowest percentage of people being underweight (5%); in contrast, 12% of the citizens in Xiamen are underweight. Xi'an is in the middle, with 6% people over skinny. According to the Chinese criteria, 60 percent of the sample adults in Xi'an, Shenyang and Xiamen are healthy in terms of BMI, which range from 18.5 to 24.0. Surprisingly, there have been more than 30 percent of the people overweight, of which 5% are even obese. Comparatively, Xiamen has the largest number of people with BMI in normal ranges, and Shenyang is at the opposite, Xi'an in between. Less than 60 percent of the individuals in Shenyang have a normal BMI, more than 30 percent of its population have a BMI between 24.0 and 28.0, and 6% are obese with BMI of 28.0 and above. Xiamen has 62% people within normal weight ranges, 22% overweight and the percentage obese is the lowest as 4%.

Applying the WHO criteria, we get similar results, but obesity becomes less serious. Although Shenyang still has the highest proportion of people overweight or obese, and Xiamen is to the opposite, the difference shrinks. Also differently, all three cities have almost the same percent of people with BMI falling in the normal range. Moreover, Xi'an is better than Xiamen under this scenario, because it becomes the one with the largest population having healthy weight.

Table 3 displays the participation of Food-Away-From-Home (FAFH) consumption and the food eating location frequencies. Overall, 66 percent of the sample adults 18 years and above participated in FAFH consumption. It is most prevalent in Xi'an where 72 percent of the adults had FAFH consumption experiences, but the least popular in Xiamen which only has 59 percent of the adult population dining out for at least once during our survey week. Shenyang is at the average level, with 66 percent of the adults taking part in FAFH consumption.

A cafeteria is the most common place that people go if they choose to dine out. Nearly 40 percent of the meals were consumed at cafeterias in Xi'an, Shenyang and Xiamen in total. Fast food restaurants have been more and more popular in urban China these years, and they took 23 percent of the FAFH consumption experiences. Visits to table-service restaurants and other eating places are almost equal, with restaurants two percent higher. Adults in all three cities eat at cafeterias most often, particularly Shenyang where almost one half the meals consumed away from home happened at cafeterias. Xiamen and Xi'an have 45 percent and 30 percent of the FAFH meals taking place at cafeterias respectively. Except the most frequently visited eating place, there are significant regional differences about the eating locations. Adults in Xi'an prefer to places other than table-service restaurants, fast food restaurants or cafeteria; 30 percent of the FAFH meals were consumed at this venue. While for people in Shenyang and Xiamen, fast food restaurants are their second frequent choice, more often for Xiamen where one third of the meals were taken at fast food outlets. Besides, the visits to table service restaurants and fast food restaurants are almost equal in both Xi'an and Shenyang, but not for Xiamen. In addition, a substantial amount of the FAFH meals occurred at either table service restaurants, or fast food restaurants, or cafeteria for Shenyang, but for Xi'an and Xiamen, there are still a fairly large portion of the meals at other places.

Food eating locations by meal and city are shown in Table 4. On the whole, the most popular place to have breakfast away from home is neither restaurants nor cafeterias, but other places like roadside stands. Cafeteria is the second often place for breakfast if adults in Xi'an,

Shenyang and Xiamen decide to have it outside. Fast food restaurants and full service restaurants are the last two venues that our sample individuals have breakfast at. For lunch, cafeteria is the busiest place in total, which took almost one half the times that people had lunch away from home. Following cafeteria, fast food restaurants gain lots of businesses by providing lunches. More than one fifth of the lunch was taken at fast food outlets. As to dinner, 37 percent was consumed at full service restaurants, while another 30 percent happened at cafeteria.

In each of the three cities, although all the people have lunch most often at cafeterias, there are significant differences in terms of breakfast and dinner. Roadside stands are the major providers of FAFH breakfast for residents in Xi'an; about half of the time people buy and consume breakfast from these places. But cafeterias and fast food restaurants are the first choices for adult individuals in Shenyang and Xiamen respectively. For dinner, adults in Xi'an and Shenyang usually choose full service restaurants if they eat away from home, but cafeterias and fast food restaurants are the top two choices for the population in Xiamen. Besides, compared with Xi'an and Shenyang, less people in Xiamen consumed at restaurants for breakfast and lunch if they dine outside, more noticeable for lunch.

The summary statistics of variables used in regressions are reported in Table 5. During our entire survey week, the average times of meals consumed at full service restaurants, fast food outlets, and cafeterias are 0.82, 0.96 and 1.63 times respectively. If we only consider the consuming FAFH sample, then the average times are 1.23, 1.45, and 2.46 respectively (Appendix 3), which is consistent with the results in Table 3.

Other socioeconomic variables for the whole sample are also reported in Table 5. 49 percent of our sample individuals are men, the mean age is 50 years ranging from 18 to 91. 81 percent of the adults are married, and 47 percent of them received education at college level and above. The sample households have children no more than two, and the average number of children younger than 18 in a household is 0.41. Per capita weekly disposable income is 480 Yuan on average. 57 percent of the individuals 18 years above worked in the labor market, either having a full-time job or part-time job, but more people were full-time employees in Xi'an than Shenyang and Xiamen (Appendix 1). 72 percent of our sample individuals never smoke, but there are still 23 percent currently smoking (Appendix 2). Averagely, people in these three cities exercise 10 times in a month. Besides, 67 percent of the individuals live in a household that has at least one member having dietary problems such as hypertension, hyperglycemia and hyperlipidemia.

Results

Table 6 reports the OLS estimates of the relationship between BMI and food eating locations. When using information of the 1,381 individuals from our sample, we do not find any significant relationship between BMI and food eating locations. However, after a 500 times bootstrap, we find that the number of meals ate at cafeterias per week becomes statistically significant at 5 percent level and is positively related to BMI. But the number of meals ate at restaurants and fast food outlets per week remain insignificant even at 10 percent level.

A non-linear relationship between BMI and food eating location may emerge. Figure 1 shows that BMI in each city is normally distributed, and considering that the number 0 to 3 of the body weight category mean nothing in terms of their value, just an ordering to show the lowest to the highest, an ordered probit model is chosen to estimate the relationship between weight categories and food eating locations.

Similar to the results when regressing BMI on food eating locations, the number of meals ate at cafeteria is positively correlated with body weight, the more meals had at a cafeteria, the more likely the this person gains weight and becomes overweight or obese. The probability of getting obese is not significantly related to the number of meals consumed at restaurants which can be seen from the insignificant coefficients on full service restaurant and fast food outlet. Though both insignificant, the signs of the coefficients are different when using different criteria. When applying the Chinese criteria of classification, the more meals ate at restaurants, the higher probability that he/she increases the body weight, but a negative relationship is shown when using the WHO classification.

The coefficients from the ordered probit model are not very meaningful, thus, the marginal effects are calculated and reported in Table 8. Despite the significance in all groups, the marginal effects of eating at cafeteria on body weight are different across the weight categories. If the number of meals ate at a cafeteria increases by one, the probability that a person in Xi'an, Shenyang and Xiamen is underweight decreases by 0.25 percentage point, and the probability for a person's weight being normal decreases by 0.49 percentage point. However, one unit increase in the number of meals ate at a cafeteria increases the probability to be overweight and obese by 0.55 and 0.19 percentage point respectively. Using the WHO classification, the marginal effects are comparable on the whole, but the magnitudes are slightly bigger for underweight group and smaller for normal and obese groups. Despite of the insignificance of the number of meals had at restaurants, these results are overall consistent with the findings of numerous studies by indicating that eating away from home contributes to overweight and obesity (Binkley et al. 2000; Bowman et al. 2004; Dunn et al. 2012; Fraser and Edwards 2010; Guthrie et al. 2002; Mancino et al. 2009; Naska et al. 2011).

In addition to food eating locations, a number of other variables significantly affect the body weight changes. The estimate for gender is significantly positive (Table 6 and Table 7), but the marginal effects differ among the four weight groups (underweight, normal, overweight and obese). We can see from Table 8 that males are 4.2 (8.2) percentage points less likely to be underweight (normal) compared to females, also they are 9.2 and 3.2 percentage points more likely to fall in the overweight and obese groups respectively (Table 8 column (1) to (4)). This is consistent with the results by (Wang et al. 2007), but conflicting with the global opinion that more women are obese than men (Kanter 2011; Ogden Cl 2006).

Age is significantly positively correlated with the probability of gaining weight. A one year increase in age leads to a 0.08 and 0.15 percentage point decrease for being underweight and normal respectively, but a 0.17 and 0.06 percentage point increase for becoming overweight and obese correspondingly. This positive relationship is consistent with different previous studies (Anderson et al. 2003; Baum 2007; Flegal Km 2002; Ogden Cl 2006; Wardle et al. 2002). Same effects are found between marital status and obesity. Married couples are more likely to gain weight and even become overweight and obese. The number of children younger than 18 is significantly and negatively related with both continuous BMI and categorical BMI, however the marginal effects are not statistically significant.

Socioeconomic factors have significant effects on our sample individuals' weight changes. Per capita weekly household disposable income is positively related with the probability of being obese in the OLS models (Table 6), but not in the ordered probit models (Table 7), which leads to the insignificant marginal effects (Table 8). Income has been found to correlate with healthier BMI in the United States and Europe (García Villar and Quintana-Domeque 2009; Jolliffe 2011; Ljungvall and Gerdtham 2010), but an inverse relationship was also found and on Chinese (Cai et al. 2013). Considering our analysis is based on samples from China, the positive correlation is acceptable and comparable. The effect of education on weight change is consistent with existing literatures. Compared with people with high school education and less, individuals that received college education and above are less likely to be overweight or obese. Groups with college education and above are 2.4 and 4.8 percentage points more likely to be underweight and have normal weight respectively, while 5.4 and 1.8 less likely to have extra weight (Table 8). Employment status has significant effects on the probability of gaining weight but different from the results on Scandinavian (Sadiq and Martin 2006) and Irish (Mosca 2013). Compared with students and others, people having labor market jobs, retired, homeworkers and unemployed all have higher probability to become overweight and obese, though at different levels. This is reasonable however, because all of these groups tend to be sedentary and under more stress which results in weight gain easily.

Besides, the smoking status matters on obesity. Current smokers and never smokers are more often to be overweight and obese while less often to stay underweight and normal. Physical activity reduces the likelihood of being overweight or obese as expected, but the marginal effects are small and not significant. Finally, we find that individuals living in households with members having dietary problems are more possible to have higher BMI compared with their counterparts. This is within expectation because households with such members usually have problematic diets and other unhealthy living behaviors, and they will cause the BMI to rise gradually. The regional differences are also found. Consistent with our descriptive analysis, compared with Xi'an, people in Shenyang are more likely to be overweight and obese, while Xiamen is in contrast to it.

Summary and Conclusions

Food eating locations in urban China are found to have significant effects on adults' BMI. Meals eaten at restaurants and cafeterias positively contribute to the gain of people's body weight. However, the number of meals eaten at full service restaurants and fast food outlets have not displayed significant effects, only those at cafeterias show a statistically significant effect. The more meals consumed at cafeterias, the less likely a person becomes underweight or stay normal, and the more possible that he/she gains extra weight to be overweight and even obese. The marginal effects of number of meals at cafeterias are significant for all of these four groups, but the magnitudes differ. It has the largest marginal effect on overweight group; having one more meal at cafeteria increases the probability of being overweight by 0.55 percent. The next largest effect is on the normal weight group, with a marginal effect of 0.49 percent. The marginal effects at the tail of the BMI distribution are the smallest comparatively. The probability of being

underweight decreases by 0.25 percent and of being obese increases by 0.19 percent if one additional meal is consumed at cafeteria.

The insignificant effect of full service restaurants and fast food restaurants on the probability of being overweight could be due to many reasons. First, about 40 percentof the meals in our sample were consumed at a cafeteria, while table service and fast food restaurants only took 20 and 23 percent, around half less than that at cafeterias. Therefore, their effects can be insignificant due to the not frequent enough consumption. Second, full service restaurants normally have balanced dishes and cooked in elegant and healthy ways, thus, they might contribute to a healthier BMI. However, Food-Away-From-Home consumption usually contains more calories and fat which are detrimental to a healthy body weight. Hence, the effect of full service restaurants on body weight change could be insignificant. Third, fast food restaurants are booming in urban China, but according to Mintel (2013), "much of the growth to date has continued to benefit from a perceived 'novelty factor' enjoyed by fast food as the segment expands into smaller cities in China. The consumers in first- and a few second-tier cities where fast food has now been available for quite some time are becoming more attuned to the health issues often associated with fast food and are actively choosing healthier options when dining out." Therefore, with the loss of consumers, fast food restaurants naturally will not have significant effect.

Meals at cafeterias are significantly contributing to obesity. Cafeteria is the major outlet that people have lunch and dinner at, when the dishes are usually abundant in variety, quantity and energy, while lack of vegetables and fruits, consequently, it is easy for consumers to have extra intakes of nutrients. In addition, meals at cafeterias are normally cheaper than that at restaurants and fast food outlets. If they are of the same prices, the subsidies given by the employers still generally drive people to eat at cafeterias inside work units. Besides, the convenience of close distance to offices keeps people choose cafeterias as well. Thus, we can see eating at cafeterias are beneficial to busy business workers nowadays, however, the characteristics of being detrimental to health needs to be noticed and corresponding measures should be taken. Though the menus at cafeterias are various, the vegetarian section tends to be small commonly, while the meats are deep fried or cooked in other not healthy enough ways. Therefore, one recommendation could be to increase the vegetarian and fruit section in cafeterias, while coming up with more healthy menus and processing methods in terms of animal foods.

The following limitations of this study should be noted. First, we only use information of 1,381 individuals aged 18 years and above, while China is broad and each province has its own specific and different dietary characteristics along with cultural differences. Thus, this study cannot represent the entire China. Second, the BMI constructed in our study is based on self-reported weight and height, which means our anthropometric indicators suffer from measurement error. This measurement error in BMI leads to an imprecise estimate on the association between BMI and the predictors, and may lead to misclassification of individuals into different weight classifications, which translates into a loss of precision and even a biased estimate of the association between weight classification and socioeconomic status (Boström and Diderichsen

1997). Nevertheless, the correlation coefficients between the self-reported and the actually measured obesity prevalence rates are very high for both men (0.76) and women (0.96) (Sanz-de-Galdeano 2007).

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Figures

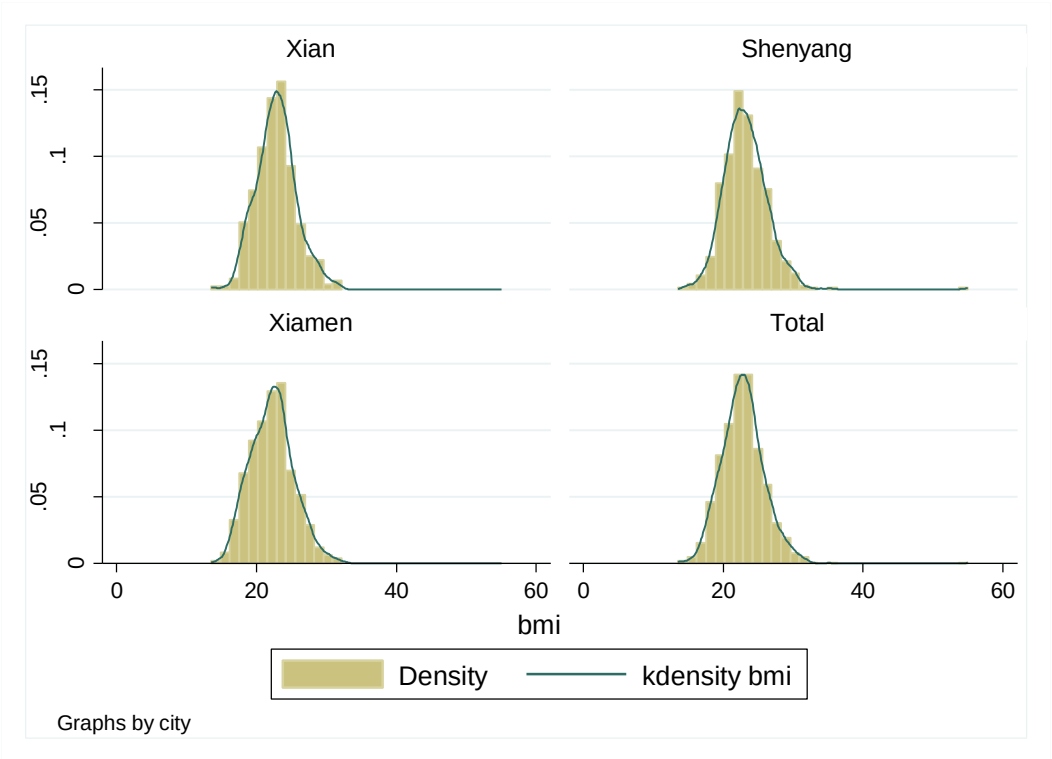

Figure 1. BMI Distribution by city

Tables

Table 1
BMI distribution in 2011 by gender. Age 18-91.

	BMI mean	BMI SD	BMI percentiles					
			p10	p25	p50	p75	p90	N
Men								
Xian	23.50	3.03	19.37	21.78	23.51	25.35	27.55	262
Shenyang	23.60	2.82	20.06	21.80	23.43	25.80	27.34	236
Xiamen	22.93	2.84	19.37	20.98	23.03	24.47	26.61	181
Total	23.38	2.92	19.71	21.62	23.18	25.35	27.10	679
Women								
Xian	22.23	2.59	18.82	20.40	22.22	23.88	25.30	269
Shenyang	22.91	3.68	19.28	20.83	22.50	24.47	26.67	250
Xiamen	21.54	3.12	17.72	19.05	21.33	23.42	25.48	183
Total	22.29	3.19	18.59	20.20	22.04	24.04	25.82	702

Table 2
Body weight categories and the prevalence of obesity.

%	Chinese criteria				WHO criteria			
	Total	Xian	Shenyang	Xiamen	Total	Xian	Shenyang	Xiamen
Underweight	7	6	5	12	7	6	5	12
Normal	60	62	57	62	72	74	71	71
Overweight	28	27	33	22	19	18	22	15
Obese	5	5	6	4	2	2	2	1
Total	100	100	100	100	100	100	100	100

Table 3
Food eating locations by city.

%	individuals consuming FAFH	restaurant	fastfood	cafeteria	other	Total
Total	66	20	23	39	18	100
Xian	72	21	18	31	30	100
Shenyang	66	23	23	48	6	100
Xiamen	59	12	32	45	11	100

Note: restaurant means full service restaurants, fastfood means fast food outlets.

Table 4
Food eating locations by meal and city.

	Total			Xian			Shenyang			Xiamen		
	bft	lun	din	bft	lun	din	bft	lun	din	bft	lun	din
restaurant	12	17	37	11	24	33	18	17	57	10	9	24
fastfood	25	23	19	18	20	16	35	22	14	39	31	32
cafeteria	27	48	30	23	37	31	36	55	26	35	52	33
other	36	11	13	48	20	20	10	6	4	16	9	11
Total	100	100	100	100	100	100	100	100	100	100	100	100

Note: For the convenience of display, bft, lun and din are abbreviations for breakfast, lunch and dinner respectively.

Table 5
Summary statistics of variables used in regressions.

Variable	Description	Obs	Mean	SD	Min	Max
Dependent Variables						
bmi	Kg/m^2	1381	22.83	3.11	13.54	55
categoryc	Chinese criteria	1381	1.31	0.68	0	3
categoryw	WHO criteria	1381	1.15	0.55	0	3
Independent Variables						
Key Variables						
restaurant	# meals at full service restaurant/week	1381	0.82	1.59	0	14
fastfd	# meals at fast food outlet/week	1381	0.96	2.02	0	16
cafeteria	# meals at cafeteria/week	1381	1.63	3.26	0	21
Controls						
gender	1=male	1381	0.49	0.50	0	1
age	years	1381	46.93	15.12	18	91
couple	1=married	1381	0.81	0.39	0	1
nchild	# of children<18 in HH (persons)	1381	0.41	0.53	0	2
college	1=college+	1381	0.47	0.50	0	1
pcawkinc	per capita weekly HHincome (1000 yuan)	1381	0.48	0.30	0.04	3.69
employ	employment status	1381	2.17	1.51	1	7
smoke	1=smoking, 2=quit, 3=never	1381	2.49	0.84	1	3
prac	times/month	1381	9.75	12.64	0	60
disease	1=HH has member with dietary problems	1381	0.67	0.47	0	1
City						
Xian		1381	0.38	0.49	0	1
Shenyang		1381	0.35	0.48	0	1
Xiamen		1381	0.26	0.44	0	1

Table 6
OLS and Bootstrapped OLS estimates of the relationship between BMI and food eating locations.

VARIABLES	OLS	Bootstrapped OLS	
	b	b	se
	(1)	(2)	(3)
# meals at full service restaurant/week	0.011	0.011	0.053***
	(0.053)	(0.040)	(0.002)
# meals at fast food outlet/week	-0.028	-0.028	0.042***
	(0.042)	(0.032)	(0.002)
# meals at cafeteria/week	0.044	0.044**	0.028***
	(0.028)	(0.019)	(0.001)
gender (0/1 dummy:1=male)	1.033***	1.033***	0.204***
	(0.204)	(0.164)	(0.004)
age	0.016*	0.016**	0.009***
	(0.009)	(0.008)	(0.000)
couple (0/1 dummy:1=married)	0.744***	0.744***	0.243***
	(0.243)	(0.208)	(0.006)
# of children in HH	-0.363**	-0.363***	0.168***
	(0.168)	(0.139)	(0.003)
college (0/1 dummy:1=college+)	-0.653***	-0.653***	0.177***
	(0.177)	(0.127)	(0.003)
Per capita weekly HHincome (1000Yuan)	0.516*	0.516***	0.288***
	(0.288)	(0.185)	(0.005)
Employment Status			
full-time	2.084*	2.084	1.134***
	(1.134)	(1.497)	(0.211)
part-time	2.100	2.100	1.475***
	(1.475)	(1.583)	(0.181)
retired	1.939*	1.939	1.148***
	(1.148)	(1.503)	(0.208)
homeworker	2.422**	2.422	1.189***
	(1.189)	(1.512)	(0.203)
unemployed	1.956*	1.956	1.175***
	(1.175)	(1.534)	(0.205)
student	1.399	1.399	1.223***
	(1.223)	(1.538)	(0.198)
other	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Smoke Status			

currently smoking	-1.032***	-1.032***	0.399***
	(0.399)	(0.347)	(0.015)
never smoke	-0.912**	-0.912***	0.395***
	(0.395)	(0.351)	(0.015)
# monthly exercise	-0.010	-0.010*	0.007***
	(0.007)	(0.006)	(0.000)
disease (0/1 dummy: 1=HH has member with dietary problems)	0.435**	0.435***	0.174***
	(0.174)	(0.121)	(0.003)
City			
Shenyang	0.340*	0.340**	0.190***
	(0.190)	(0.134)	(0.003)
Xiamen	-0.755***	-0.755***	0.214***
	(0.214)	(0.161)	(0.004)
Constant	19.873***	19.873***	1.263***
	(1.263)	(1.565)	(0.194)
Observations	1,381	1,381	1,381
R-squared	0.106		

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7
Ordered Probit estimates of the relationship between Body weight classification and food eating locations.

	(1) Chinese criteria	(2) WHO criteria
main		
# meals at full service restaurant/week	0.003	-0.004
	(0.020)	(0.022)
# meals at fast food outlet/week	0.001	-0.017
	(0.016)	(0.017)
# meals at cafeteria/week	0.021*	0.023**
	(0.011)	(0.011)
gender (0/1 dummy:1=male)	0.350***	0.361***
	(0.079)	(0.084)
age	0.007**	0.008**
	(0.003)	(0.004)
couple (0/1 dummy:1=married)	0.219**	0.226**
	(0.094)	(0.100)
# of children in HH	-0.146**	-0.175**
	(0.065)	(0.069)
college (0/1 dummy:1=college+)	-0.204***	-0.088
	(0.068)	(0.073)
Per capita weekly HHincome (1000Yuan)	0.113	0.116
	(0.110)	(0.119)
Employment Status		
full-time	0.759*	1.011**
	(0.442)	(0.467)
part-time	1.401**	1.463**
	(0.565)	(0.603)
retired	0.680	0.922*
	(0.447)	(0.473)
homeworker	1.009**	1.288***
	(0.463)	(0.490)
unemployed	0.680	1.001**
	(0.457)	(0.483)
student	0.580	0.792
	(0.477)	(0.504)
other	.	.
	.	.
Smoke Status		
currently smoking	-0.512***	-0.369**
	(0.150)	(0.158)
quit smoking	.	.
	.	.

never smoke	-0.415***	-0.327**
	(0.148)	(0.156)
# monthly exercise	-0.004	-0.008***
	(0.003)	(0.003)
disease (0/1 dummy: 1=HH has member with dietary problems)	0.134**	0.130*
	(0.067)	(0.072)
City		
Xi'an	.	.
	.	.
Shenyang	0.138*	0.134*
	(0.073)	(0.078)
Xiamen	-0.317***	-0.285***
	(0.083)	(0.088)
cut1		
Constant	-0.624	-0.234
	(0.490)	(0.516)
cut2		
Constant	1.413***	2.193***
	(0.491)	(0.520)
cut3		
Constant	2.660***	3.571***
	(0.494)	(0.526)
Observations	1381	1381
Pseudo R^2	0.047	0.052
BIC	2811.314	2291.490

Standard errors in parentheses
* $p < .1$, ** $p < .05$, *** $p < .01$

Table 8
Marginal effects from ordered probit estimations of the relationship between Body weight classification and food eating locations.

	Chinese criteria				WHO criteria			
	c1	c2	c3	c4	c1	c2	c3	c4
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ME:restaurant	-0.0003	-0.0006	0.0007	0.0002	0.0005	0.0006	-0.0010	-0.0001
P:restaurant	0.8970	0.8970	0.8970	0.8970	0.8490	0.8490	0.8490	0.8490
ME:fastfd	-0.0001	-0.0002	0.0002	0.0001	0.0021	0.0027	-0.0042	-0.0006
P:fastfd	0.9680	0.9680	0.9680	0.9680	0.3120	0.3170	0.3120	0.3220
ME:cafeteria	-0.0025	-0.0049	0.0055	0.0019	-0.0027	-0.0035	0.0055	0.0007
P:cafeteria	0.0560	0.0560	0.0550	0.0570	0.0490	0.0510	0.0480	0.0610
ME:gender*	-0.0417	-0.0824	0.0922	0.0319	-0.0429	-0.0558	0.0869	0.0119
P:gender*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0010
ME:age	-0.0008	-0.0015	0.0017	0.0006	-0.0009	-0.0012	0.0018	0.0002
P:age	0.0500	0.0500	0.0490	0.0510	0.0340	0.0360	0.0330	0.0440
ME:couple*	-0.0290	-0.0461	0.0576	0.0175	-0.0299	-0.0279	0.0516	0.0062
P:couple*	0.0360	0.0080	0.0180	0.0100	0.0430	0.0050	0.0170	0.0190
ME:nchild	0.0173	0.0345	-0.0387	-0.0131	0.0208	0.0271	-0.0423	-0.0056
P:nchild	0.0250	0.0260	0.0240	0.0270	0.0110	0.0130	0.0110	0.0210
ME:college*	0.0245	0.0477	-0.0540	-0.0182	0.0105	0.0135	-0.0212	-0.0028
P:college*	0.0040	0.0030	0.0030	0.0040	0.2300	0.2260	0.2260	0.2340
ME:pcawkinc	-0.0134	-0.0267	0.0300	0.0101	-0.0138	-0.0180	0.0280	0.0037
P:pcawkinc	0.3080	0.3080	0.3080	0.3080	0.3270	0.3270	0.3270	0.3320
ME:1.employ*	-0.1000	-0.1589	0.1931	0.0658	-0.1388	-0.1204	0.2262	0.0331
P:1.employ*	0.1290	0.0390	0.0610	0.0930	0.0660	0.0020	0.0160	0.0780
ME:2.employ*	-0.0594	-0.4474	0.1797	0.3271	-0.0596	-0.4708	0.3292	0.2013
P:2.employ*	0.0000	0.0020	0.0050	0.1240	0.0000	0.0190	0.0000	0.2500
ME:3.employ*	-0.0657	-0.1867	0.1723	0.0802	-0.0839	-0.2044	0.2380	0.0504
P:3.employ*	0.0670	0.1590	0.0870	0.2340	0.0160	0.1070	0.0480	0.2260
ME:4.employ*	-0.0598	-0.3261	0.2022	0.1838	-0.0646	-0.3990	0.3203	0.1433

P:4.employ*	0.0000	0.0350	0.0000	0.1680	0.0000	0.0220	0.0000	0.2010
ME:5.employ*	-0.0504	-0.2117	0.1618	0.1003	-0.0602	-0.2928	0.2669	0.0861
P:5.employ*	0.0080	0.1870	0.0470	0.3080	0.0000	0.0990	0.0160	0.2800
ME:6.employ*	-0.0454	-0.1777	0.1423	0.0808	-0.0534	-0.2191	0.2154	0.0571
P:6.employ*	0.0420	0.2850	0.1360	0.3900	0.0010	0.2260	0.1050	0.3790
ME:7.employ*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
P:7.employ*	.	.	.	.	.	.	.	.
ME:1.smoke*	0.0755	0.0920	-0.1307	-0.0368	0.0512	0.0408	-0.0824	-0.0096
P:1.smoke*	0.0050	0.0000	0.0000	0.0000	0.0440	0.0000	0.0110	0.0110
ME:2.smoke*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
P:2.smoke*	.	.	.	.	.	.	.	.
ME:3.smoke*	0.0432	0.1095	-0.1087	-0.0439	0.0349	0.0598	-0.0822	-0.0124
P:3.smoke*	0.0020	0.0100	0.0040	0.0180	0.0220	0.0690	0.0430	0.0890
ME:prac	0.0004	0.0009	-0.0010	-0.0003	0.0009	0.0012	-0.0019	-0.0003
P:prac	0.1740	0.1740	0.1740	0.1740	0.0070	0.0080	0.0060	0.0120
ME:disease*	0.0165	0.0306	0.0355	0.0116	-0.0159	-0.0189	0.0308	0.0040
P:disease*	0.0560	0.0390	0.0470	0.0410	0.0820	0.0570	0.0670	0.0720
ME:4.city*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
P:4.city*	.	.	.	.	.	.	.	.
ME:5.city*	0.0159	0.0336	0.0366	0.0128	-0.0154	-0.0218	0.0328	0.0045
P:5.city*	0.0520	0.0660	0.0590	0.0700	0.0770	0.1030	0.0890	0.1140
ME:6.city*	0.0424	0.0657	-0.0829	-0.0252	0.0376	0.0356	-0.0653	-0.0079
P:6.city*	0.0010	0.0000	0.0000	0.0000	0.0040	0.0000	0.0010	0.0020

Note: (*) dP/dx is for discrete change of dummy variable from 0 to 1. For continuous variables, the ME and P are calculated at the meal level. C1 is underweight, C2 is Normal, C3 is overweight, C4 is obese.

Appendixes

Appendix 1

Employment status of sample individuals.

%	full-time	part-time	retired	homeworker	unemployed	student	other	Total
Total	56.3	0.7	28.2	4.8	5.4	4.1	0.5	100
Xian	60.8	0.2	25.8	2.8	4.7	5.1	0.6	100
Shenyang	54.1	0.8	33.3	1.9	5.4	4.3	0.2	100
Xiamen	52.8	1.4	24.7	11.5	6.3	2.5	0.8	100

Appendix 2

Smoking status of sample individuals.

%	smoking	quit smoking	never	Total
Total	23.0	5.2	71.8	100
Xian	26.9	4.5	68.6	100
Shenyang	22.4	3.9	73.7	100
Xiamen	18.1	7.7	74.2	100

Appendix 3
Summary statistics of variables used in regressions for consuming FAFH sample.

Variable	Obs	Mean	Std. Dev.	Min	Max
Dependent Variables					
bmi	917	22.80	3.12	13.54	55
categoryc	917	1.30	0.67	0	3
categoryw	917	1.15	0.54	0	3
Independent Variables					
Key Variables					
restaurant	917	1.23	1.82	0	14
fastfd	917	1.45	2.33	0	16
cafeteria	917	2.46	3.74	0	21
Controls					
gender	917	0.52	0.50	0	1
age	917	43.28	13.51	18	90
couple	917	0.81	0.39	0	1
nchild	917	0.42	0.52	0	2
college	917	0.54	0.50	0	1
pcawkinc	917	0.50	0.30	0.08	3.69
employ	917	1.87	1.47	1	7
smoke	917	2.45	0.87	1	3
prac	917	9.03	12.10	0	60
disease	917	0.65	0.48	0	1
City					
Xian	917	0.41	0.49	0	1
Shenyang	917	0.35	0.48	0	1
Xiamen	917	0.24	0.42	0	1