

CHINA'S URBAN HOUSEHOLD FOOD CONSUMPTION, NUTRITION, AND HEALTH

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ABSTRACT

The effect of family structure on household nutrition intake and the effect of wine, beer, and spirits consumption on household nutrition and health are examined. To evaluate nutrition intake, an Eating Healthy Index (EHI) is developed following the Compilation of Food-Based Dietary Guidelines, published by the Chinese Nutrition Society, and the Healthy Eating Index-2010 components and standards for scoring from USDA. Using previously collected household survey data from 11 cities in China, an EHI is developed and calculated for each family to assess their nutrition intake. The score is calculated such that it increases if consumption is in a range representing healthy food intake. The relationship between the score, representing healthy nutrition intake, and household income, wife's education level, demographics, and household composition is explored using regression analysis. The results indicate that changes in family structure have significant effects on household nutrition intake.

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1. INTRODUCTION

China is a developing country with a population of 1.3 billion. In China, a relatively large portion of income is spent on food, however, urban expenditure of food varies dramatically by income level. Based on the Global Nutrition Report (2015), 88 million Chinese are overweight, which suggests that households are not maximizing nutrition intake and many are eating an unhealthy diet.

China's one-child policy and emphasis on the family may result in increased expenditures, especially food when there is a child in the household. The one-child policy, a part of the family planning policy, was a population control policy of China which was introduced between 1978 and 1980 and began to be formally phased out in 2015. The policy allowed many exceptions and ethnic minorities were exempt. In 2007, 36% of China's population was subject to a strict one-child transition. An additional 53% could have a second child if the first child was a girl. Parents want to give their child the "best" food, but is the best food providing the best, or perhaps too much nutrition? The prevalence of overweight and obesity, especially among children, suggests nutrition may be an issue. Households especially those who have a child may consume too much food to make them over-nutrition. Furthermore, there are several other reasons such as household income and household size that may lead to over-consume. Thus, this research will examine the effects of income, food expenditures, and household demographics on nutrition intake in China.

In China, household income is increasing rapidly but the proportion of food consumption is in the opposite way. On the contrary, the rate of spending money on alcohol is increasing dramatically. Hence, a steady increase in alcohol production has also been observed in the country, together with a rise in alcohol-related harm. This study will discuss the alcohol

consumption relate to habit of food consumption in China. Based on the data collected from 11 cities in China, this study developed the Eating-Health-Index (EHI) that is like the HEI in USDA, but current research uses the different standard in China. Also, this study considered some demographics may affect the score, and determine the relationship between them. Finally, this study use the data of alcohol consumption at home and food away from home to figure out how the alcohol consumption affect eating habit on households. The results indicate that having a child has a positive effect on healthy household food consumption of eggs, vegetables, fruits, and dairy. And two kinds of the alcohol consumption will make the overall score decrease, the coefficient for beer and spirit show that household drink food away from home cause a worse effect than drink at home. In the contrast, wine consumption away from home show some positive effect on the EHI, which may suggest that if people consume a little of wine may make people towards to healthier.

This thesis has five chapters, Chapter 1 is the introduction, Chapter 2 presents a review of literature on nutrition intake and food expenditure, Chapter 3 discusses the effect of China's one-child policy on household nutrition intake and food expenditure which is the first research article. The next chapter presents the second article titled China's Urban Wine, Beer, and Spirits Consumption: Implications for Household Nutrition and Health. Finally, Chapter 5 presents the conclusions.

2. LITERATURE REVIEW

In 1995, Ye and Taylor found out the impact of income growth on farm household nutrient intake. In their study, they present econometric estimates food and nutrient intake elasticities for a certain area in northern China. In this article, they used a structural model to control the endogeneity of nutrient costs and their income elasticities of food and nutrient demand related to calorie and protein intake. Furthermore, income can affect nutrition intake in two ways, quantity and quality which suggest that when expenditure increased, households would switch food sources. At the same time, they found households would choose more expensive nutrients as their income increased, but soybean consumption was quite low in this area, that may cause a problem in soybean market, so they suggested there were potential development of soybean markets to offer a high quality and cheap source of protein. Their research provides strong evidences that income will change the quality of nutrition intake, and for some certain nutrients, income raise will decline those nutrient intakes which suggests that income can affect nutrition intake.

Subramanian and Deaton (1996) found that there are some connections between nutrition and expenditure in rural Maharashtra in India. From investigation, they estimated different regressions by using 5630 households to estimate the relationship between income or total expenditure and nutrition intake which is measured as calories. Their results show that the elasticity of calorie intake with total expenditure is 0.3-0.5, also in India, the calories for a day's cost less than 5 percent of the daily wage, which is hard to believe. This study provides evidence shows that some connections between income and nutrition intake.

Vitoria et al. (2008) pointed out that maternal and child malnutrition (maternal height, birthweight, intrauterine growth restriction, and weight, height, and body-mass index at 2 years

according to the new WHO growth standards) were related to adult outcomes (height, weight, body mass index, blood glucose, and blood pressure). They conducted a systematic review of these results and indicators with lipids, cardiovascular diseases, lung and immune function, cancer, osteoporosis, and psychiatric disorders in low income and middle-income countries. Finally, they pointed out that at the age of 2, height is the best predictor of human capital and the lack of nutrition is associated with lower human capital. They concluded that the damage in early life is perpetual and may affect future generations. Its prevention may result in significant health, education, and economic benefits. Chronic diseases are common in children with malnutrition and appear to have a rapid increase in weight. From this they used BMI to determine the relationship between undernutrition and low income, which similar to the current research but use different standards to estimate the relationship

In a significant contribution, Deaton and Dreze (2009) provide a detailed analysis of the calorie drops during the period 1983 to 2004. Their key findings are as follows. In India, the rural areas of 1983 to 2004, 10% of the medium calorie, consumption is compared with 2005. In urban areas, there is a slight change in the average calorie intake in this period. The fall in consumption per capita is not limited to calories. It also applied to protein and other nutrients, except in the use of rural and urban areas of this period. As income growth, these declines are puzzling. A controversial view of Dyaton and Dreze (2009), the latter is due to the relative price changes in food prices overall measured calories, the price difference is not significant in the same period. Thus, the problem is: in a particular per capita consumption level, per capita energy consumption, at a given level, in the entire expenditure scale, at low levels of per capita spending, as well as high. In other words, there is a steady downward shift of the Engel curve of the heat. Deaton and Dreze (2009) also stressed that the downward shift of the Engel curve of the

calorie was due to the low-calorie demand and better health and lower activity levels. To provide evidence is one-sided, fragmentary, which is a largely speculative explanation.

Blakely et al. (2011) in their research were aiming to determine if the effects of price discounts and tailored nutrition education on food consumption vary by ethnicity, household income and education in New Zealand. They collected 1104 samples from a 2×2 factorial trial of shoppers randomized to receive a 12.5% discount on healthier foods and/or nutrition education for 6 months. There was an association of price discounts with healthy food purchasing (0.79 kg/week increase; 95% CI 0.43 to 1.16) that varied by ethnicity (p=0.04): European/other 1.02 kg/week (n=755; 95% CI 0.60 to 1.43); Pacific 1.20 kg/week (n=101; 95% CI 0.06 to 2.34); Maori -0.15 kg/week (n=248; 95% CI - 1.10 to 0.80). The result indicated that there was a significant variation by ethnicity in price discounts, and null findings for nutritional education across all groups, which may suggest that price more effective than education in food consumptions in New Zealand.

Rahman, Kranz and Bauer (2012) figured out that food consumption, nutrition and demand for farmers' households are affected by region. In their research, they collected 300 households, and used LA/AIDS model to estimate food consumption, nutrition and demand. Their main findings can be concluded as farmers consumed less food in per capita and protein intake, food costs are 58% of their total cost. More than that, some region in their study is extremely poor so which is easy to understand price of the food is significant affected food demand. Also, they pointed out prices should be controlled by policy so that farmers can consume enough food, at the same time policy can increase farmers' income, which is another way to help them. From their study, the current research learned that policy can help poor people get enough food and make sure they will be health, compare with current research, there are so

many regions are still poor and households cannot consume enough food to be health, that is why the current research need to find out and may become a guideline for policy makers.

Sean Mark et al. (2012) published a paper about household income, food insecurity and nutrition in Canadian youth. In their study, they were aiming to examine the influence of low income and insecurity on dietary in Canadian youth, they used data from the Canadian Community Health Survey (CCHS) Cycle 2.2, to find out the diets of 8938 children who were between 9-18 years old. To get the result by using generalized linear models between low income and food insecurity, food and nutrition intakes. Based on what they got, the result indicated that child from low-income households had lower height than those in higher-income households. In addition, the girls from low-income families had a higher prevalence of BMI than those in higher-income households. At the same way, calcium and vitamin D intakes also lower in low-income households, and similarly result for milk intake. This study directly prove that nutrition intake is highly affected by household income no matter boy or girl, and income has a positive effect for nutrition intakes, which suggests high-income households have more healthier food than low-income one.

Gaiha, Jha and Kulkarni (2013) in their research found that in India, despite the rise in income, there has continued to decline in the per capita calorie intake. Their study is seeking to the changes in the pattern of food consumption and the calories, proteins and fats people intake for a short time since 1993 to 2004. In the paper, the develop an equation for calories, proteins, and fats by using unit level record data which they collected from rural and urban India from 1993 to 2004 and use this equation to do a robust regression. In the regression there are two refinements, one is the time dummy, and the other is a price dummy. Finally, their results show a robust food and expenditure effects. Moreover, the price elasticity significantly shifts over time.

This study really closes to what the current research do, but still have some differences such as the current research use seven different foods and develop a new standard for China, more than that the current research also put household demographics.

David Atkin (2013) pointed out that the food expenditure patterns in different regions are very different, and the family is not to maximize the nutrition, but it seems to show a preference for a particular food. In the paper, he mentioned a glance at the food consumption data showed that two kinds of facts. First, the food expenditure patterns in different regions are very different. Just like in the Indian, West Bengal will be 48 percent of rice and 5 percent of wheat ethnic food expenditure households in 1987-1988. Despite similar prices in Rajasthan, the families of their food costs are thirty percent of wheat and one percent of rice. Research can see a huge difference between those regions. Secondly, the family is not to maximize the nutrition, but it seems to show a preference for a certain kind of food. If the average family in West Bengal is in the same family in Rajasthan, it will get more than twenty-three percent of the cost. These unrealized nutritional gains are striking given that over 50 percent of children in West Bengal classified as underweight around this time, and presumably, these additional calories would have brought nutritional benefits.

Popkin (2013) published a paper to point out that Chinese people had a huge effect shifted by eating, drinking and moving since 1949 when the People's Republic of China established, and the China Health and Nutrition Survey (CHNS) started doing a survey by choosing some households since 1989. With the developing, everything if household change a lot such as eating, drinking, housing and so on. The paper is aiming to determine the changes in China and compare with low- and middle-income countries (LMICs). What Popkin found is the usage of vegetable oils is grow fast and rapid, that remarkable change the way they cook

including baking, steaming and boiling, to deep-frying and stir-frying. Due to the changes of eating behavior, the number of obesity increased dramatically at the upper end of the body mass index (BMI). From this study, the healthy issue in China will become a huge one in future and that is why this research want to find out the problem is and how this research can avoid that before it happens.

Zhou and Turvey (2015) in their study to investigate the link between climate change, income and nutrition intake in rural China. By Using a system of simultaneous equations in a three-stage least squares model, the authors found effects on nutrition would change when climate change. Furthermore, they found a significant evidence of income effect and this one was opposite the climate effect. The authors believed that there were three aspects would be interesting. First, in short term, poorer household would be the most sensitive and fragile to climate change. And in long term, all household would be able to deal with change of climate. Second, the writers didn't find strong evidence to prove a nutrition trap in rural China. At last, the nutrition intake of Chinese was more sensitive to gradual changes, such as climate changes, but not for some big events.

As mentioned before household eating out a lot, just as Liu et al. (2015) pointed out food-away-from-home (FAFH) in urban China can be effected by household composition, income and other economic variables. In their paper, they used data from surveys which they did in six cities in China before, and by using a two-step process, they found out that household income and composition have significant effects on FAFH, which suggested that FAFH expenditures in urban China will continue growing in future. Based on their study this research make some changes, this research want to know the effect between drinking alcohol and FAFH, also this research

added some other economic variables in it too. This study gives us some thoughts and come up the idea for the research.

Zhang et al. (2017) determined the diet diversity and nutritional status among adults in southwest China. This study used data from 2011-2012 National Nutritional Survey in Yunnan Province, southwest China (N = 1105). Three continues 24-hour dietary were aiming to calculate dietary diversity scores (DDS) and nutrient adequacy ratio (NAR). Also, they used BMI and waist circumference to figure out nutritional status. The result showed that mean DDS was 5.2 for total is 9, and young age females who had higher education and income were positive effect on DDS. Excluded grains and vegetables, other food groups' consumptions increased when DDS increased. Moreover, people who had medium and high DDS were at higher risk to be obesity than others with DDS less than 4. This study is quite same as current research, but more than what they did, current research have more samples and more variables, even though both studies used same standards but the result may quite different.

Reynolds et al. (2003) showed that heavy alcohol consumption increases the relative risk of stroke while light or moderate alcohol consumption may be protective against total and ischemic stroke.

Liu et al. (2010) pointed out, in western countries, a U-shaped connection between diabetes mellitus and alcohol intake was observed. But there were few for Chinese, so they want to investigate this connection among middle-age and elderly Chinese. The samples the collected were 1458 males and 1831 females who aged from 50-70 in Beijing and Shanghai. The main findings were alcohol consumption decreased the risk of having diabetes mellitus in females by controlling several variables such as socio-demographic factors, physical activity, smoking, family income, family history of cardiovascular disease or diabetes, macronutrients intake, body

mass index, and markers of inflammation and adipocytes. Furthermore, both low and high alcohol intake increased risk of having diabetes and IFG for males which was an J-shaped connection between alcohol consumption and combined diabetes and IFG.

Tian and Liu (2011) published a paper that showed that price can affect the demand of alcohol in China. In their article, they used data from China Health and Nutrition Survey for 1993, 1997, 2000, 2004 and 2006, they built two-part models for alcohol demand. The main findings are the price elasticity for beer is zero and only -0.12 for liquor, which much smaller than in developed countries, and most important thing is they concluded that increasing alcohol tax can be one of the ways to reduce alcohol-related issues but not effective when it is alone, and can raise government revenue either.

Zhang and Holman (2011) tried to find out the relationship between alcohol intake and breast cancer risk in Chinese women, in their study, they used a case-control study in China from 2004-2005. There were 1009 samples with histologically confirmed breast cancer and 1009 age matched samples controls recruited. By using a questionnaire, their main finding was in low-to-moderate alcohol consumption, there were an opposite effect associated with this cancer risk. The women who drinks less than 15g per day would decrease the risk of breast cancer, but more than 15g per day would increase the risk. From their study, a standard for healthy consumption of alcohol can be developed

Zhao Li et al. (2016) pointed out heavy drinking is a risk factor for coronary heart disease and hypertension. Globally, there are 3.8% of all deaths and 4.6% of disability adjusted life-years because of unhealthy alcohol use. In their study, the used 11,269 adults who are over 35 years old to do a standard questionnaire, and by using a multivariate logistic regression to find out the risk difference between heavy drinkers and non-drinking group, from the results that they got, there

are 7.5% are moderate drinkers and 16.7% are heavy drinkers and there are 1.3-fold and 1.7-fold greater risk for heavy drinkers who may have coronary heart disease and hypertension. Cause the study this research knows that drinking too much will be terrible for health and this research knows what kind of disease may happen, that helps to understand how important and worth to do this research.

The Dietary Guidelines for Americans are the basis of nutrition policy for the United States Government, The original Healthy Eating Index (HEI) was released in 1995 which included 10 components; five of them came from five major food groups of the Food Guide Pyramid. Through a survey and testing, the Dietary Guidelines are renewed every 5 years. And in 2010 version, this index ungraded to 12 components. In original HEI, each component had a standard based on guidelines, and scores for each component was 0 to 10, the total score was 100, over 80 was “good,” 51-80 was considered “needs improvement,” and less than 51 was “poor.” In HEI 2010, they scored 1-day dietary intakes from sample they collected from nation. By using the Total dietary intake and energy intake for day, they calculated the score for each component score, then sum them to get an individual’s 1-day total HEI score.

3. THE EFFECT OF CHINA'S FAMILY STRUCTURE ON HOUSEHOLD NUTRITION

3.1. Introduction

China's one-child policy, part of China's family planning strategy, was introduced between 1978 and 1980 and formally phased out in 2015. Because of the essentially "only one child" restriction, parents want to invest in their child by providing the "best" to ensure the future of the family as well as their own retirement since children are expected to take care of parents in their old age. However, providing the "best" has created entitled children or "little emperors" who are spoiled by their parents and doting grandparents especially in extended family households that include at least one set of grandparents. This family structure, including one child or seniors, will likely affect food expenditures as the family strives to provide the best for the child or for seniors, but does this provide the most nutritious or healthiest diet?

A recently published article in *The Lancet* shows that China has exceeded the US in absolute number of obese population. Chinese men and women contributed 16.3 percent and 12.4 percent, respectively, to global obesity in 2014. Although these numbers did not account for China's large population base, they reflect a sharp increase since 1975 when there were only 2.1 percent of obese men and 2.5 percent of obese women living in China (NCD-RisC, 2016). The increased obesity has at least partially contributed to the incidence non-communicable diseases such as type 2 diabetes, cardiovascular diseases, and cancer. Non-communicable diseases have become China's number one health threat resulting in more than 80% of the country's 10.3 million annual deaths and nearly 70% of its total disease burden (*The Lancet Editorial*, 2014). The situation has become worse in recent years as more, young people, especially the "little emperors", and low-income people have become obese (Popkin, 2008; Yan *et al.*, 2012).

In this paper, the effect of family structure on household nutrition intake is examined. To evaluate nutrition intake, Eating Healthy Index (EHI) is developed following the Compilation of Food-Based Dietary Guidelines, published by the Chinese Nutrition Society, and the Healthy Eating Index-2010 components and standards for scoring from USDA. Using previously collected household survey data from 11 cities in China, an EHI is developed and calculated for each family in order to assess their nutrition intake. The score is calculated such that it increases if consumption is in a range representing healthy food intake. For example, if protein consumption is 300g per day and the recommended range is between 200g—400g, then the individual would receive a high score. If nutrition intake is either above or below the healthy range, the score is reduced. Consumption below the recommended range indicates low nutrition intake reducing productivity and immunity to disease, both of which have associated externalities (Atkin 2013). Consumption above the recommended range may result in obesity increasing the incidence of illness or other health issues. Conceptually, the score should be somewhat like a normal distribution with the higher scores in the middle representing healthy levels of consumption and the tails representing unhealthy consumption.

The relationship between the score, representing healthy nutrition intake, and household income, wife's education level, demographics, and household composition is explored using regression analysis. The results indicate that changes in family structure have significant effects on household nutrition intake. The expectation is that when parents spend more money on food, their nutrition intake will change. If they are purchasing better quality and perhaps more nutritious food, the nutrition intake score will represent a healthy relationship. However, overeating and eating more away from home, including fast food, as incomes increase may not be healthy. Also, when the household structure changes, the nutrition intake of household

members will change, such as when there is a child born into the household. These results may provide suggestions to guide healthier eating as well as developing recommendations to guide policymakers.

3.1. presents the background of nutrition intake and food expenditure in China. 3.2. introduces the data and describes guidelines followed by the method used to develop the EHI and score for each household. 3.3. explores the relationship between the score, representing healthy nutrition intake, and household income, wife's education level, and demographics. And provide suggestions as recommendations to policymakers. 3.4. concludes.

3.2. Methodology

The U.S. Department of Agriculture's (USDA) Healthy Eating Index is a measure of diet quality in terms of conformance to the Dietary Guidelines for Americans, which are the basis of nutrition policy for the United States government and the foundation of all federal nutrition guidance. The accompanying USDA Food Patterns translates key recommendations of the Dietary Guidelines into specific, quantified recommendations for types and amounts of foods to consume at 12 calorie levels with limits on calories from solid fats and added sugars. Whether assessing diets or some aspect of the food environment, the basic steps for deriving USDA's Healthy Eating Index 2010, scores are the same: (1) identify the set of foods under consideration; (2) determine the amount of each relevant food group, subgroup, and nutrient in the set of foods; (3) derive the pertinent ratios; and (4) score each component using the appropriate standard (Table 3.1.).

The Chinese Nutrition Society published the Compilation of Food-Based Dietary Guidelines in 2007. These guidelines suggest that Chinese consumers should eat a variety of foods, mainly cereals; consume plenty of vegetables, fruits and tubers; consume milk, beans or

dairy- or bean-products every day; consume appropriate amounts of fish, poultry, eggs and lean meat; and reduce fatty meat and animal fat in the diet. The guidelines suggest balancing food intake with physical activity to maintain a healthy body weight and choosing a light diet that is also low in salt; if consuming alcoholic beverages, to do so in limited amounts; and avoid unsanitary and spoiled foods. The standards for seven types of food are presented in Table 3.2.

Table 3.1. USDA Healthy Eating Index Standards

Component	Max Points	Standard for maximum score	Standard for minimum score of zero
HEI-2010			
Adequacy:			
Total Fruit	5	≥0.8 cup equiv. per 1,000 kcal	No Fruit
Whole Fruit	5	≥0.4 cup equiv. per 1,000 kcal	No Whole Fruit
Total Vegetable	5	≥1.1 cup equiv. per 1,000 kcal	No Vegetables
Greens and Beans	5	≥1.1 cup equiv. per 1,000 kcal	No Dark Green Vegetables or Beans and Peas
Whole Grains	10	≥1.5 oz equiv. per 1,000 kcal	No Whole Grains
Dairy	10	≥1.3 cup equiv. per 1,000 kcal	No Dairy
Total Protein Foods	5	≥2.5 oz equiv. per 1,000 kcal	No Dairy
Seafood and Plant Proteins	5	≥0.8 oz equiv. per 1,000 kcal	No Seafood or Plant Proteins
Fatty Acids	10	(PUFAs + MUFAs)/SFAs >2.5	(PUFAs + MUFAs)/SFAs <1.2
Moderation:			
Refined Grains	10	≤1.8 oz equiv. per 1,000 kcal	≥4.3 oz equiv. per 1,000 kcal
Sodium	10	≤1.1 gram per 1,000 kcal	≥2.0 grams per 1,000 kcal
Empty Calories	20	≤19% of energy	≥50% of energy

The U.S. Department of Agriculture's (USDA) Healthy Eating Index 2010

Table 3.2. Chinese Dietary Guidelines Per Person/Day

Component	Standards	Value of M_j^a
Meat	50g-75g	62.5
Fruit	200g-400g	300
Vegetable	300g-500g	400
Seafood	75g-100g	87.5
Dairy	$\geq 300g$	300
Grain	250g-400g	325
Egg	25g-50g	37.5

The Compilation of Food-Based Dietary Guidelines, The Chinese Nutrition Society

^aValues measured in grams.

Based upon the USDA healthy eating index, Table 3.1., and the Chinese Compilation of Food-Based Dietary Guidelines, Table 3.2., this study defines the maximum points for each food as 10. Each food type has a standard range, M_j , that is calculated as the average value of the range. For example, the average value of dairy is 300 grams, if the household consumes the quantity in recommended range the score is 10 points, otherwise the score will decrease as follows:

$$S_{ij} = \alpha_j |Q_{ij} - M_j| + \beta \quad (\text{Eq.3.1})$$

where S_{ij} represents the points that household i scores and j food group; α_j is the slope coefficient; β is constant; Q_{ij} is the quantity that the household i consumes and j food group; and M_j represents the mean value of the standard range of j food group. Each food type has a standard range, M_j , that is calculated as the average value of the range¹.

¹ The value of the coefficients α_j and β for dairy can be calculated as follows. Using the average value of dairy (300 grams from Table 1), assuming S_{ij} equal to 10, when Q_{ij} equals 300, then $\beta = 10$. Then to calculate α assume S_{ij} equals 0, when Q_{ij} equals 0, $\alpha_j = \frac{-10}{M_j} = -\frac{10}{300} = -1/30$.

3.3. Regression between score and demographics

Based on the household data collected from the 11 Chinese cities, four indicator variables are created for child, senior, wife's education and region. Ordinary least squares (OLS) is used to estimate the relationship between score and household income, household size, and the four dummy variables to evaluate the effects on household nutrition intake as follows:

$$S_{if} = \beta_0 + \beta_1 I_i * (L_{if} + M_{if} + H_{if}) + \beta_2 Z_i * (L_{if} + M_{if} + H_{if}) + \beta_3 E_i + \beta_4 C_i * (L_{if} + M_{if} + H_{if}) + \beta_5 D_i * (L_{if} + M_{if} + H_{if}) + \beta_6 R_i + \beta_7 W_i + \beta_8 A_i + \varepsilon \quad (\text{Eq.3.2})$$

where S_{if} is the score that ith household for fth food groups, I_i represents household income, $L_{if} = 1$ if ith household for fth food groups who is in the under-consumption range, 0 otherwise representing not in that range. $M_{if} = 1$ if ith household for fth food groups who is in the recommended-consumption range, 0 otherwise representing not in that range. $H_{if} = 1$ if ith household for fth food groups who is in the over-consumption range, 0 otherwise representing not in that range. Z_i is the household size, E_i is a variable which represents wife's education, defined as wife's education years. C_i is a variable that takes the value for households with the number of child. D_i is an indicator variable for seniors, the number of seniors collected if the age of a household member is greater than 65 for male and 60 for female. R_i , W_i represents region indicator, $R_i = 1$ if the city is in the East and $W_i = 1$ if the city is in the West region, 0 otherwise representing the Middle region. A_i is wife's age in years. ε is the error term.

3.4. Results

By using general statistic method, the Table 3.3. shows, households were divided into 3 groups by EHI for further analysis: Low, Medium, and High. The low EHI group included households with EHI ranging from 0 to 4, the medium EHI group included households with EHI

ranging from 4 to 6, and the high EHI group included households with EHI ranging from 6 to 10. In each group the mean and percentage show in the table either. The general result shows that the number of households who consume meat and grain are extremely high which are 81% and 73%, that is one of reasons that people get overweight and obese. But the result also indicates that most of households consume egg and seafood healthy, and vegetable, fruit and dairy need some improvements.

Table 3.3. Mean and Percentage of Nutrition Intake by EHI Group

Component	Standards	Low (0-4)	Medium (4-6)	High (6-10)
Meat	50g-75g	208g (81%)	78g (6%)	66g (13%)
Fruit	200g-400g	350g (54%)	238g (15%)	283g (31%)
Vegetable	300g-500g	686g (55%)	437g (16%)	401g (29%)
Seafood	75g-100g	46g (18%)	61g (18%)	81g (64%)
Dairy	≥300g	38g (53%)	146g (16%)	245g (31%)
Grain	250g-400g	595g (73%)	371g (14%)	324g (13%)
Egg	25g-50g	86g (13%)	40g (16%)	38g (71%)

As shown in Figure 3.1., graphs of household nutrition intake scores demonstrate a normal distribution, except for dairy, which has only a minimum recommended consumption level. As previously mentioned a perfect score for each commodity is 10 for each household, which are standardized in the following graphs such that 10 is a perfect score. Horizontal axis is household consumption in grams. The graphs clearly indicate that some households under-consume and some over-consume food. For example, according to the guidelines, healthy meat consumption should be in the range of 50-70 grams. The graph of meat consumption clearly shows that many of the households surveyed consume more than the recommended quantities.

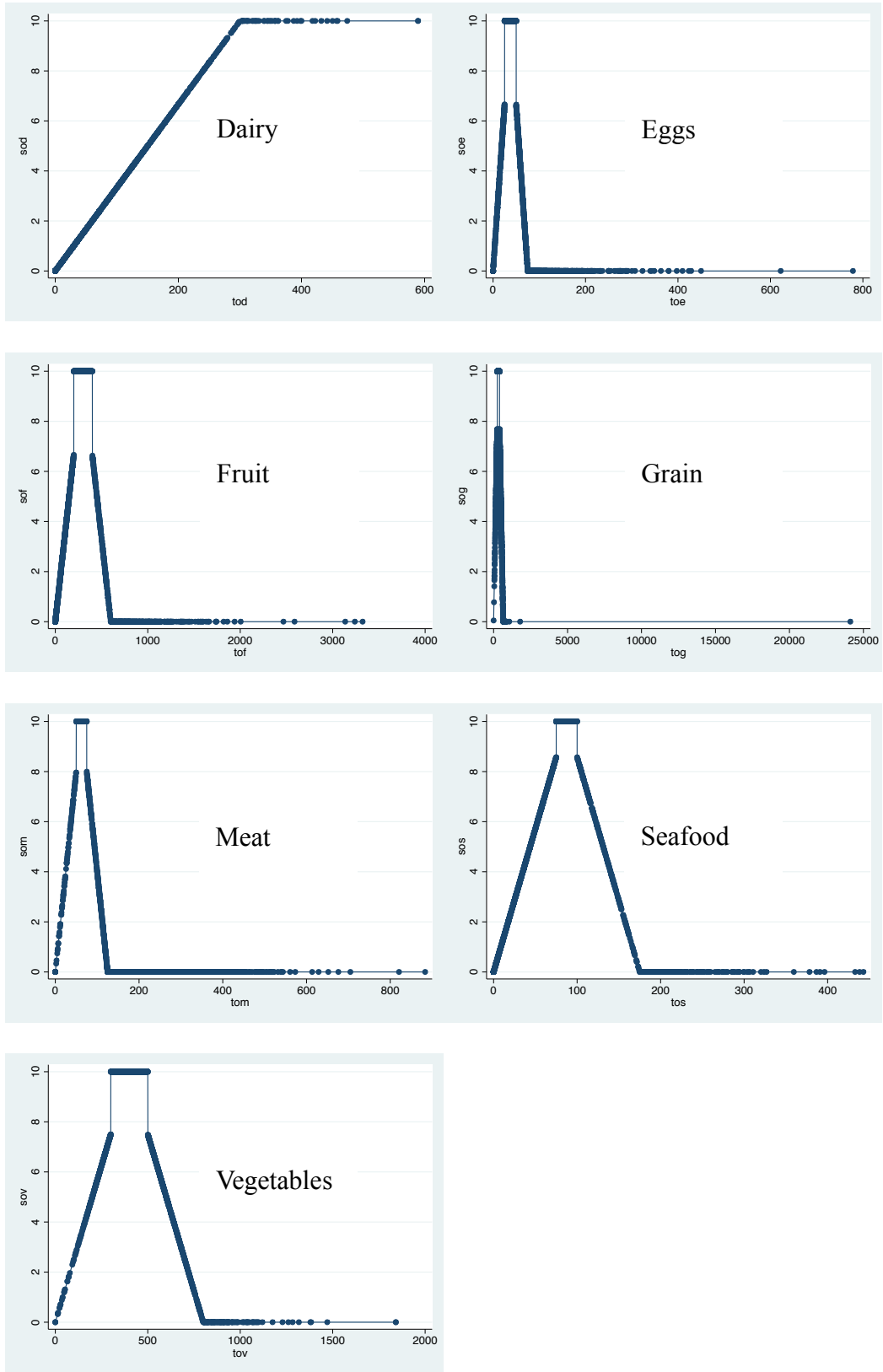


Figure 3.1. EHI Scores

The regression results, shown in Table 3.4., indicate that households with more children have significantly higher scores for eggs, vegetables, fruit, and dairy than households with less children in under range. Thus, the presence of a child in the household suggests that the household will consume a healthier diet presumably to provide the child with better nutrition. But in the recommended range the number of child increase will decrease the score expect dairy, which means the households who already in the health range will consume less food, cause the costs of child are high such as education cost, and with a certain household income the food consumption will decrease but still in a health range. As same reason as health range, in over-consumption range child has a positive effect expect dairy and seafood.

Table 3.4. OLS Estimation Results

	Grain	Meat	Seafood	Eggs	Veg	Fruit	Dairy
HH Inc_L	4.16e-05	0.205***	0.078***	0.017	0.002	0.022	0.013
HH Size_L	-0.333***	0.712***	-0.022	-0.213**	-0.358***	-0.448***	-0.352***
Child_L	0.093	-0.092	-0.018	0.544***	0.400**	0.390***	0.450***
Senior_L	-0.020	-0.136	-0.250**	-0.272*	0.234*	0.004	0.046
W City	0.212**	-0.376***	-0.433***	0.095	-0.031	0.059	1.028***
E City	0.322***	-0.597***	0.945***	0.104	0.113	-0.009	0.427***
HH Inc_M	0.031**	0.148***	0.039	0.094***	0.036**	0.103***	-0.018
HH Size_M	0.955***	2.714***	2.332***	1.877***	1.121***	1.945***	2.562***
Wife's Edu	0.043	0.006	0.161***	0.053	0.025	0.017	0.255***
Child_M	-0.473***	-1.665***	-1.293***	-1.097***	-0.503***	-1.037***	-1.039
Senior_M	0.029	0.333*	0.080	0.048	0.089	0.055	0.227
Wife's Age	2.18e-04	0.012**	0.004	0.005	-0.002	-0.002	0.028***

Table 3.4. OLS Estimation Results(continued)

	Grain	Meat	Seafood	Eggs	Veg	Fruit	Dairy
HH Inc_H	-0.004	-0.041***	-0.089***	-0.041**	-0.057***	-0.054**	
HH Size_H	-0.832***	-0.130**	0.375***	-0.827***	-0.831***	-0.667***	
Child_H	0.754***	0.277***	-0.348	0.666***	1.159***	0.563***	
Senior_H	-0.108	0.010	0.079	-0.048	-0.073	-0.074	
R²	0.6711	0.5987	0.3801	0.7339	0.6840	0.7125	0.1713

Note: confidence level *10% ** 5% *** 1%; “+” or “-” means the estimated coefficient is statistically insignificant.

Households that include seniors score significantly higher for meat have a significant positive effect in health range, but for eggs and seafood senior has a negative effect when household undernutrition, but opposite in vegetable which means households in under range will consume more vegetable when have more seniors, other food consume less because of the food share decrease.

There are significant regional differences for many of the foods. Western cities score significantly lower for meat and seafood relative to the reference region, Middle cities, but significantly higher for dairy and grain than Middle region cities. Eastern cities score significantly higher on grain, seafood, and dairy but significantly lower on meat relative to Middle cities. These results suggest that households in Eastern cities have healthier diets. The reason for Western cities, such as Xi’an or Lanzhou, those cities abound with meat, especially beef, at the same time, the production of dairy are rich either. Because of the location of Western cities are far away from sea, no doubt the seafood will be scarce. Eastern cities, in contrast have access to more seafood.

Household income is found to have negative and significant effects on household's score for all food except grain and dairy in over-nutrition, suggesting that as income increases the household will likely buy more meat resulting in consumption beyond the recommended levels resulting in a less healthy diet. Dairy consumption will likely increase with higher household income and result in a higher dairy score and a healthier diet. Household income is found to have significant positive effects on household scores for both under and recommended ranges, which suggest that income plays an important role. Overall, increases in income would result in less healthy consumption levels of meat but a healthier level of dairy consumption.

As the wife's education level increases, the results suggest that the household EHI score will increase for seafood, dairy, resulting in a healthier diet than households with lower wife's education. Also, as the wife's age increases, scores for meat and dairy are significantly higher suggesting that as the wife has more knowledge about how to eat healthy, either due to education or experience, the household consumes a more nutritious diet.

Household size has a significant positive effect on scores for most types of food in recommended range. Household size play a negative role in under range for most food except seafood, because of when more people in a family, the share of food will decrease when household already in a under range, as same as in over range, households will consume more food to make sure everyone get enough food, but since they already in over-consumption, so that makes everyone eat more and unhealthier. These results for household size suggests that, the more people in household, the more effort in planning meals carefully resulting in more equal allocation and healthier eating in health range. But for dairy the results suggest that as the number of household member's increase, individual shares of dairy consumption decrease perhaps due to a reduced proportion of children who would be more likely to consume milk.

3.5. Conclusions and future research

Overall, the results suggest that having a child has a positive effect on healthy household food consumption of eggs, vegetables, fruits, and dairy. There are also significant regional effects in healthy food consumption. Higher household income has mixed effects on healthy eating as it tends to increase the healthy intake of dairy, but lower the healthy intake of meat. The wife's education level and age tend to increase healthy eating with higher education being associated with healthier intake of seafood, dairy, and overall while higher age being associated with healthier intake of meat and dairy. Increasing household size has a positive healthy effect on consumption of all foods.

Obesity, resulting from poor nutrition and overconsumption, can contribute to health issues. According to statistics, obese patients with cerebral embolism and heart failure are higher than the normal weight, and affect the labor force, vulnerable to traumatic body fat are often afraid of heat, sweating, fatigue, lower extremity edema, varicose veins, skin folds at dermatitis and so on. Future research of this topic may include household health insurance, a more detailed assessment of nutrition intake, and the implications for world food markets.

From a policy perspective, it is difficult to reduce overconsumption of food or unhealthy eating habits. However, policies to reduce food waste may reduce overconsumption by advertising penalties for waste resulting in reduced consumption, particularly away from home.

4. CHINA'S URBAN WINE, BEER, AND SPIRITS CONSUMPTION: IMPLICATIONS FOR HOUSEHOLD NUTRITION AND HEALTH

4.1. Introduction

A daily glass of wine, a single beer, or a shot of spirits can improve health. However, exceeding this claim regularly can lead to increased overall health issues. Wine, beer, and spirits consumption has been traditionally accepted in China especially during major social events, such as the spring festival, wedding ceremonies and birthday parties. Today in China, people often dine away from home with friends, family or even their boss, which may lead to consuming more food while they drink more.

In China, per capita wine, beer, and spirits consumption (along with alcohol related health issues) has increased rapidly over the last 50 years as household income has increased. Excessive alcohol consumption is a risk factor several diseases especially coronary heart disease and hypertension. Despite these trends, China's policies on the sale and consumption of alcoholic beverages are weak compared with those of other countries in Asia, which may contribute to increased health issues and societal problems.

Rising incomes have also resulted in increased food consumption and perhaps contributed to overconsumption. According to the 2015 Global Nutrition Report, 88 million Chinese are overweight, which suggests that households are not maximizing nutrition intake and many are eating an unhealthy diet. A recently published article in *The Lancet* shows that China has exceeded the US in absolute number of obese persons. Chinese men and women contributed 16.3 percent and 12.4 percent of global obesity in 2014, respectively. Although these numbers did not account for China's large population base, they reflect a sharp increase since 1975 when there were only 2.1 percent of obese men and 2.5 percent of obese women living in China (NCD-

RisC, 2016). Thus, obesity and alcohol related diseases including type 2 diabetes, cardiovascular diseases, and cancer have become China's number one health threat, contributing to more than 80% of the country's 10.3 million annual deaths and nearly 70% of its total disease burden.

In this paper, the effect of wine, beer, and spirits consumption on household nutrition and health is examined. To evaluate nutrition intake, an Eating Healthy Index (EHI) is developed following the Compilation of Food-Based Dietary Guidelines, published by the Chinese Nutrition Society, and the Healthy Eating Index-2010 components and standards for scoring from USDA. Using Chinese household survey data, an EHI is developed and calculated for each family to assess their nutrition intake. Consumption below the recommended range indicates low nutrition intake reducing productivity and immunity to disease, both of which have associated externalities. Consumption above the recommended range may result in obesity increasing the incidence of illness or other health issues. Conceptually, the score should be somewhat like a normal distribution with the higher scores in the middle representing healthy levels of consumption and the tails representing unhealthy consumption.

The results suggest that wine, beer, and spirits consumption has significant effects on household nutrition intake which can lead to cardiovascular disease and cerebrovascular disease. Globally, an estimated 3.8% of all deaths and 4.6% of disability adjusted life-years are attributable to pathological alcohol use. These alcohol-attributable costs exceed 1% of the gross national product of high- and middle-income countries, making pathological alcohol use one of the largest avoidable risk factors for the global burden of disease.

Section I presents the background of nutrition intake and food expenditure in China. Section II introduces the data and describes guidelines; followed by the methodology used to develop the EHI and score for each household. Section III explores the relationship between the

score, representing healthy nutrition intake, and alcohol consumption at home or food away from home, and demographics. Section IV concludes and provide recommendations to households and policymakers.

4.2. Methodology

The Chinese Nutrition Society published the Compilation of Food-Based Dietary Guidelines in 2007. These guidelines suggest that Chinese consumers should eat a variety of foods, mainly cereals; consume plenty of vegetables, fruits and tubers; consume milk, beans or dairy- or bean-products every day; consume appropriate amounts of fish, poultry, eggs and lean meat; and reduce fatty meat and animal fat in the diet. The guidelines suggest balancing food intake with physical activity to maintain a healthy body weight and choosing a light diet that is also low in salt; if consuming alcoholic beverages, to do so in limited amounts; and avoid unsanitary and spoiled foods. The standards for seven types of food are presented in Table 4.1. Also, this study calculates the alcohol equivalent for beer, wine and spirit based on Alcohol by volume.

Table 4.1. Chinese Dietary Guidelines Per Person/Day

Component	Standards	Value of M_j^a
Meat	50g-75g	62.5
Fruit	200g-400g	300
Vegetable	300g-500g	400
Seafood	75g-100g	87.5
Dairy	$\geq 300g$	300
Grain	250g-400g	325
Egg	25g-50g	37.5

The Compilation of Food-Based Dietary Guidelines, The Chinese Nutrition Society

^aValues measured in grams.

Based upon the USDA healthy eating index and the Chinese Compilation of Food-Based Dietary Guidelines, Table 4.1., the maximum points for each food as 10. For example, if the household consumes the quantity in standard range the score is 10 points, otherwise the score will decrease as follows:

$$S_{ij} = \alpha_j |Q_{ij} - M_j| + \beta \quad (\text{Eq.4.1})$$

where S_{ij} represents the points that household i scores and j food group; α_j is the slope coefficient; β is constant; Q_{ij} is the quantity that the household i consumes and j food group; and M_j represents the mean value of the standard range of j food group. Each food type has a standard range, M_j , that is calculated as the average value of the range. For example, the average value of dairy is 300 grams (Table 5), this study may use those to calculate the value of α_j and β , just like linear equation if this study assume the S_{ij} equal to 10, when Q_{ij} equal to 300, then $\beta = 10$, in the same way, assuming S_{ij} equal to 0, when Q_{ij} equal to 0, hence, $\alpha_j = \frac{-10}{M_j} = -\frac{10}{300} = -1/30$, that how to calculate α_j and β .

Also, these values are used to calculate the weighted value, W_j , of each food as:

$$W_j = M_j / \sum_{i=1}^{n=7} M_j. \quad (\text{Eq.4.2})$$

The overall weighted total score of all the seven groups of foods are calculated as:

$$WS = \sum_{j=1}^{n=7} \left(\frac{M_j}{\sum_{j=1}^{n=7} M_j} \right) * (\alpha_j |Q_{ij} - M_j| + \beta) \quad (\text{Eq.4.3})$$

4.3. Regression between score, alcohol consumption and demographics

Based on the household data collected from the 11 Chinese cities, four dummy variables are created for child, senior, wife's education and region. Ordinary least squares (OLS) is used to estimate the relationship between score, alcohol consumption at home and food away from home and household income, household size, and the four dummy variables to evaluate the effects on

household nutrition intake as follows:

$$WS_i = \beta_0 + \beta_1 I_i + \beta_2 Z_i + \beta_3 E_i + \beta_4 C_i + \beta_5 D_i + \beta_6 R_i + \beta_7 A_i + \beta_8 qfah_{ij} + \beta_9 qfafh_{ij} + \varepsilon \quad (\text{Eq.4.4})$$

where WS_i is the overall score that ith household get, I_i represents household income, Z_i is the household size, E_i is a dummy variable which represents wife's education, defined as wife's education higher than high school = 1, otherwise is 0. C_i is a dummy variable that takes the value 1 for households with one child, and 0 otherwise. D_i is a dummy variable for seniors, 1 if the age of a household member is greater than 65 for male and 60 for female, 0 otherwise. R_i represents region dummies, R=1 if the city is in the East, 0 otherwise representing the other regions. A_i represents region dummies, A=1 if the city is in the West, 0 otherwise representing the other regions, $qfah_{ij}$ is the value of alcohol consumption at home, which for ith household and jth kind of alcohol. $qfafh_{ij}$ is the value of alcohol consumption food away from home, which for ith household and jth kind of alcohol. ε is the error term.

4.4. Results

The guideline of Chinese primary prevention of cerebrovascular disease in 2015 recommended that males drink less than 50ml of spirit, 640ml of beer and 150ml of wine per day, and females limit consumption to half of males. Based on the alcohol content of beer, wine and spirit, the standards become 32ml, 21ml and 30ml. There are two groups to show the situation of males and females alcohol consumption. From the result, wine consumptions seem not too much, but spirit and beer show an opposite way, the average consumption of beer and spirit for male who over the standards are 48ml and 62ml. Table 4.2. presents the mean values of alcohol consumption and the averages of those who consume more or less than recommended. Furthermore, as Figure 4.1. and Figure 4.2. shown that females who consume spirits or beer over

the standard is 30ml or 37ml, which can be found female heavy drinkers consume more spirits than males.

Table 4.2. Mean of Alcohol Consumption

Component		Standards	Above	Below		Standards	Above	Below
Beer	Male	32ml	48ml	3ml	Female	16ml	30ml	2ml
Wine		21ml	30ml	0ml		10.5ml	14ml	0ml
Spirit		30ml	62ml	2ml		15ml	37ml	1ml

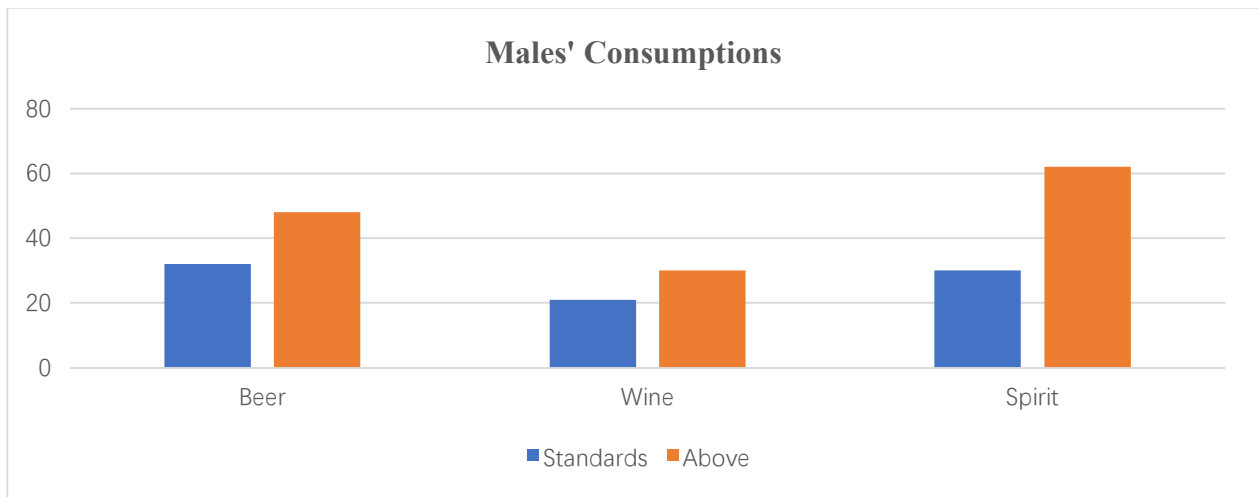


Figure 4.1. Males' Alcohol Consumptions

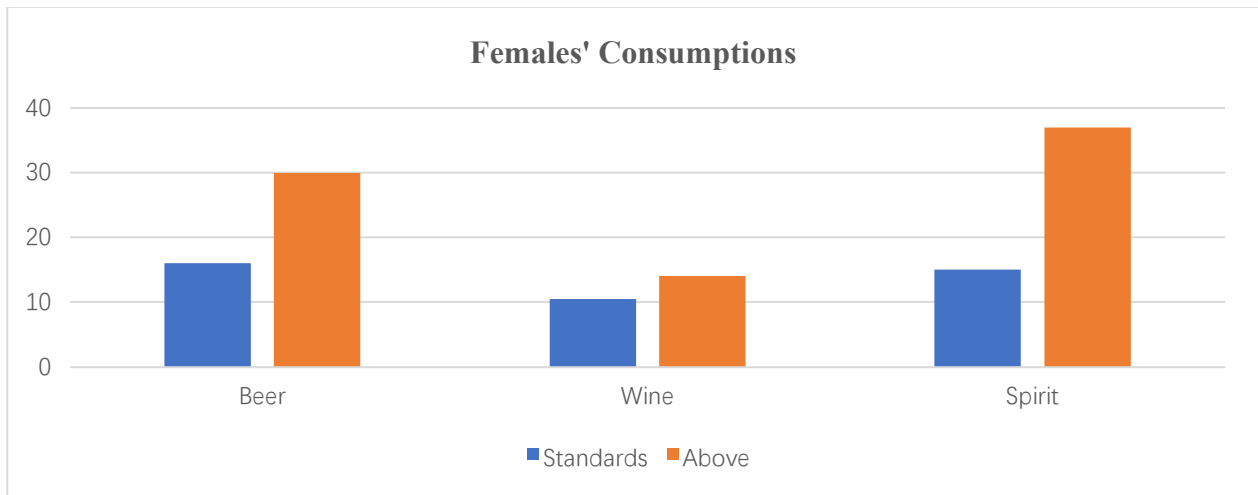


Figure 4.2. Females' Alcohol Consumptions

As shown in Figure 4.3., graphs of household consumption in alcohol at home and food away from home, which can be directly noticed household in China drink more alcohol at home than away from home, more than that, in Figure 4.4. the household spend money on beer and spirit are significantly higher than wine, half of their alcohol consumption is spirit called “Baijiu” which is ordinary one in China, but few people buy wine which means wine is not that kind of popular in China than in other countries such as France or Italy.

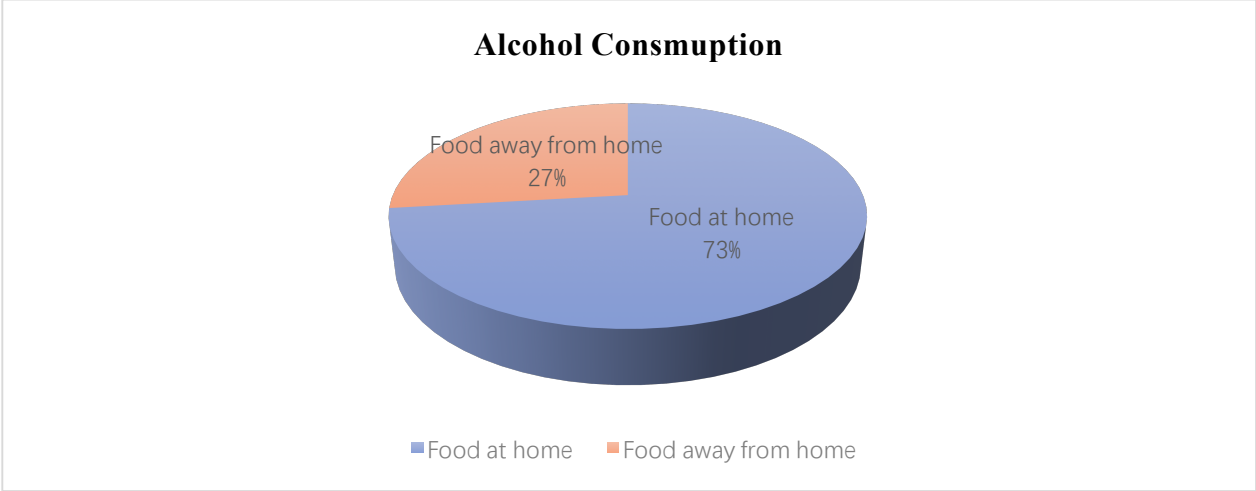


Figure 4.3. Alcohol Consumption Food At Home vs Food Away From Home

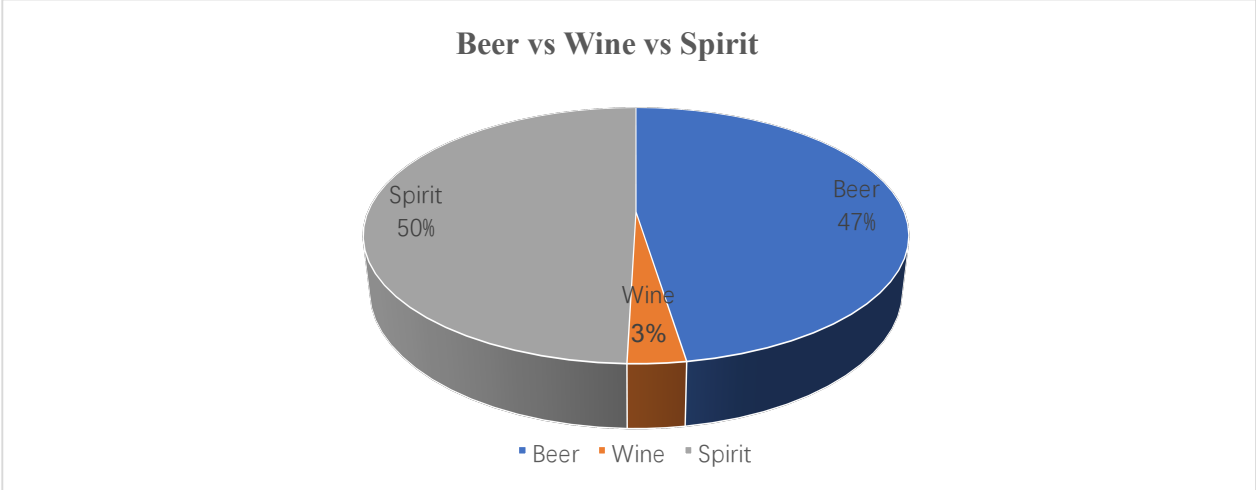


Figure 4.4. Three Types of Alcohol Consumption

The regression results, shown in Table 4.3., indicates that households with a child or a senior have a significantly higher score for the overall eating index than households without a child or a senior. Thus, the presence of a child in the household suggests that household will consume a healthier diet presumably to provide the child with better nutrition. And people in Median region are eating much healthier than other regions. Household size has a significantly positive effect on scores for overall score which means the more people in household, the more effort in planning meals carefully resulting in more equal allocation and healthier eating. But household income will make that worse, which suggest people may consume more food in higher payment than lower one.

Table 4.3. OLS Estimation Results

Variables	Coefficients
Child	0.250***
Senior	0.347***
W City	-0.052***
E City	-0.061***
HH Inc	-3.30E-06***
Wife's Edu	0.003
HH Size	0.267***
Beer fah	-0.031***
Beer fafh	-0.041***
Wine fah	-0.004
Wine fafh	0.004
Spirit fah	-0.010***
Spirit fafh	-0.022***
R ²	0.08

Note: confidence level *10% ** 5% *** 1%; “+” or “-” means the estimated coefficient is statistically insignificant.

Also, this result can indicate that two kinds of the alcohol consumption will make the overall score decrease, the coefficient for beer and spirit show that household drink food away from home cause a worse effect than drink at home. In the contrast, wine consumption away

from home show some positive effect on the EHI, which may suggest that if people consume a little of wine may make people towards to healthy. The best way to explain is drinking alcoholic beverages has been traditionally accepted in China during major social events, such as the spring festival, wedding ceremonies and birthday parties. And, nowadays in China, people often eat away from home with friend, family or even their boss, that may lead people to eat more food while they drink more alcohol, furthermore, people only drink alcohol but eat few foods. Either of such situation can make the overall score goes down.

Furthermore, alcohol is now commonly consumed to relieve stress, facilitate social interaction and foster good relations between supervisors and employees, since these often eat out together after work or hold business meetings over dinner. That makes consume alcohol food away from home may cause worse for nutrition intake than drink at home. but not only for our health issue, but also it is turning to a public issue, such as transportation security, import market and policy issue. Hence, the guideline of Chinese primary prevention of cerebrovascular disease in 2015 recommended that male may drink less than 50ml of spirit, 640ml of beer and 150ml of wine per day, and female is half of male, that may decrease occurrence of disease.

4.5. Conclusions

The results of the regression on the overall EHI score that includes all foods indicates that children or seniors in the household, and larger household size contribute positively to a healthier overall food intake for the household. However, the rapid growth in the Chinese economy has been accompanied by noticeable changes in the drinking behavior of the Chinese population.

Furthermore, alcohol is now commonly consumed to relieve stress, facilitate social interaction and foster good relations between supervisors and employees, since these often eat out together after work or hold business meetings over dinner. That makes consume alcohol food

away from home may cause worse for nutrition intake than drink at home. but not only for our health issue, but also it is turning to a public issue, such as transportation security, import market and policy issue. Hence, the guideline of Chinese primary prevention of cerebrovascular disease in 2015 recommended that male may drink less than 50ml of spirit, 640ml of beer and 150ml of wine per day, and female is half of male, that may decrease occurrence of disease. Alcohol has been a part of human culture since the beginning of recorded history, and there are many studies showing that alcohol use is associated with cardiovascular disease. However, in China, recent data about the status of alcohol consumption are lacking, and studies analyzing the relationship between drinking and eating healthy among rural population are few. From our conclusion, this study want to show the relationship between drinking and eating healthy issue, so not only for other researchers or households can be alerted by this and treat it as a reference for further research or a guideline, but also for policy changes that could help contain the rapid increase in alcohol-related harm currently observed in the country.

5. CONCLUSIONS

Overall, the results suggest that having a child has a positive effect on healthy household food consumption of eggs, vegetables, fruits, and dairy. There are also significant regional effects in healthy food consumption. Higher household income has mixed effects on healthy eating as it tends to increase the healthy intake of dairy, but lower the healthy intake of meat. The wife's education level and age tend to increase healthy eating with higher education being associated with healthier intake of seafood, dairy, and overall while higher age being associated with healthier intake of meat and dairy. Increasing household size has a positive healthy effect on consumption of all foods. Obesity, resulting from poor nutrition and overconsumption, can contribute to health issues. According to statistics, obese patients with cerebral embolism and heart failure are higher than the normal weight, and affect the labor force, vulnerable to traumatic body fat are often afraid of heat, sweating, fatigue, lower extremity edema, varicose veins, skin folds at dermatitis and so on. Furthermore, alcohol is now commonly consumed to relieve stress, facilitate social interaction and foster good relations between supervisors and employees, since these often eat out together after work or hold business meetings over dinner. That makes consume alcohol food away from home may cause worse for nutrition intake than drink at home. but not only for our health issue, but also it is turning to a public issue, such as transportation security, import market and policy issue.

From a policy perspective, it is difficult to reduce overconsumption of food or unhealthy eating habits. However, policies to reduce food waste may reduce overconsumption by advertising penalties for waste resulting in reduced consumption, particularly away from home. From our conclusion, this study want to show the relationship between drinking and eating healthy issue, so not only for other researchers or households can be alerted by this and treat it as

a reference for further research or a guideline, but also for policy changes that could help contain the rapid increase in alcohol-related harm currently observed in the country.

Future research of this topic may include household health insurance, a more detailed assessment of nutrition intake, and the implications for world food markets.

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