SOCIAL SCIENCES & HUMANITIES

Factors Affecting Adult Overweight and Obesity in Urban China

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ABSTRACT

This paper aims to examine the factors determining adult overweight or obesity in rapidly developing urban China. Quantitative analysis was performed using individual questionnaire data from the Survey for the Purpose of an Estimation of Preference Parameters conducted by Osaka University in six urban cities, Beijing, Shanghai, Guangzhou, Chengdu, Wuhan, and Shenyang. The estimation results of relative-risk ratios by the multinomial logistic regression model showed that 1) women and those whose subjective satisfaction with health were poor tended to be lean; 2) men, middle-aged or elderly people, those eating meals at irregular times, and those with a lower relative standard of living compared to others living around them tended to be overweight; and 3) men, middle-aged or elderly people, those with a strong sense of stress and depression, those with a lower level of subjective satisfaction with daily life, and those with lower or higher annual household incomes tended to be obese. However, the frequency of physical exercise and education level, which were pointed out by previous studies to be determinant factors of overweight and obesity, are not significant. It is recommended that various preventive measures targeting high-risk groups be introduced and promoted.

Keywords: Body mass index, China, lifestyle diseases, non-communicable diseases, obesity, overweight

INTRODUCTION

In China, which has the world's second-largest economy, consumers' living standards have greatly improved with rapid economic growth led by the manufacturing and service sectors in recent years. As a result, dietary habits have been dramatically westernized (Hsiao, 2013) from traditional carbohydrate-centric diets to high-fat and high-calorie diets (Du et al., 2004; Su et

al., 2015). In addition, it is widely reported that less energy-consuming lifestyles, such as those involving increased sedentary time and usage of electronic devices such as smartphones, tablets, personal computers, and videogames, have been pervasive particularly in rapidly developing urban areas (Dong et al., 2017). Due to these changes in dietary and lifestyle habits, the proportion of overweight and obese people is increasing for both men and women (Su et al., 2015). As a result, the prevalence rate of noncommunicable or lifestyle diseases such as cardiovascular diseases, diabetes, and hypertension is higher in the order of China > Korea > Japan in East Asia (Ma et al., 2017). At the moment, addressing the increasing number of diseases and preventing adult overweight and obesity have become an urgent policy issue in China.

For this reason, a wide range of research on overweight, obesity, and noncommunicable/lifestyle diseases has been done actively in China in recent years. Previous Chinese studies can be broadly divided into 1) studies on factors resulting in overweight and obesity; 2) studies on factors resulting in noncommunicable/ lifestyle diseases; and 3) studies on factors affecting dietary behavior that have been highly associated with overweight, obesity, and non-communicable/lifestyle diseases.

The first study mentioned above, which is most closely related to our study, points out that the factors associated with overweight and obesity include excess calorie intake or carbohydrate, lipid, and protein intake along with the westernization of diets (Hu et al., 2002; Ma et al., 2017; Su et al., 2017); rising age (Hu et al., 2002; Su et al., 2017; Zhou et al., 2017); marital status (Hu et al., 2002; Zhou et al., 2017); education level (Hu et al., 2002; Su et al., 2017); income and economic levels (Hu et al., 2002; Su et al., 2015, 2017); less frequent physical exercise (Dong et al., 2017; Hu et al., 2002; Su et al., 2015, 2017; Zhou et al., 2017); long television viewing time (Dong et al., 2017); lack of sleep (Gong et al., 2017; Su et al., 2017); more frequent eating out (Dong et al., 2017); less frequent eating of vegetables and fruits (Dong et al., 2017); more frequent eating of snacks and nocturnal meals (Watanabe & Yu, 2016), smoking (Hu et al., 2002; Su et al., 2017), and drinking alcohol (Hu et al., 2002; Su et al., 2017); misunderstandings of parents and grandparents about the appropriate weight of children and grandchildren (Jiang et al., 2007; Shi et al., 2007); and place of residence (Su et al., 2017).

However, while Hu et al. (2002) pointed out that the higher the education level, the higher the obesity level for both men and women, Su et al. (2017) reported the negative correlation between education and obesity level for women. Moreover, various contradicting results of the relationship between income levels or economic status and overweight/obesity prevalence have been reported. For instance, although Hu et al. (2002) found, irrespective of gender, a person in the higher-income group was more likely to be overweight/obese, Su et al. (2017) found the significant correlation

between income levels and overweight/obesity only for men, and Zhou et al. (2017) insisted a person in the lower-income group was more likely to be overweight/obese. In addition, although review articles conclude that depression and chronic social stress are likely to increase the risk of developing obesity in the USA (Luppino et al., 2010; Scott et al., 2012), whether depression and stress lead to being overweight or obese has not been well studied in China. In a situation where tackling overweight and obesity along with rapid economic growth has recently become one of the urgent social issues in the country, it is necessary to compile research findings on factors determining overweight and obesity not only to better understand the background of the widely pervasive overweight and obesity from the viewpoint of public health study but also to map out preventive measures in China as well as other Asian countries showing rapid economic growth.

Therefore, this study aims to examine the factors affecting adult overweight and obesity in urban China using individual data from the Survey for the Purpose of an Estimation of Preference Parameters (SPEPP).

MATERIALS AND METHODS

We used individual questionnaire data from the SPEPP conducted by Osaka University in urban areas of China. In the SPEPP, adult men and women between the ages of 20 and 69 (in the year of 2009) who lived in Beijing, Shanghai, Guangzhou, Chengdu, Wuhan, and Shenyang, the country's six major cities,

were surveyed annually from 2009 to 2013 by home-visit questionnaire survey. The survey was conducted on 1,380 people (6 cities × 5 age groups × men and women × 23 persons) who were randomly selected within each district after the number of samples to be collected was determined according to the population composition of each randomly selected district. This study used only the year 2013 data, which provided information on dietary and lifestyle habits. Data from 818 respondents who answered all the questions we needed were used for the analysis.

In the SPEPP, only height and weight were asked about the extent of overweight/obesity. Therefore, the extent of overweight/obesity is measured based on Body Mass Index (BMI), which can be calculated by body weight in kilograms divided by height in meters squared. In most countries, based on World Health Organization (WHO) criteria, it is common to classify those with BMI of less than 18.5 as being lean or underweight, those with BMI of 18.5 or more and less than 25 as being normal, those with BMI of 25 or more and less than 30 as being overweight, and those with BMI of 30 or more as being obese. However, WHO Expert Consultation (2004) recommends that the cut-off points for Asian people be set at approximately 2 to 2.5 below the standard cut-off points since the above standard cut-off points are based on European people. Thus, for convenience in this study, those with BMI less than 18.5 were classified as being underweight or lean, those with BMI of 18.5 or more and less than 23.5

were classified as being normal, those with BMI of 23.5 or more and less than 27 were classified as being overweight, and those with BMI of 27 or more were classified as being obese. Subsequently, a multinomial logit model was applied to determine factors affecting adult overweight and obesity in China. The dependent variable is the four categories of body weight (being underweight [BMI < 18.5], normal [$18.5 \leq$ BMI < 23.5], overweight [$23.5 \leq$ BMI < 27], and obese [BMI $\geq$ 27]), using the normal body weight as a reference category.

Considering the findings of previous studies and the limitations of questions in the survey, we used the following explanatory variables: dummy for gender (male = 1, female = 0), dummy for age group (20s [reference], 30s, 40s, 50s, and 60s or over), dummy for education level (junior high school [reference], high school, and college/university), eating meals at regular times (always = 5, very often = 4, sometimes = 3, rarely = 2, never = 1), sleep time (hours), frequency of physical exercise (every day = 5, 2–4 times a week = 4, once a week = 3, once a month = 2, rarely = 1), stress and depression intensity (details mentioned later), subjective satisfaction with health (very good = 5, good = 4, so-so = 3, poor = 2, very poor = 1), subjective satisfaction with daily life (details mentioned later), relative living standards compared to those living around the respondent (much higher than yourself = 5, higher than yourself = 4, roughly as much as yourself = 3, lower than yourself = 2, significantly lower than yourself = 1), and dummy for annual

household income (less than 50,000 yuan, 50,000 yuan or more but less than 75,000 yuan, 75,000 yuan or more but less than 100,000 yuan [reference], 100,000 yuan or more but less than 125,000 yuan, and more than 125,000 yuan). As for stress and depression intensity, we used the sum of the answers for the following four questions: 1) Do you feel stress recently?, 2) Do you feel depression recently?, 3) Do you have difficulty in sleeping recently?, and 4) Do you feel lonely recently?" (always = 5, very often = 4, sometimes = 3, rarely = 2, never = 1). Subjective satisfaction with daily life is calculated by summing the answers for the extent of satisfaction with daily life in general, region in which the respondent lives, leisure time, current economic wellbeing, and relationships with friends (all of which are satisfactory = 5 to unsatisfactory = 1 on a Likert scale). The weighted values of Cronbach's alpha are 0.846 for stress and depression and 0.781 for subjective satisfaction with daily life, suggesting internal consistency.

We used sample weight provided by Osaka University to estimate finite population regression coefficients.

RESULTS AND DISCUSSION

Before going into the estimation results in detail, we took a look at the proportions (weight-adjusted) of being lean, normal, overweight, and obese. The proportions were 5.6 percent for underweight, 60.0 percent for normal weight, 25.6 percent for overweight, and 8.8 percent for obesity,

indicating that approximately one in every three Chinese adults living in surveyed urban areas was estimated to be overweight or obese. The mean BMI was 23.2 (weight-adjusted), which is just below the cut-off point between normal and overweight.

Next, we look at the results of the estimation results by multinomial logistic regression. Table 1 shows the estimated values of the coefficient and relative-risk ratio (RR). In a case when the RR or coefficient is not significant, the explanatory variable does not have a significant relation with being lean, overweight, or obese. On the other hand, in a case when it is significantly larger (smaller) than 1, the explanatory variable increases (suppresses) being lean, overweight, or obese. As for the estimation results for underweight, RRs were significant for the dummy for gender and subjective satisfaction with health. The RR of the dummy for gender was significantly less than 1 (RR = 0.235), indicating that men were 76.5 percent less likely than women to be underweight; in other words, women are more likely to be thinner than men. Similarly, in Japan, which is an advanced country in East Asia, it is pointed out that women are more likely to prefer being slim than men and are actually thinner (Ministry of Health, Labour and Welfare, 2018). Even in the rapidly growing urban areas of China, women's tendency to be thin is prominent (Lee & Lee, 2000), and attention should be paid to the impact of women's underweight on health. Similar to the dummy for gender, RR for subjective satisfaction with health is significantly less

than 1 (RR = 0.641), indicating that those with poor subjective health condition tend to be underweight. However, it should be noted here that the actual causal relationship between underweight and health condition is not clear and should be examined using longitudinal data for further analysis.

Estimation results for overweight persons showed that RRs of dummies for gender and age group, eating meals at regular times, and relative living standards are significant. The RR for the dummy for gender was significantly greater than 1 (RR = 2.429), indicating that men were somewhat more likely than women to be overweight. RRs of the age dummy by age group were 2.140 in the 30s group, 3.796 in the 40s group, 4.280 in the 50s group, and 6.546 in the 60s group. Estimates of higher RR values with increasing age indicate a higher probability of being overweight in older age groups than in younger age groups, which is consistent with findings from previous studies (Hu et al., 2002; Su et al., 2017; Zhou et al., 2017). It is also consistent with the Japanese survey results of the National Health and Nutrition Survey in 2016 conducted by the Ministry of Health, Labor and Welfare, in which, except for men in their 60s, the obesity rate is higher in the older age group among men and women in their 20s to 60s. While the basal metabolic rate decreases with the decrease in muscle mass (Shimokata & Kuzuya, 1993), the proportion of overweight or obese people increases with age because of the decrease in the minimum required energy consumption and inadequate physical exercise. While

Table 1
Estimation results by multi-logistic model

	Lean (BMI < 18.5)			Overweight (23.5 ≤ BMI < 27)			Obese (27 ≤ BMI)			Mean	s.d.
	Coefficient	RR	z-value	Coefficient	RR	z-value	Coefficient	RR	z-value		
Dummy for gender (Male = 1, Female = 0)	−1.449	0.235	−3.217	0.888	2.429	4.544	0.583	1.791	2.026	0.495	
Dummy for the age group (in their 20s [reference])											
30s	−0.595	0.552	−1.124	0.761	2.140	2.116	0.228	1.255	0.422	0.246	
40s	−0.933	0.394	−1.611	1.334	3.796	3.662	1.031	2.803	1.814	0.240	
50s	−1.975	0.139	−2.484	1.454	4.280	3.612	1.296	3.656	2.183	0.188	
60s	−1.012	0.364	−1.318	1.879	6.546	4.671	1.679	5.363	2.751	0.107	
Dummy for education level (Junior high school [reference])											
High school	−0.243	0.785	−0.547	0.093	1.097	0.391	−0.165	0.848	−0.488	0.355	
College or higher	−0.426	0.653	−0.905	0.153	1.165	0.546	0.095	1.100	0.207	0.321	
Eating meals at regular times (5-Likart scale)	−0.209	0.812	−0.995	−0.386	0.680	−2.908	0.169	1.184	0.907	3.501	0.027
Length of sleep time (hours)	0.029	1.029	0.099	−0.075	0.928	−0.756	0.101	1.106	0.631	8.671	0.032
Frequency of physical exercise (1-5 scales)	0.011	1.011	0.100	0.004	1.004	0.064	−0.141	0.869	−1.383	2.908	0.053
Stress and depression intensity (4 to 20 points)	0.039	1.040	0.810	0.018	1.019	0.568	0.105	1.111	2.208	11.486	0.116
Subjective satisfaction with health (5-Likart scale)	−0.444	0.641	−2.266	−0.024	0.976	−0.199	−0.171	0.843	−1.060	4.090	0.031
Subjective satisfaction with daily life (5 to 25 points)	0.037	1.037	0.441	0.024	1.024	0.639	−0.178	0.837	−3.005	18.439	0.096
Relative living standards (5-Likart scale)	0.172	1.188	0.822	0.349	1.417	2.700	−0.079	0.924	−0.356	2.952	0.024
Dummy for annual household income (75,000 yuan to less than 100,000 yuan [reference])											
Less than 50,000 yuan	0.597	1.816	0.598	0.146	1.157	0.420	1.743	5.715	3.309	0.093	
50,000 yuan or more but less than 75,000 yuan	1.098	3.000	1.560	0.444	1.558	1.605	0.351	1.420	0.716	0.287	
100,000 yuan or more but less than 125,000 yuan	1.640	5.157	2.250	−0.299	0.742	−0.851	0.986	2.680	1.987	0.204	
125,000 yuan or more	1.308	3.700	1.681	0.431	1.539	1.444	0.980	2.663	2.013	0.234	
Constant	−1.596	0.203	−0.456	−2.295	0.101	−1.567	−2.090	0.124	−0.899		

Note: Authors' estimation. Based on WHO Expert Consultation (2004), we used the following four categories for body weight and BMI: Underweight (BMI < 18.5), normal (BMI < 23.5), overweight (23.5 ≤ BMI < 27), and obese (BMI ≥ 27); normal body weight was used as the reference category. It is widely accepted, however, to use a slightly different BMI for these same bodyweight categories: Lean (BMI < 18.5), normal (18.5 ≤ BMI < 25.0), overweight (25.0 ≤ BMI < 30), and obese (BMI ≥ 30).

the value of RR rises by 1.140 (= 2.140 – 1.000) between the 20s and 30s groups, it rises by 1.656 (= 3.796 – 2.140) between the 30s and 40s groups, by 0.484 (= 4.280 – 3.796) between the 40s and 50s groups, and by 2.266 (6.546 – 4.280) between the 50s and 60s groups. Except for the 40s group, the proportion of being overweight increases more rapidly with rising age. Therefore, we should pay attention to the possibility that the proportion of people who are overweight will increase with age. Previous studies (Hu et al., 2002; Ma et al., 2017; Su et al., 2017) had shown that obese Chinese adults were more likely to consume calories and carbohydrates, lipids, and proteins. Considering the evidence that the increase in high-lipid and high-calorie diets is responsible for the increase in lifestyle diseases in China (Du et al., 2004), it is important for the government to further promote awareness-raising programs and activities targeting middle-aged and elderly people to disseminate information on healthy diets and nutritional balance commensurate with their age to prevent noncommunicable or lifestyle diseases.

Because the RR of eating meals at regular times is significantly less than 1 (RR = 0.680), the more irregular the dietary time is, the more likely the individual is to be overweight. In view of the fact that breakfast skipping and disturbed dietary habits in a broader sense induce noncommunicable/lifestyle diseases (Luo et al., 2016; Yang et al., 2015), the importance of regular eating habits, along with the abovementioned proper energy intake and nutritional balances, should be recognized anew.

The RR of the relative living standards is significantly higher than 1 (RR = 1.417), showing that those who feel their living standards are lower than those of other households living around them tend to be overweight. However, the dummies for annual household income and subjective satisfaction with daily life were not significant. In the rapidly growing Chinese economy, it has been pointed out that there is a tendency for consumers in urban areas to take on conspicuous consumption behavior by the Veblen effect. Those who feel that their standard of living is relatively low may tend to consume high-lipid, high-calorie meat, which is a relatively expensive ingredient with high-income elasticity, as a result of their conspicuous consumption behavior in accordance with the standard of people living around them. In this respect, a more detailed analysis using other data is needed.

In the estimation result of obese persons, the RRs of gender dummy; age dummy in the 50s and 60s groups; stress and depression intensity; subjective satisfaction with daily life; and the dummy for annual household income less than 50,000 yuan, 100,000 yuan or more, and 125,000 yuan or more were significant. The RR of the dummy for gender is greater than 1 (RR = 1.791), and male adults are more likely than female adults to be obese. Similar to the estimation results of overweight persons, the

RR of the age dummy is larger than 1 and is larger as the age group rises. The RRs of the 50s and 60s groups greatly exceeded 1 at 3.656 and 5.363, suggesting the probability that obesity was increased in the 50s and over age group.

The RR of stress and depression intensity was significantly higher than 1 (RR = 1.111) whereas the RR of subjective satisfaction with daily life was significantly lower than 1 (RR = 0.835). This suggests that stress, depression, and dissatisfaction with life may contribute to obesity. Although previous studies in China have not indicated an association between stress, depression, or dissatisfaction with daily life and obesity, stress and depression had been reported to promote obesity through disruption of dietary habits in the USA (Luppino et al., 2010; Scott et al., 2012). To control adult obesity, therefore, it is necessary to strengthen educational activities aimed at improving coping skills for stress/depression and improving the level of satisfaction with life.

As for annual household income, the RR for less than 50,000 yuan is significantly higher than 1 (RR = 5.715), and people in low-income households are more likely to be obese. Furthermore, the RRs for 100,000 yuan to 125,000 yuan (RR = 2.680) and RMB 125,000 or more (RR = 2.663) are significantly higher than 1, suggesting high-income households are also more likely to be obese. Studies using longitudinal data in China have shown that the higher the middle group, the more likely it is to be overweight or obese due to rising incomes (Su et al.,

2015). In a cross-sectional study in China, it was pointed out that, in urban areas, the higher the income group, the more likely eating behavior was unfavorable (Wang et al., 2017), and the more likely it is to be overweight or obese (Hu et al., 2002). On the other hand, Zhou et al. (2017) pointed out that the lower the income group, the more it was overweight and obese. In our study, both low- and high-income groups were more likely to be obese compared with a mid-income group, probably due to unfavorable eating behavior.

It has been pointed out that educational background is associated with eating behavior, overweight, and obesity, such as obesity tendency among persons with higher education (Hu et al., 2002) and disruption of eating behavior among persons with lower education (Chen et al., 2014). However, in this study, education levels were not associated with being lean, overweight, or obese. The association between the length of sleep time (Gong et al., 2017; Su et al., 2015) and lack of exercise (Dong et al., 2017; Hu et al., 2002; Su et al., 2015, 2017; Zhou et al., 2017) and overweight/obesity has also been noted, but this study did not find any significant association. With respect to the frequency of physical exercise, a more overweight or obese person may be exercising to reduce weight, and our cross-sectional analyses may not have adequately ascertained the impact of frequency of physical exercise on overweight and obesity. In the SPEPP, there were no questions about sedentary time or the duration of playing videogames. Therefore, the association

between more detailed lifestyle factors and obesity may need to be considered given the fact that increased sedentary, TV-viewing, or videogame-playing times increase obesity and the risks of future cardiometabolic diseases (Dong et al., 2017; Ye, 2018). A more detailed analysis using longitudinal data remains an issue for further study.

CONCLUSION

This study aimed to examine the factors determining adult overweight or obesity in urban China. The multinomial logistic regression analysis was performed using individual questionnaire data from the SPEPP conducted by Osaka University in six urban cities: Beijing, Shanghai, Guangzhou, Chengdu, Wuhan, and Shenyang. Estimation results from the multinomial logistic model show that 1) women and those who are not in good health tend to be lean; 2) men, middle-aged people, those eating meals irregularly, and those with a lower relative standard of living tend to be overweight; and 3) men, middle-aged people, those with a strong sense of stress and depression, those with a lower level of satisfaction with life, and those with lower or higher annual household incomes tend to be obese.

The results of this analysis suggest a need to further strengthen awareness-raising activities aimed at preventing overweight and obesity in men and middle-aged and elderly people. To do so, it is necessary to strengthen the provision of information on food and health particularly for men and middle-aged people on websites or social network services where information

is frequently collected and, at the same time, to activate food education activities for middle-aged people in the workplace and for elderly people in the community. Furthermore, to not only promote regular dietary habits but also improve living satisfaction and strengthen resistance to stress, it is necessary to provide opportunities to learn about improving coping skills from early on through public relations activities by the government and various educational activities at workplaces and communities as well as through educational opportunities in schools.

ACKNOWLEDGMENTS

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