# RESEARCH ARTICLE

## CROSS-SECTIONAL ANALYSIS OF FOOD CONSUMPTION AND DIETARY HABITS OF CHINESE RESIDING IN URBAN CITIES

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| ARTICLE INFO | ABSTRACT |
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| | **Background:** Dietary habits and food consumption of Chinese are influenced by urbanization, sociodemographic factors, religious dietary restrictions, and belief in the medicinal values of food. Since the 1980s, China has experienced the largest rural-to-urban migration in its history. Urban lifestyle and dietary habits may be contributing to increasing the risk factors for noninfectious diseases. **Objective:** This study was designed to examine the differences in dietary habits, food consumption patterns, and related health practices of Chinese adults residing in four urban cities to identify certain dietary behaviors that could potentially be linked to the risk of diet-related diseases. **Methods:** A 23-question self-administered questionnaire was employed to collect data on sociodemographic indicators, eight dietary habits, food consumption patterns, and related health behaviors from 662 adult male and female respondents. A t-test was conducted to analyze the parametric variables and Chi-square analyses were performed for the nonparametric variables. **Results:** Among the residents of the four cities, Jinan had a significantly higher daily frequency of breakfast consumption; Zhengzhou and Jinan had a higher daily frequency of baking food than frying it; Kaifeng had a higher daily frequency of water intake vs. all other beverages; Xi'an had a higher daily frequency of fresh fruit shopping; both Kaifeng and Jinan had a significantly higher frequency of consuming three or more full meals each day; by a narrow margin, all four cities reported consuming their last meal of the day between 17:00-24 PM; married couples had a significantly higher daily frequency of breakfast consumption than singles, while singles had a significantly higher level of college education than married couples. The results draw attention to the effect of sociodemographic indicators on food consumption patterns and dietary habits. **Conclusions:** A myriad of common health problems in China are linked to poor dietary habits and food preparation choices. Further research-based evidence examining the role of dietary habits and food consumption in preventing diet-related diseases is vital. Meanwhile, there is a need to develop short-term and long-term strategies aimed at further improving the dietary health practices and food consumption patterns of Chinese residing in urban areas. |

## INTRODUCTION

Dietary habits and food consumption are deeply influenced by socioeconomic factors, culture, urbanization, food therapeutic effects, and religious dietary guidelines. For various reasons, even in one country or culture, people usually prepare and consume a variety of food ingredients for different purposes or beliefs. Kittler, Sucher, and Elms (2012) described food habits or food culture as the traditional ways by which people consume food, including how their food is cultivated; purchased; warehoused; prepared, and the manner in which food is served and to whom is presented. Kittler *et al.* (2012)

further explained that the significance of this process is unique to humankind, as food functions vary according to each culture in classifying food to reflect its priorities and identity. Food habits may also be employed as an important, or even a determining cultural criterion in a group of people who share the same food denoting their eating patterns, cooking styles, and behaviors toward food. However, even within the same culture, dietary behaviors do not necessarily have to be homogenous. In reality, as a general rule, they are not the same by reason of sociocultural phenomena such as diversity in food resources, religious beliefs, demographics, and socioeconomic strata (Chang, 1977). When people within the same culture resort to eating the same food, they do that by necessity for the purpose of survival where food can be measured only by its caloric value. However, people with different cultural or

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socioeconomic backgrounds usually have different diets and broadly consume food differently with a variety of choices. Likewise, people with different religious beliefs have different dietary rules that dictate what is permissible to consume and what is not (Valera, 2008). Furthermore, dietary habits can be shaped by social phenomena, including urbanization, sociodemographic factors, rural-urban migration, and group affiliation. In both ancient and modern cultures, food has been consumed not only for its health and nutritional values but also as a means for people to establish and express relationships between one another. Because of the seminal societal role of food in a community, this relationship can exist among various community members, individuals, religious groups, and ethnic groups (Ma, 2015). Evidently, this suggests that food can be directly connected with groups' identity, morbidity, mortality; and dietary intake can be a significant risk factor for diet-related chronic diseases such as diabetes, heart disease, certain forms of cancer, and obesity. Understanding the rapid transition in food consumption and dietary habits is a vital tool for providing answers to the cause-effect relationship between diet and these preventable conditions.

Since the 1980s, in China, as well as a myriad of other developing countries, urbanization has become a major sociodemographic phenomenon of growing migration of rural populations to urban cities. Based on 2010 data gleaned from the National Bureau of Statistics of China (NBSC), Gong *et al.* (2012) reported that during the past three decades, China has witnessed the largest human migration in history. This influx of migrants was the leading catalyst to an upsurge in urban population from 191 million in 1980 to 622 million in 2009. This rapid increase was driven chiefly by rural-to-urban migration. As a result, with higher wages; urban dietary habits; and different food consumption patterns, urbanization, and public health issues in China are becoming increasingly relevant and imperative issues to investigate. Globally, the rates of urbanization have been steadily increasing as well. In 1970, 36.6% of the world population was living in urban areas. In 1994, the rate increased to 44.8%. These rates are estimated to increase up to 61.1% by 2025 (Yusuf *et al.,* 2001). More recent data reported by the World Health Organization (2016) on the health of city-dwellers in nearly 100 countries showed that the urban populations continue to grow at alarming rates. Currently, about 3.7 billion people live in urban cities. An additional 1 billion people are expected to be added by 2030, with 90% of the growth being in low-and-middle-income countries. On the lasting effects of migration, Ma and Lain (2011) observed that the migration of rural labor force to urban areas is both an inevitable and irreversible trend within the natural process of economic growth and human social development. In more recent years, with the acceleration of the process of urbanization, with increasingly rapid rates, the surplus agrarian labor force has been gradually redirected to seek jobs in nonagricultural sectors in urban settings. Rural migrant workers have become a significant new labor force emerging along with the urbanization through the centralization of populations, and it is the major source of urbanization growth in China (Zhang and Song, 2003). This major demographic transition into urbanization in China stimulated an unprecedented transition in an urban food culture marked by an exposure to newly created environmental influences, including stressful urban lifestyle, newly adopted food consumption and dietary patterns. With additional

disposable financial means at hand, Chinses changed their millennial-honored traditional diet with an increased consumption of a diet high in sugar, saturated fat, processed carbohydrates, and fast food; coupled with a lower intake of whole grains and dietary fiber. The newly adopted nutritional transition in china ushered a myriad of modern lifestyle disease patterns, particularly non-communicable diseases (NCD) such as particular forms of cancer; obesity; Type2 diabetes; and cardiovascular diseases (Popkin, 1993). There is a growing body of evidence corroborating the effects of wide-ranging rural-to-city migration and urbanization on the changes of traditional dietary habits together with the emergence of diseases related to the adoption of new dietary behaviors. Popkin, Adair, and Ng (2012) identified urbanization as a major driving force in a global pandemic of emerging nutrition transition-related diseases, especially in low and middle-income developing countries. Moran (2001) described this shift in diet-connected diseases as "the epidemiologic transition", which implies a change in disease patterns from the 19th century epidemic of infectious diseases caused by the invasion of microorganisms into a modern lifestyle epidemic of "man-made diseases". Studies conducted on recent migrants from rural areas to urban settings compared with long-time urban inhabitants in China showed an overall decrease in energy-dense food intake, coupled with an increase in the amount of energy intake obtained from food sources high in saturated fat, deep fried food, sweetened food products, and cholesterol. According to Hawkes (2006), in China, within a 10-year period (1994-2004), cooking oil production increased by nearly 50%, which was mainly driven by low prices and rising in average household income. This transition from a traditional rural diet to more urban-style diet may contribute to higher risks of diet-associated chronic diseases (He *et al.,* 1996; He *et al.,* 1991). Research by Gong *et al.* (2012) showed that the unintended consequences of the largest human migration in the Chinese history resulted in a precipitous sprawling urbanization in a few decades, which generated considerable negative health effects for the public health system. Gong *et al.* (2012) further explained that as a result of this large-scale urbanization, there is a growing disease burden placed upon urban cities attributable to diet and lifestyle choices. As a consequence, this major public health challenge created disparities in the healthcare access, vaccination coverage, higher rates of accidents and injuries in China's rural-to-urban migrant population. Du and Keys (2015) argued that dietary habits play a critical role in the development of many noninfectious chronic diseases such as certain types of cancer, cardiovascular disease, obesity, Type2 diabetes, and stroke. Du and Keys (2015) further asserted that there is not much known about the effects of dietary habits on these growing lifestyle-related conditions in China, where the dietary patterns differ greatly from the Western populations. Guan (2015) postulated that there is a high prevalence of diseases among the ethnic minority groups in rural China due to several factors among them indigenous customs, culture, food consumption, and genetic backgrounds. Moreover, Guan (2015) further suggested that the socio-economic status of the rural ethnic groups is a major contributing factor to the health disparity between the Chinese minority ethnic groups and the majority Chinese Hans. Research by Popkin *et al.* (1993) demonstrated that China faced numerous challenges of under-nutrition that had existed for decades. However, China was able to manage nation-wide problems of food insufficiency

and has undergone a successful transition in the structure of its food adequacy, as well as improving the quality of diet in the last few decades. In a separate, but related research, based on the 1991 China Health and Nutrition Survey (CHNS), Popkin (2014) pointed out that due to a number of drastic dietary changes, adoption of a nontraditional lifestyle, coupled with modernization across the socioeconomic strata in China, the prevalence of obesity and other non-communicable diseases have increased as a major public health burden that has principally affected the low-income Chinese. Fu, Wang, and Wang (2005) reported differences in food consumption and nutrient intake were also found in groups divided according to their gender, residence, and household income. Fu *et al.* (2005) further explained that the staple food was identified as cereals, which provided 53.4-70.1% of the total energy intake in the diet of the study participants.

The second and third nutrients were fat and protein with 19.2-34.3% and 10.4-12.0%, respectively. Fat and protein constituted a greater proportion of energy intake than carbohydrate did in the diet of the study participants, who earned a higher income and lived in both developed and urban areas. In a similar study on the effects of adopting a non-traditional diet by Chinese employing the Diet Quality Index (DQI) showed that the quality of diet is sensitive to under-nutrition, over-nutrition factors, as well as sociodemographic variables. The China DQI may predict the connection between modern dietary changes and development of new diet-related non-communicable diseases (NCD) in China (Stoke *et al.,* 2000). Research by Mendez and Popkin (2005); Popkin (2006) provided evidence of the connection between the structural changes in dietary intakes and the increased incidents of degenerative diseases associated with more contemporaneous dietary transition introduced to the traditional food consumption habits of the Chinese. Mendez *et al.* (2005); Popkin (2006) further suggested that nutrition transitions such as the prevalence of fast food eateries, sugary soft drinks, and low-priced cooking oils were major contributors to a set of uncommon chronic conditions. That was on top of significant decreases in processed carbohydrate food prices, increased access to supermarkets, and sprawling urbanization. These dietary changes were among some of the key underlying effects of global food energy imbalances and the sharp rise in obesity and diabetes rates that led to major global public health problems. That was especially evident in low-income and moderate-income countries such as China.

The previous findings were supported by a more recent study by Cheng *et al.* (2016) who examined the overall diet quality in Chinese school-aged children living in urban areas by employing the 16-component Chinese Children Dietary Index (CCDI). The results of this study showed that the CCDI scores of girls were higher than those of boys, and CCDI scores were lower with older children. Cheng *et al.* (2016) further found that Children with higher CCDI scores had lower Body Mass Index (BMI) and spent less time being physically inactive. Moreover, Cheng *et al.* (2016) indicated that there were age and gender differences in the consumption of food quality and that the overall diet quality among Chinese school-aged children who were residing in an urban environment needs to be greatly improved, especially in adolescents. Urbanization-related transitions in dietary habits and regular physical activity have been associated with an increase in cancer rates in China. Differences in cancer mortality rates between rural and urban areas have long been documented (Gong *et al.,* 2012). Several studies examined the prevalence of certain forms of cancer associated with dietary habits and food consumption among Shanghai residents. A study by Ji *et al.* (1998) reported increased risks of newly diagnosed stomach cancer patients (age 20-69). These risks were found to be associated with frequent intake of white-flour noodles and white bread in both men and women. A separate but related study on forms of cancer linked to diet by Ji *et al.* (1995) similarly reported increased risks of pancreatic cancer among permanent residents of Shanghai (age 30-74). These increased risks were linked to frequently consuming preserved vegetables, deep-fried foods, as well as foods that were grilled, cured, or smoked. Conversely, Ji *et al.* (1995) maintained that risks of pancreatic cancer were inversely associated with consumption of fresh vegetable and fruit among both men and women.

In Zhejiang, a coastal Chinese Province, Zhang *et al.,* (2002) examined the etiological association of dietary factors with the incident of ovarian cancer. Findings from this study showed that increased risk of ovarian cancer was found in women who habitually consumed a high intake of animal fat, cooking oil, and salted vegetables. Research conducted in Hunan and Zhejiang Provinces demonstrated that habitually consuming spicy food and animal fat were the driving causes for developing quantitative adult adiposity. Additionally, results of this research revealed that daily intake of spicy food of 30.4% in men and 30.0% in women were found to be associated with an increased risk of adult obesity in both men and women, especially an increased risk factor of developing central obesity in men (Sun *et al.,* 2014).

## MATERIALS AND METHODS

### *Survey Development and Procedures*

Our cross-sectional study was conducted in China between May 2015 and August 2015. Respondents were 662 Chinese adults aged 18 years and older, including men (N = 356) and women (N = 306). They responded to an adapted version of a paper-and-pencil self-administered food frequency, dietary history, and food consumption cross-sectional population survey. The questions included food and beverages consumption preferences, healthy food shopping patterns, healthy cooking methods, healthy food preparation techniques (baking food vs. frying it); the number of full meals consumed each day; the time of the last meal consumed each day; and related health practices. The study employed a modified version of the National Cancer Institute Food Frequency Questionnaire (FFQ) and the Diet History Questionnaire (DHQ) (National Cancer Institute (NCI), 2007; Thompson *et al.,* 2000). The questionnaire encompassed 23 questions to collect relevant data from the respondents concerning their sociodemographic information, including level of education; marital status; employment status; family size based on the number of adults over 18 years of age and children under 18 years of age living in the same household; ethnic group affiliation; and gender identification. Respondents were volunteers randomly selected from four urban cities (Zhengzhou, Kaifeng, Xi'an, and Jinan) located in the Central Plains, Northwestern, and Midwestern of China (Figure 1).

Source: Retrieved From China Map, https://www.travelchinaguide.com/map/

**Figure 1. Map of Study Cities Located in Three Chinse Provinces**

### Data Statistical Analysis

The Statistical Analysis Software (SAS) Package, Version 9.3 was employed to analyze the collected data. T-tests were performed for nominal (classification) variables vs. ordinal variables where the nominal variable had exactly two levels (e.g., gender). Chi-square (mostly 2 by 2) analyses were utilized if both variables were nominal. Certain nominal data items with multiple levels were re-coded into one of two levels prior to performing a 2 by 2 Chi-square test ($\chi2$). Most of the analyses involved calculating p-values and classifying any value of a test statistic with a p-value of less than an alpha level of 0.05 as statistically significant. In this study, the tests were two-tailed.

## RESULTS

### Sociodemographic Factors

Participants in our study were 662 urban-dwelling volunteers randomly selected from four urban cities in central China (Figure 1). The majority of the respondents hailed from the Han Chinese Nationality (71.54%), while (28.46%) hailed from the Hui Chinses Nationality. All participants responded to a modified self-administered Food Frequency Questionnaire (FFQ). Participants were sampled from the cities of Zhengzhou (N= 241, 36.40%); Kaifeng (N= 264, 39.88%); Xi'an (N= 85, 12.84%); and Jinan (N =72, 10.88%) (Table 1). Gender distribution among the 662 respondents indicated that the total male respondents were (56.15%), while the total female respondents were (43.85 %) (Table 1). The Marital status analysis showed that the single respondents constituted (50.77%), whereas the married respondents encompassed (49.23%) (Table 1).

As it can be observed in Table 1, participants' level of education results indicated that (22.05%) of all respondents completed a Bachelor's degree; (15.77) completed a Master's degree; (1.68%) completed a Doctorate degree; (13.02%) completed a high school or equivalent degree; (12.25%) completed an associate degree; (10.11 %) received some or no college education; (1.99%) received vocational training; (15.31%) received K-8th grade education; and (2.91%) did not receive any formal education. The education level vs. marital status results presented in Figure 2 revealed that single respondents were more likely to be more educated with (67.46%), whereas their married counterparts with (27.27 %), there was statistically significant difference in the education level of single and married respondents,$\chi^2$ (1, N = 581), p < .001. With regard to marital status across the four cities (Table 1), Zhengzhou were more likely to have a married couples (57.32%) than single individuals (42.68%); whereas Jinan were more likely to have a single individuals (61.62%) more than married couples (38.18%); Kaifeng came in second to Jinan of having single individuals (59.45%) more than married couples with (40.55%); while Xi'an were more likely to have married couples with (56.76%) and single individuals with (43.24%), there was statistically significant difference between the four cities' respondents in the marital struts factor, $\chi^2$(3, N = 585), p < .007. Regarding the employment status (Table 1), the results indicated that (30.66%) of the respondents were the main wage earner in the household; (29.62%) were the second wage earner in the household; (6.10%) of them were full-time homemaker; and (33.62%) of them did not earn any income. Compared with the other employment status categories, the possible explanation of the high rate of no income of (33.62%) suggests that those respondents who did not earn an income were either full-time students, full-time homemakers, unemployed adults, or a mélange of all three categories.

**Table 1. Summary of Key Results of Study Socioeconomic Factors**

| Study Cities | Zhengzhou % | Kaifeng % | Xi'an % | Jinan % | All 4 Cities Combined % |
|---|---|---|---|---|---|
| Socioeconomic Factors | | | | | |
| Total respondents N=662) | 36.40 | 39.88 | 12.84 | 10.88 | 100% |
| Male respondents | 55.19 | 62.70 | 41.56 | 51.56 | 56.15% |
| Female respondents | 44.81 | 37.30 | 58.44 | 48.44 | 43.85% |
| Marital status: Married | 57.32 | 40.55 | 56.76 | 38.18 | 49.23% |
| Marital Status: Single | 42.68 | 59.45 | 43.24 | 61.62 | 50.77% |
| Education: Doctorate Degree | – | – | – | – | 1.68% |
| Education: Master's Degree | – | – | – | – | 15.77% |
| Education: Bachelor's Degree | – | – | – | – | 22.05% |
| Education: Some college, no degree | – | – | – | – | 10.11% |
| Education: Associate Degree | – | – | – | – | 12.25% |
| Education: Vocational Training | – | – | – | – | 1.99% |
| Education: High School or equivalent | – | – | – | – | 13.02% |
| Education: Kindergarten-8th grade | – | – | – | – | 15.31% |
| Education: No formal education | | | | | 2.91% |
| Employment Status: Main Wage Earner | – | – | – | – | 30.66% |
| Employment Status: Second Wage Earner | – | – | – | – | 29.62% |
| Employment Status: Full-Time Homemaker | – | – | – | – | 6.10% |
| Employment Status: No Job, No Income | – | – | – | – | 33.62% |

**Table 2. Average Family Size and Number of Children Living at Home per Household**

| Children Under 18 Years Old Living at Home | | | | |
|---|---|---|---|---|
| Number of Children-at-Home | Frequency Count | Percent (%) | Cumulative Frequency | Cumulative Percent |
| No Children | 274 | 49.55 | 274 | 49.55 |
| One Child | 203 | 36.71 | 477 | 86.26 |
| Two Children | 60 | 10.85 | 537 | 97.11 |
| Three Children | 8 | 1.45 | 545 | 98.55 |
| Four Children | 7 | 1.27 | 552 | 99.82 |
| Six Children | 1 | 0.18 | 553 | 100.00 |
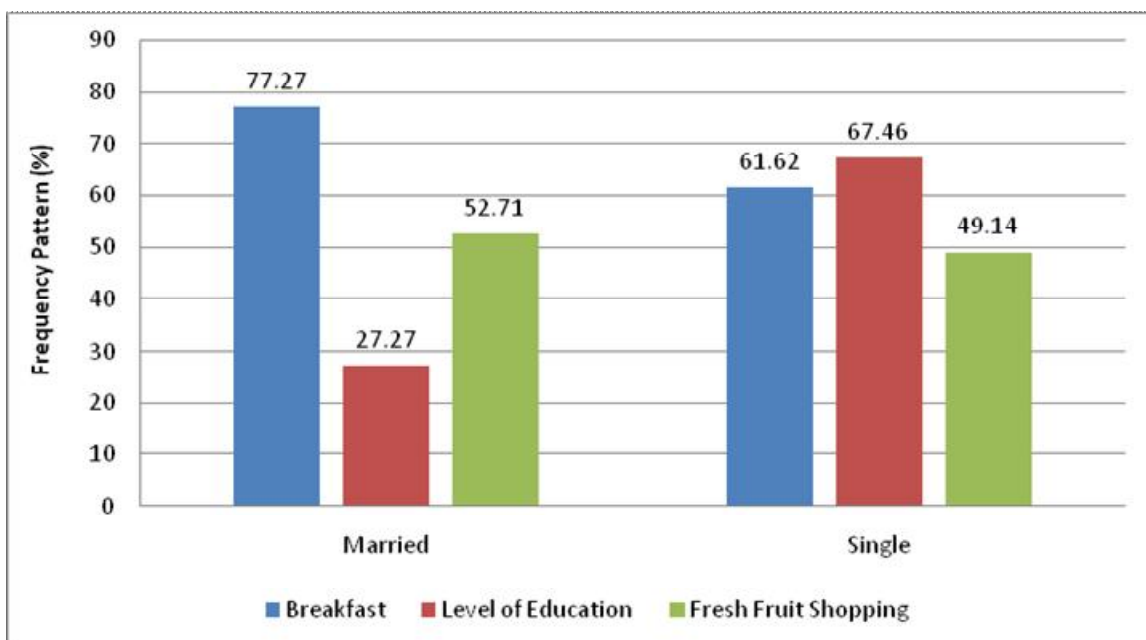


Three or More Times per Week Patterns According to Marital Status (%)

**Figure 2. Daily Breakfast Consumption, Education Level, and Fresh Fruit Shopping of**
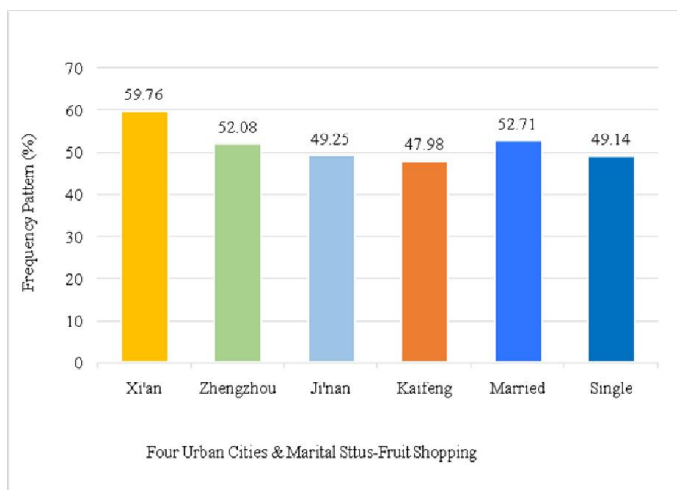
And Marital Status (%)

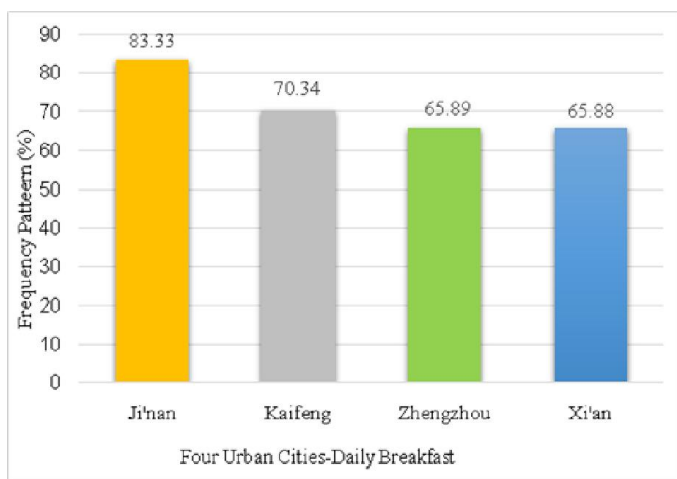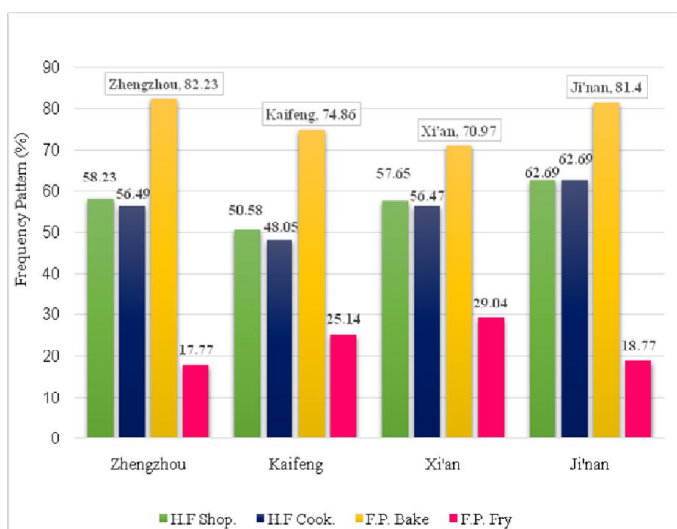**Figure 3. Three or More per Week Fresh Fruit Shopping Patterns According to City**



**Figure 4. Habitual Daily Breakfast Consumption Patterns by City (%)**



**Legend**: **H.F Shop.** (Healthy Food Ingredient Shopping); **H.F Cook.** (Applying Healthy Food Cooking Methods); **H.F Prep.** (Healthy Food Preparation Techniques: F.P Bake vs. F.P Fry)

**Figure 5. Healthy Food Ingredient Shopping, Applying Healthy Food Cooking Methods, and Healthy Food Preparation Techniques (Bake vs. Fry) Patterns by City (%)**
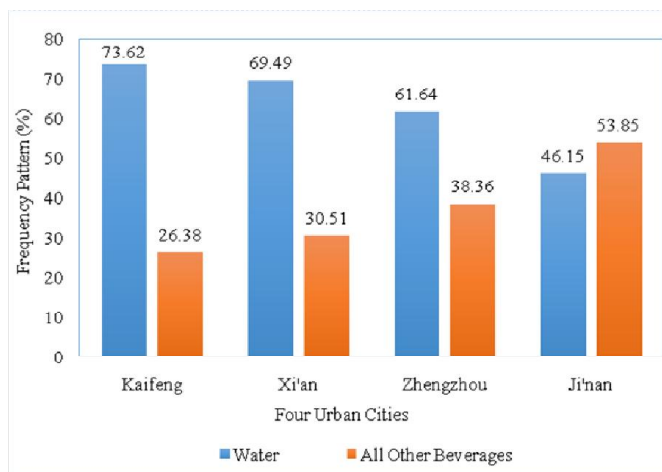


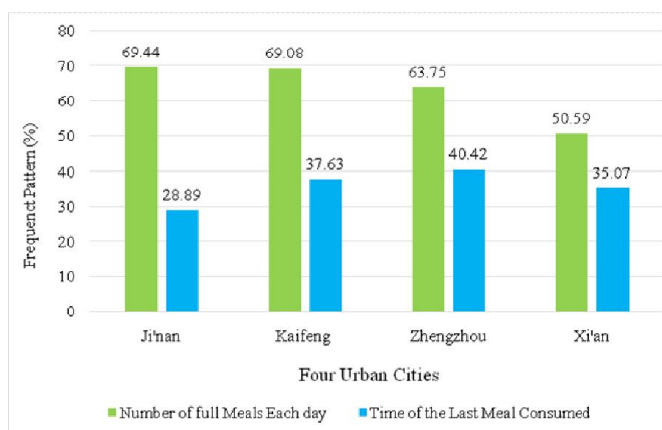**Figure 6. Water Consumption vs. All Other Beverages Patterns by City (%)**



**Figure 7. Number of Full Meals Consumed Each Day and the Time of the Last Meal Consumed Each Day Each Day (17:00-24:00 PM) Patterns by City (%)**

With respect to the factor of family structure per household, the results indicated that among all the four-city respondents who reported having children under the age of 18 years old living at the same household, nearly half of them (49.55%) had no children living at home; whereas (36.71%) had one child; (10.85%) had two children; (1.45%) had three children; (1.27%) had four children; and (0.18) had six children who were living in the same household (Table 2).

***Dietary Habits and Food Consumption Patterns Factors***

FFQ questions pertaining to eight dietary habit factors, including habitual dietary habits; food consumption patterns; and diet-related health practices were responded to by study participants (N = 662). Respondents were permanent residents in the four Chinese cities of Zhengzhou, Kaifeng, Xi'an, and Jinan (Figure 1). The eight dietary factors included in the FFQ were frequency of fresh fruit shopping (three or more each per week); shopping healthy food ingredients (all the time); applying healthy food cooking methods (all the time); healthy food preparation techniques ((baking food vs. frying it); breakfast consumption on a daily basis; habitual beverage consumption (ware vs. all other beverages); the number of full meals consumed each day (three to four); and time of the last meal consumed each day. Figure 3 depicts the results of fresh

fruit shopping patterns (three or more times per week). Xi'an City respondents reported a slightly higher frequency of fresh fruit shopping with (59.76%), followed closely by Zhengzhou with (52.08%), while Jinan reported (49.25%), and Kaifeng followed lastly with (47.98%), no statistically significant difference was found in frequent fresh fruit shopping (three or more times per week) among the respondents from the four cities, $\chi^2(3, N = 637)$, p < .307.

As it can be observed in Figure 4, the city-by-city analysis of the habitual daily breakfast consumption revealed that respondents from Jinan reported the highest rate of daily intake of breakfast with (83..33%), followed by Kaifeng with (70.34%), thereafter Zhengzhou with a rate of (65.89%), whereas Xi'an reported (65.88%), there was statistically significant difference in the daily breakfast intake pattern among the four cities' respondents, $\chi^2(3, N = 660)$, p < .034. Figure 2 illustrates the daily breakfast intake pattern results according to the marital status of the respondents; these results showed that married respondents reported consuming daily breakfast regularly with (77.27%), compared with single respondents who reported (61.62%), there was a significant difference between married and single respondents in their daily intake of breakfast habit, $\chi^2(1, N = 583)$, p < .001. In the Discussion Paragraph below, we will provide a possible detailed explanation as for why married respondents were more likely to consume daily breakfast on a regular basis compared with their single counterparts. Figure 5 explicates the patterns of adopting healthy dietary behaviors (all the time) reported by the four-city participants. Jinan respondents reported healthy food ingredient shopping with (62.69%), followed by Zhengzhou with (58.23%), then followed narrowly by Xi'an reporting (57.65%), whereas Kaifeng respondents reported (50.58%), there was no statistically significant difference between the four cities in the frequent healthy food ingredient shopping pattern, $\chi^2(3, N = 646)$, p < .187. With respect to applying healthy food cooking methods, Jinan responses were (62.69%), followed by Zhengzhou with (56.49%), then Xi'an with (56.47%), and trailed by Kaifeng with (48.05%), no statistically significant difference was found, $\chi^2(3, N = 647)$, p < .090. Regarding the frequency of applying healthy food preparation techniques (baking food vs. frying it), Zhengzhou respondents were more likely to bake food with (82.23%) and fry it with (17.77%), followed tightly by Jinan respondents baking food with (81.4%) and frying it with (18.60%), thereafter Kaifeng baking food with (74.86%) and frying it with (25.14%), trailed by Xi'an baking food with (70.97%) and frying it with (29.03%), no statistically significant difference was found between the four cities in three healthy food behaviors patterns, $\chi^2(3, N = 485)$, p < .159. However, the aforementioned statistics indicated that Zhengzhou and Jinan respondents were more likely to bake food and less likely fry it. On the other hand, even though with a narrow margin, the respondents from Xi'an and Kaifeng were more likely to prepare food by baking it less and frying it more frequently, when compared to the healthy food preparation techniques of other two cities' respondents (Table 5).

A Chi-square test of goodness of fit was performed to examine the relationship between the overall healthy dietary behaviors manifested by the actual practice of healthy beverage shopping, (water vs. all other non-water beverages), healthy food consumption patterns, i.e., number of full meals

consumed each day, and the time of the last meal consumed each day among the four-city respondents. As it can be seen in Figure 6, habitually water consumption pattern vs. consumption of all other non-water beverages results indicated that Kaifeng respondents reported the highest frequency of daily water intake with (73.62%), compared to all other beverages with (26.38%); followed by Xi'an with a rate of (69.49%), compared to all other beverages with (30.51%); whereas Zhengzhou reported daily water intake with (61.64%), weighed against all other beverages with (38.36%); trailed by Jinan's scoring (46.15%), contrasted with all other beverages with (53.85%), there was a statistically significant difference in the water consumption pattern as a typical drink, compared to all other non-water beverages, $\chi^2(3, N = 493)$, p < .004. With reference to the frequency of habitually eating three or more full meals each day, findings from the four-city analyses (Figure 7) revealed that Jinan's respondents reported consuming, at least, three to four full meals each day with (69.44%), followed very tightly by Kaifeng with (69.08%), then Zhengzhou reported a rate of (63.75%), while Xi'an recorded (50.59%), there was a statistically significant difference in the number of full meals consumed (three or more) each day among the four cities, $\chi^2(3, N = 659)$, p < .015. With regard to the time of the last meal consumed each day (17:00-24:00 PM), Figure 7 illustrates that Zhengzhou reported (40.42%), followed by Kaifeng with (37.63%), then Xi'an with (35.07%), and finally Jinan with (28.89%), no statistically significant difference was found between the respondents from the four cities in connection with the time of the last meal consumed each day, $\chi^2(3, N = 593)$, p < .156.

## DISCUSSION

The aim of our study was to examine the differences in sociodemographic factors in dietary habits, food and beverages consumption, and related health practices of Chinese living in four urban Chinese cities (Figure 1). The results of this study clearly show that there are a number of key differences in some of the dietary habits, food and beverages consumption, and related health practice factors. Similarly, noteworthy differences were found in the sociodemographic factors among the residents in the four urban cities in China. In particular, the results of our study bring to light that sociodemographic indicators may possibly have a direct influence on dietary habits and food consumption patterns of people.

### Sociodemographic Factors

With respect to the sociodemographic factors, we found some noteworthy results to discuss. One of them is marital status, where results indicated differences in the marital status indicators among the residents of four cities. Kaifeng and Jinan had considerably higher proportions of single respondents than their married counterparts (Table 1). This difference can be explained by the fact that they are major university urban cities with large single student populations. On the other hand, Zhengzhou and Xi'an had higher proportions of married respondents than their single counterparts (Table 1). This sizable marital status difference can be explained by the fact that these two urban cities are major business hubs with key commercial and industrial centers. In addition, they are the capital cities of two populous provinces in China where many families work and reside.

With regard to the marital status in relation to family size results (Table 2), these results are in line with the characteristics of the study population as well. As we indicated in the above-stated data, single respondents were comprised of (50.77%), and their married counterparts made up (49.23%) of the aggregate respondents. This clearly explains the association between having a clear majority of the participants (49.55%) reporting having no children; and having a clear majority of the respondents (50.77%) being single, which we can reasonably assume that they have no children (Table 2). Furthermore, the second largest majority of participants (36.71%) reported having one child only. This result is consistent with the one-child per family policy, which was introduced in 1979, as a mandate for the family planning program in China. However, in 2015, China decided to phase out this policy by early 2016 (Letcher, 2016). These results demonstrate that the study population represents a true a reflection of the general Chinese population. For those respondents who reported having 3-6 children living in the same households (Table 2), this can be possibly explained as those respondents might have been having an extended family with children, parents, grandparents, and other relatives, who all live in the same household. Traditionally, in China, family structure functions as one unit, where married sons; their wives; and their children live with the son's own parents in the same household providing care and support for the young children, as well as the aging parents until those aging parents are deceased (Xu and Xia, (2014).

### Dietary Habits and Food Consumption Patterns Factors

Our analyses of the association between being married, the level of education, and habitually consuming a daily breakfast revealed noteworthy findings. As it can be observed in Figure 2, married respondents who had lower levels of the college education had a significantly higher rate of habitually consuming daily breakfast (77.27% vs. 61.62%) than those single respondents. Conversely to our expectation, as Figure 2 also illustrates that single respondents who had a considerably higher level of college education than their married counterparts (67.46% vs. 27.27%), were less likely to consume breakfast on a regular basis. A reasonable explanation for this finding could be that it appears that having a higher level of education has not necessarily translated into adopting a healthy dietary behavior such as eating daily breakfast regularly by the single respondents. Moreover, we can infer that married couples were more influenced by the traditional Chinese culture of the importance of consuming daily breakfast for health reasons, as well as they might be having more access to nutritional knowledge; especially, if they were having children as well. Our explanation is supported by research by Ma (2015) who maintained that residents in Beijing with (74.8%), Shanghai with (86.8%), and Guangzhou with (90.5%) reported having breakfast every day. Ma (2015) further suggested that the proportion of the residents who revealed having breakfast on a daily basis aged >35 years old was higher than their counterparts aged <35 years old. In this research, women were found to be more likely to consume breakfast with a higher consistent regularity than men. Residents who did eat breakfast habitually cited reasons for skipping eating breakfast; including lack of enough time, lack of appetite, and the desire to lose or maintain body weight.

Several studies provided evidence demonstrating that consuming a daily breakfast is associated with having improved overall quality of diet and daily essential nutrient intake (Nicklaus, *et al.,* 2002; Ruston and Kirk, 1997). Inferentially, our possible explanation for the single respondents reporting not eating daily breakfast as frequently as their married counterparts is that most of them could have been single students, especially female students. We can extrapolate from the above-cited results by Ma (2015) that it is possible that they might have been influenced by the role of mass media, social media-related emphasis on thinness, and/or peer pressure creating certain perceptions about the perceived association between daily breakfast intake and gaining body weight, rather than focusing on the health benefits of having that daily breakfast for its positive nutritional advantages, as reported above. There a perception among young adults, especially females that skipping eating a breakfast on a regular basis may be associated with either weight maintenance or reduction. However, contrary to that perception, Wyatt *et al.,* (2002) suggested that consuming regular breakfast meals may possibly be a key factor in weight loss maintenance. Moreover, research on the effects of breakfast on body weight changes by Berkley *et al.,* (2003) showed that overweight children who never eat their daily breakfast may lose some body fat; on the other hand, children with normal body weight do not. Several studies examined the effects of breakfast intake on academic performance. Results from these studies indicated that eating a breakfast rich in complex carbohydrate regularly may lead to an improved cognitive function of college students. This cognitive function improvement was reflected by achieving better test scores compared with those students who consistently skipped consuming breakfast. Similarly, daily breakfast intake showed marked increases in information retention, memory span, and attention focus in the morning period of school-aged children. Behaviorally, results from psycho-behavioral studies suggested that children who consumed breakfast on a regular basis were more likely to get along well with other children, as well as they would generally be exhibiting positive behavior within the school day than those peers who do not habitually consume breakfast. (Alamo, Olson, and Frongillo, 2001; Benton, Maconie, and Williams, 2007; Phillips, 2005; Wesnes, *et al.,* 2003). Founded on the above-mentioned results of the positive health benefits of breakfast intake, students and non-students alike should be encouraged to consume a daily breakfast on a regular basis. An additional perspective to interpret the relationship between marital status, the level of education and breakfast intake result could be that married respondents were more likely to place a greater health and social value on consuming a daily breakfast as a family meal than their counterpart single respondents. Moreover, it could be possible that being single can be somewhat socially isolating from eating with other family members. Sociologically, it appears that commensality plays a key role in promoting a social group, such as married couples, to eat their meals together more often than eating alone, including breakfast. The belief in the overall health benefits of habitually eating a daily breakfast is corroborated by a convincing body of evidence from numerous other studies. Smith (1998) found that people who consumed a daily breakfast had a healthier lifestyle, felt better physically and mentally, and were less likely to smoke than those who did not. Fulkerson *et al.,* (2009); Eisenberg *et al.,* (2004) maintained that regular family meals may promote higher self-

esteem, lower risk of depression, and have a better academic performance among adolescents. Papoutsou *et al.* (2014) examined the dietary patterns in childhood and concluded that boys and girls who consumed a daily breakfast on a regular basis had lower Body Mass Index (BMI) scores; were also less likely to have abnormal blood serum triglycerides levels; had a higher level of the high-density lipoprotein (HDL), also called the "good cholesterol"; and had normal diastolic blood pressure. Research by Henderson (2002) revealed that centenarians who lived up to or beyond the age of 100 years old maintained a habit of consuming a daily breakfast more regularly than those who skipped that first meal of the day. Furthermore, it seems that being married and having a familial life may promote the habitual intake of eating breakfast. One additional explanation for this result is that single individuals might consider preparing a daily breakfast for one person is not worth the time nor the efforts.

With reference to applying healthy food preparation techniques (baking food vs. frying it), our results showed that while baking food rates are higher than frying it is a positive dietary health behavior for two of the four cities (Zhengzhou and J'inan). In contrast, our results also showed that deep frying food is still a commonly practiced in food preparation with higher proportions than what they should be for health reasons. Especially, in the City of Xi'an, where nearly one-third (29.03%) and Kaifeng nearly one-fourth (25.14%) of the respondents indicated that they cook food by frying it in oil or another fat (Figure 5). Earlier in this study, Ji *et al.* (1995) and Zhang *et al.,* (2002) provided epidemiological evidence on the increased risks of pancreatic and ovarian cancers among the permanent residents of some Chinese cities, which were found to be linked to consuming deep-fried foods and other animal fats. With respect to marital status indicators in connection with to fresh fruit-shopping patterns (three or more times per week), our results indicated that there are marked differences between married and singles respondents. As it can be observed in Figurer 3, married respondents reported a fresh fruit shopping rate with (52.71%), while single respondent's rate was (49.14%), albeit, with a narrow statistical margin, this result is consistent with research conducted on consumer behaviors and shopping patterns. The results showed that most single consumers have a tendency not to purchase fresh fruits and vegetables as frequently or in large quantities as the average married couples do, who also are more likely to have children (Steinhofer, 2005). Similarly, consistent with our results which were reported earlier in this study, Zhang *et al.,* (2009) found no significant difference between sociodemographic factors such as marital status and the frequency of fruit consumption patterns. Our reading into the relative proximity between the statistical results of the married and single respondents in fresh fruit shopping leads us to extrapolate that both groups were most likely more informed about the health benefits of the consumption of fresh fruit. Similarly, fresh fruit shopping patterns reported by the four-city respondents did not reveal wide-margin statistical differences among them (Figure 3). We can reasonably explain this result as it was mainly due a similar explanation we have provided above for the marital status cohorts. In addition, based on our first-hand field observations, these four cities are surrounded by many fruit orchards and the residents have a relatively easy access to various nearby local farmers' markets with a variety of choices and price ranges. Our earlier

explanation that it was more likely that both married and single groups had nutritional knowledge about the health benefits of regularly consuming fresh fruit is aligned with evidence gleaned from several studies that examined the association between the health benefits of the habitual consumption of fresh fruit and preventing certain forms of cancer and cardiovascular disease. (Hu *et al.,* 1998; Jacobs, 1988; Steinmetz and Potter, 1996; Trock *et al.,* 1990; Wang *et al.,* 2014).

With regard to practicing healthy eating behaviors in association with the number of full meals consumed each day (three to four), Figure 7 showed that high proportion of respondents in the four cities were more likely to consume 3 to 4 full meals each day. Jinan led reporting the highest rate with (69.44%), Kaifeng reported nearly similar rate with (69.04). The other two cities were not widely far afield, where Zhengzhou followed with (63.04%) and Xi'an trailed with (50.59%). Inferentially, taking these findings altogether, it can be reasonably assumed these results appropriately reflect the traditional Chinese culture tradition of the importance of consuming at least 3 full square meals each day. In corroboration of our results, as well as our explanation, The China National Nutrition Survey (CNNS) indicated that Chinese people with different ethnic backgrounds might differ on the exact number of meals they consume each day. Nevertheless, the majority (94%) of Chinese consume three meals a day, while approximately 5% consume two meals a day. However, the number of meals changes from urban to rural areas. Approximately (25%) of residents living in relatively poor rural areas consume two meals per day. On the other hand, in urban areas, residents usually consume 3 to 4 meals every day (Ma, 2015). These data reported by the CNNS are consistent with the findings of our study.

**Conclusion**

The current study presented evidence to show that residing in an urban environment is more likely to be associated with a mixed picture of healthy and unhealthy dietary habits and food consumption patterns. On one hand, we found positive dietary behaviors in some, but not all of the 4 urban cities on some but, not all of the healthy dietary behavior factors. For instance, our results indicated higher increases of fresh fruit consumption, water intake vs. all other beverages, healthy food ingredient shopping and preparation, consuming daily breakfast regularly, and consuming 3 to 4 full meals each day. On the other hand, we found evidence of some unhealthy dietary habits such as frying food more frequently than baking it or boiling it, single adults skipping eating daily breakfast, applying unhealthy food cooking methods, consuming higher proportions of sugary beverages than water; notably reported by Jinan respondents, and nearly all the four city residents consumed their last meal of the day later at night, e.g. 17:00-24:00 PM. We have presented epidemiological presented suggesting that some of these unhealthy dietary behaviors may be linked to chronic disease, including heart disease, stroke, diabetes, and certain forms of cancer.

In the Introduction Paragraph, we presented a considerable body of empirical evidence that confirmed most of the common health problems in China are associated with lifestyle choices, especially dietary habits. These preventable diseases

are weighing down the health care system with an enormous financial burden, physical disability, and negative effects on life expectancy and overall quality of life. This study revealed some key results with different gradations of statistical significance between dietary habits, food consumption patterns, and related health behaviors. As the results demonstrated, sociodemographic factors such as gender, marital status, the level of education, and living in an urban environment are fundamental factors that should be considered when designing nutrition policy recommendations and interventions for preventing any future and/or managing any existing diet-related chronic diseases. The major objective should aim at further improving the dietary habits and related health practices of the inhabitants of urban cities. A particular emphasis should be given to some the poor dietary habits such as consuming fried food, skipping eating daily breakfast, consuming sweetened beverages, and consuming meals late in the evening. In the meantime, promoting the adoption of a healthy diet with increased consumption of fresh fruit and vegetables, low-fat dairy products, whole grains, consuming breakfast on a daily basis, and encouraging consuming most of the meals during the day or early in the evening. The results of this study offer evidence-based information can be considered for application by public health policymakers, nutritionists, healthcare professionals, and health educators to develop effective policy recommendations for urban-specific health promotion initiatives and dissemination of information aimed at the residents of urban areas. We believe that this study is important because of the fact that most of the common lifestyle-associated chronic diseases can be prevented and managed by adopting proper nutrition and healthy dietary habits. Nutrition is widely accepted and practiced as a medical nutrition therapy (MNT), and it can be successfully employed as an effective tool in the prevention and treatment of many diet-related chronic diseases. Understating the role of urban diets in preventing related diseases patterns can be invaluable to continue evaluating their effectiveness in preventing and mitigating the negative effects of those diseases. For that reason, in the pursuit of that goal, as a recommendation for future studies, it would be advantageous to include rural migrant populations of different age groups that have recently migrated to urban areas within 5 years or less to study the effects of their adoption of urban style dietary habits and food consumption patterns and compare the results with those of the long-time inhabitants of urban areas.

**Declaration of Conflict of Interest**

The authors of this manuscript declare that they have no conflict of interest concerning its drafting, publication, or application.

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