

Association of diet-related knowledge, attitude, behaviors and self-rated health among Chinese adults: a population-based study

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Abstract

Background: Diet and nutrition play an important role in one's health status. The objectives of this study were to (a) determine knowledge, attitude, and behaviors (KABs) related to diet among a sample of Chinese adults, and (b) assess the association between diet-related KABs and self-rated health.

Methods: We analyzed the 2015 CHNS data. Individuals aged 18 years and older were included as study subjects ($n = 12,814$). Five variables were selected to assess diet-related knowledge, attitude, and behaviors. Comparison of diet-related KABs in urban and rural was conducted using chi-square test. Ordinal logistic regression was conducted to quantify the association between diet-related KABs and self-rated health.

Results: The awareness proportion for Chinese diet pagoda/DGCR was 27.1%, and only 34.3% of the subjects were assessed as having adequate dietary knowledge literacy. 24.3% reported positive attitude towards healthy diet. 27.6% and 65.9% reported the behavior of actively looking for nutrition knowledge and eating fruit & vegetables, respectively. Chi-square test indicated that rural residents experienced significant poorer diet-related knowledge, attitude, and behaviors than urban (all p -values < 0.01). Adjusted ORs with 95% CI revealed significant association between diet-related KABs and self-rated health.

Conclusions: Chinese adults experienced poor diet-related knowledge, attitude, and behaviors, while rural residents were significantly worse than urban. Better diet-related knowledge, attitude, and behaviors was associated with higher self-rated health.

Background

According to the Global Burden of Disease Study 2017, 11 million deaths (22% of all deaths among adults) and 255 million Disability Adjusted Life Years (DALYs) were attributable to dietary risk factors [1]. In China, we are confronting with the plight: coexistence of under- and over-nutrition, as well as high incidence of nutrition-related diseases [2]. Chinese residents' daily salt and edible oil intake, together with fat ratio is all higher than the recommended standards (WHO and Dietary Guidelines for Chinese Residents (DGCR)) in 2012 [2]. The overweight and obesity rates in adults maintain an upward trend, while 6.0% and 9.0% of whom still have problems of malnutrition and weight loss. To promote the solution of nutrition-related problems, the Chinese government announced the implementation of "Healthy China Action (2019-2030)" in July 2019, "Appropriate Diet" was involved as one of its fifteen major actions [3].

Knowledge, Attitude/Belief, and Behavior/Practice (KAB) is originally proposed to emphasize the vital role of knowledge, attitude, and behavior in promoting individuals' health management [4]. According to the theory, individuals' health behavior is composed of three consecutive processes: acquire knowledge, generate beliefs, and form behaviors. KAB evaluation is considered the first step of health behavior education, which can grasp the individual's understanding, health beliefs, and actions taken regards a

specific health issue, and then provide scientific basis for the development of intervention plan. Adequate knowledge of health-related behavior has been reported to influence the patient's attitude and practice in health management [5]. Specifically, assessing diet-related knowledge, attitude, and behaviors has been reported to be vitally important in achieving dietary health promotion at the population level [6-8], thus should be a necessary prerequisite for dietary intervention in China.

Previous studies have shown that diet-related behavior is a key factor influencing individuals' health, for example, associating with mortality and morbidity of non-communicable diseases [1], risk of cardiovascular disease [9, 10], metabolic syndrome [11-13], cancer [9, 14], and all-cause mortality [9]. Knowledge and attitude indirectly affect health status by promoting behavioral change [15, 16]. However, no existing study has systematically described the association of Chinese residents' dietary behavior on individuals' health, based on the KABs theory perspective. For these consideration, we conducted this study to (a) determine knowledge, attitude, and behaviors related to diet among a sample of Chinese adult residents, and (b) assess the association between diet-related KABs and self-rated health.

Methods

Date source

The China Health and Nutrition Survey (CHNS) is a longitudinal survey and open cohort conducted from 1989 to the currently available 2015 wave, with multistage and random cluster procedures. This comprehensive dataset aims to study the influences of nutrition, health, and family planning policies established by both national and local government agencies in China. Furthermore, the CHNS investigates the impact of social and economic transitions in Chinese society on residents' overall health and nutrition status. In the 2015 CHNS wave, a total of 15,291 individuals from nine provinces (Liaoning, Heilongjiang, Jiangsu, Shandong, Henan, Hubei, Hunan, Guangxi, and Guizhou) and three municipalities (Beijing, Chongqing, and Shanghai) were surveyed.

In this study, we used the data of adult population (aged 18 and over) in the 2015 CHNS wave ($n = 12,872$). After excluding those with missing socio-demographic, diet related variables, and self-rated health information, a total of 12,814 subjects were involved in the final analysis.

We used de-identified and publicly-available datasets from the official CHNS website (<https://www.cpc.unc.edu/projects/china>). Hence, approvals from Institutional Review Boards were not required at authors' institutions.

Variables

Diet-related knowledge

We applied two variables to assess diet-related knowledge: the awareness of Chinese diet pagoda or Dietary Guidelines for Chinese Residents (DGCR) and adequate dietary knowledge literacy. The awareness of diet pyramid/ DGCR was identified by a question "Do you know about the Chinese Pagoda

or the Dietary Guidelines for Chinese Residents (yes/no)?" Dietary knowledge literacy was computed from 17 dietary questions. Referring to the statistical analysis of Chinese residents health literacy monitoring [17] and previous relevant article [18], individuals with the actual dietary knowledge score $\geq 80\%$ were defined as having adequate dietary knowledge literacy (i.e. the total score of 17 dietary questions ≥ 14).

17 questions which originally coded as "strongly disagree", "disagree", "neutral", "agree", and "strongly agree" in the 2015 CHNS questionnaire was transferred into dichotomous variables. For seven negative items (Q2, Q4, Q6, Q12, Q14, Q15, Q16), the response of "strongly disagree" or "disagree" was scored 1 point, otherwise 0. For the other ten positive items, the response of "strongly agree" or "agree" was scored 1 point, otherwise 0. Cronbach's alpha for the 17 dietary questions was 0.86 in this study.

Diet-related attitude

The attitude towards the importance of "eating a healthy diet" were selected as diet-related attitude measurement. The answers were dichotomized to positive attitude ("very important" or "the most important") and non-positive attitude ("not important at all", "not very important", or "neutral").

Diet-related behaviors

Two categorical variables were applied to assess diet-related behaviors: actively looking for nutrition knowledge, and prefer eating fruits & vegetables. The behavior of looking for nutrition knowledge was measured by a question "Do you proactively look for nutrition knowledge (yes/no)?" The response of "yes" was referred to as positive behavior. The question regarding behavior of eating fruits & vegetables were dichotomized to positive behavior ("like" and "like very much") and non-positive behavior ("dislike very much", "dislike", "neutral").

Self-rated health

Self-rated health was assessed by the question "How do you rate the quality of your life at present?" The original coding included "very good", "good", "fair", "bad", and "very bad". The response of "very good" and "good" was recognized as good health, "fair" as moderate health, "bad" and "very bad" as poor health.

Covariates

Covariates including age, gender, marital status, education level, work status, and place of residence were collected. Age was classified into three categories (18-44, 45-59, and ≥ 60). Marital status was dichotomized into married and others (never married, divorced, widowed, separated, etc.). Education level was classified into four categories (elementary school and below, middle school, high school, and college and above). Work status was classified into two categories (yes and no). Place of residence was dichotomized into urban and rural.

Statistical analysis

Data analysis was performed by using IBM SPSS Statistics Version 22.0 (SPSS, Inc., Chicago, IL). Descriptive statistics including means and standard deviation (SD), frequency and percentages were calculated. Comparison of diet-related knowledge, attitude, and behaviors among urban and rural residents were conducted using chi-square test. Ordinal logistic regression was conducted yielding adjusted odds ratios (ORs) to identify the association between diet-related KABs and self-rated health. In all analyses, a p -value of ≤ 0.05 was considered significant.

Results

General information

A total of 12,814 adult individuals were involved in this study, composed of 39.5% ($n=5,061$) in urban and 60.5% ($n=7,753$) in rural areas. The participants' average age was 52.6 years old ($SD=15.3$), of which 30.3% ($n=3,887$), 34.1% ($n=4,375$), and 35.5% ($n=4,552$) were young, middle, and older adults, respectively. Of these participants, 46.9% ($n=6,016$) were male, 86.1% ($n=11,038$) were married, 32.2% ($n=4,132$) received an education level below middle school, 46.0% ($n=5,891$) were currently employed. 8.5% ($n=1,089$), 40.3% ($n=5,159$), and 51.2% ($n=6,566$) of the participants self-reported poor, moderate, and good health status, respectively. The differences of self-rated health in demographic characteristics were statistically significant (all p -values < 0.05). **Table 1** lists the detailed characteristics of the study sample by self-rated health.

Diet-related KABs

In regards to diet-related knowledge, only 27.1% of the participants knew Chinese diet pagoda/DGCR, and 34.3% were assessed as having adequate dietary knowledge literacy. In attitude, 24.3% of the participants hold positive attitude towards healthy diet. In terms of behaviors, 27.6% of the participants reported the behavior of actively looking for nutrition knowledge, and the majority (65.9%) reported preference to fruits & vegetables. The comparative analysis indicated that participants in urban areas had significantly better knowledge, attitude, and behaviors related to diet than that in rural (all p -values < 0.01). Most prominently, the awareness proportion of Chinese diet pagoda/DGCR (38.6%) and the proportion of actively looking for nutrition knowledge (40.5%) in urban was almost the double of which in rural (19.5% and 19.2%). As shown in **Table 2**.

Besides, **Table 3** demonstrated the awareness proportion of 17 dietary knowledge-based questions and the differences in urban and rural. The awareness proportion of the 17 questions ranged from 28.1% (Q14, *refined grains contain more vitamins and minerals than unrefined grains*) to 83.2% (Q9, *consuming beans and bean products is good for one's health*), with an average of 64.9%. And only 1.1% ($n = 143$) of the participants were aware of all the 17 items. Urban participants reported significantly higher awareness proportion of dietary knowledge (except for Q9 and Q14) than rural (p -value < 0.01).

Association between diet-related KABs and self-rated health

Adjusted ORs with 95% CI were computed to clarify the association between diet-related KABs and individuals' self-rated health (**Table 4**). Participants aware of Chinese diet pagoda/DGCR (OR = 1.11, 95% CI = 1.08-1.15), having diet knowledge literacy (OR = 1.12, 95% CI = 1.10-1.15), holding positive attitude towards the importance of healthy diet (OR = 1.14, 95% CI = 1.09-1.19), actively looking for nutrition knowledge (OR = 1.11, 95% CI = 1.08-1.15), and preferring fruits & vegetables (OR = 1.09, 95% CI = 1.07-1.12) were detected with significant better self-rated health.

Discussion

With the improvement of people's living standards, the dietary patterns of Chinese residents have gradually changed – the unhealthy dietary structure such as high-energy, high-fat, and high-sugar intake has been increasingly prominent [19, 20]. Advocating a balanced diet and strengthening diet-related health education have become a noteworthy topic in China [3]. This study showed that Chinese adults experienced poor diet-related knowledge, attitude, and behaviors, while rural residents were notably worse than urban. We also found that diet-related knowledge, attitude, and behaviors all associated with individuals' self-rated health.

This study demonstrated that the awareness proportion of Chinese diet pagoda/DGCR was 27.1%, and the proportion of having adequate dietary knowledge literacy was 34.3%, which was consistent with Li et al.'s report (27.0% and 36.0%) [18]. Notably, compared with historical data [21], the awareness proportion of Chinese diet pagoda/DGCR presented a clear upward trend (2004, 7.8%; 2006, 11.9%; 2009, 14.6%; and 2011, 24.4%), but still at a low level. Besides, only about one-third of the Chinese adult residents were equipped with basic dietary knowledge, and the awareness proportions of several dietary knowledge were extremely low. For example, the correct proportions for Q14 (*Refined grains contain more vitamins and minerals than unrefined grains*), Q5 (*Choosing a diet with a lot of staple foods is not good for one's health*), and Q16 (*Vegetables contain more starch than staple foods*) were only 28.1%, 41.2% and 44.5%, respectively. It can be seen that certain diet-related knowledge of Chinese adult residents is still poor and needs to be strengthened. Therefore, the residents are not only supposed to acquire basic nutrient information, but also should be recommended appropriate diet patterns according to their nutritional status by general practitioner, nutritionist and related professionals [22].

As the important dimension of the health belief model, individuals' health-related attitude greatly affects the formation of health-related behaviors [23]. Only about one quarter of participants reported positive attitude towards healthy eating (24.3%). Despite the fact that high diet quality is closely associated with lower incidence of hypertension and other diseases [24, 25], Chinese residents have not generally recognized the importance of healthy lifestyle yet.

In terms of diet-related behaviors, we obtained identical results with Li et al. [18]. Although the minority of the participants (27.6%) reported actively looking for nutrition knowledge, most (65.9%) adult residents preferred fruits and vegetables in their daily diet. However, according to Li et al. [26] and Ouyang et al. [27], the actual intake of fruits and vegetables of Chinese residents have not yet met the international

recommendation. Some even reported a decrease in the consumption of vegetables [28]. Because people tend to eat ultra-processed foods that are known to decrease the overall diet quality in recent years [29, 30]. Thus, future measures are expected to encourage intake of fruits and vegetables as well as improve the traditional Chinese cooking methods to prevent nutrient loss. In general, diet-related knowledge, attitude, and behaviors of Chinese adult residents are not satisfactory, and it is necessary to carry out targeted health education to guide and improve.

Comparative analyses suggested that rural residents experienced significant worse diet-related knowledge, attitude and behaviors. Especially for the awareness proportion of Chinese diet pagoda/DGCR (knowledge) and the proportion of actively looking for nutrition knowledge (behavior), rural areas were just about 1/2 of urban. The results were consistent with previous findings that also exhibited an obvious urban-rural dual structure of diet-related KABs in China [31, 32]. There was thus a need to address this gap in research and to develop interventions that targeted rural residents in particular. While urbanization in China gave rural residents more opportunity to all aspects of the information, not enough health resources are available. The government still should strengthen the effort to promote diet-related health education. For example, both free clinic activity and bulletin boards are valid health promotion medium for rural residents.

The results of regression analysis showed that positive diet-related knowledge, attitude, and behaviors were the protective factors for individuals' self-rated health. A study across five European countries addressed consistent findings that [16], enhancing nutrition-related knowledge and attitude could strongly and positively influence the health status and quality of life among the older population. Aune et al. [9] stated that fruit and vegetable intakes closely associated with individuals' health, and could effectively reduce the risk of cardiovascular disease, total cancer, and all-cause mortality. These findings are primer for policy makers to implement diet-related health education programs.

With the construction of "Health China", the Chinese government implemented "Appropriate Diet" action as part of the "Healthy China Action (2019-2030)" [3]. However, improving diet-related KABs in China is not an easy task. It requires not only an understanding of the demand discrepancy between urban and rural adults, but also an insight into the factors preventing adults from a healthy diet. As the KABs theory demonstrates, our study reinforced the importance of creating good conditions for diet-related health resources, especially in rural areas. Holistic policy intervention is warranted to target Chinese adults' overall diet-related knowledge and behavior rather than relative motivation alone.

Several potential limitations should be mentioned regarding the present study. Firstly, limited by the data structure and content of the CHNS database, we only selected two variables (looking for nutrition knowledge, eating fruit and vegetables) to evaluate diet-related behavior, which may not fully reflect the dietary behavior of Chinese adult residents. Secondly, all measures in the study are self-reported, and thus are subject to various measurement errors. For example, the application of self-rated health may result an assess gap with individuals' actual health status. Due to data limitation, this study is not able to address more objective and comprehensive health status indicators (i.e. illness, blood pressure, blood glucose).

Thirdly, considering the data timeliness, the 2015 CHNS data may not fully reflect China's current situation. Despite these limitations, the present study systematically described the dietary condition of Chinese adult residents based on large sample data. And this is the first to explore the impact of diet-related knowledge, attitude, and behaviors on individuals' health among the Chinese adult population, which might be a valuable reference for the implementation of current "Appropriate Diet" actions and further relevant research.

Conclusions

Chinese adults experienced poor diet-related knowledge, attitude, and behaviors, while rural residents were significantly worse than urban. Great diet-related knowledge, attitude, and behaviors significantly associated with the improving of individuals' self-rated health. The "Appropriate Diet" action implemented in China is in line with the general scientific path of promoting population health through behavioral intervention. It is necessary to develop targeted interventions towards three dietary dimensions (knowledge, attitude, and behavior). Moreover, the focus of policy on rural areas to address the urban-rural gap in dietary health might make great sense.

Abbreviations

CHNS: China Health and Nutrition Survey; CI: Confidence interval; DALYs: Disability Adjusted Life Years; DGCR: Dietary Guidelines for Chinese Residents; KABs: Knowledge, attitude, and behaviors; OR: Odds ratio; SD: Standard deviation

Declarations

Ethics approval and consent to participate

We used publicly-available datasets from the official CHNS website (<https://www.cpc.unc.edu/projects/china>). Hence, the need for ethics approval was waived by the Institutional Review Board of Wuhan University. The CHNS provides respondents guarantees of their privacy and confidentiality. All participants provided written informed consent. Details about the study design are available elsewhere [33].

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and/or analysed during the current study are available from the official CHNS website (<https://www.cpc.unc.edu/projects/china>).

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

YY and DH designed the study. LW, SW, LC, ML analyzed and interpreted the data. YY and DH drafted the manuscript. ZM supervised the study and critically revised the manuscript for important intellectual content and final approval of the version to be published. All authors have read and approved the final manuscript.

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Tables

Table 1. General information.

Variables	All participants (n=12814)	Self-rated health			p-value
		Poor (n=1089, 8.5%)	Moderate (n=5159, 40.3%)	Good (n=6566, 51.2%)	
Age					<0.001
18-44	3887 (30.3)	173 (4.5)	1323 (34.0)	2391 (61.5)	
45-59	4375 (34.1)	307 (7.0)	1776 (40.6)	2292 (52.4)	
≥60	4552 (35.5)	609 (13.4)	2060 (45.3)	1883 (41.4)	
Gender					0.033
Male	6016 (46.9)	472 (7.8)	2418 (40.2)	3126 (52.0)	
Female	6798 (53.1)	617 (9.1)	2741 (40.3)	3440 (50.6)	
Marital status					<0.001
Married	11038 (86.1)	868 (7.9)	4474 (40.5)	5696 (51.6)	
Others (never married, divorced, widowed, separated, etc.)	1776 (13.9)	221 (12.4)	685 (38.6)	870 (49.0)	
Education level					<0.001
≤Elementary school	4132 (32.2)	585 (14.2)	1917 (46.4)	1630 (39.4)	
Middle school	4068 (31.7)	286 (7.0)	1723 (42.4)	2059 (50.6)	
High school	2845 (22.2)	148 (5.2)	1024 (36.0)	1673 (58.8)	
≥College	1769 (13.8)	70 (4.0)	495 (28.0)	1204 (68.1)	
Work status					<0.001
Yes	5891 (46.0)	810 (11.7)	2965 (42.8)	3148 (45.5)	
No	6923 (54.0)	279 (4.7)	2194 (37.2)	3418 (58.0)	
Place of residence					<0.001
Urban	5061 (39.5)	404 (8.0)	1925 (38.0)	2732 (54.0)	
Rural	7753 (60.5)	685 (8.8)	3234 (41.7)	3834 (49.5)	

Table 2. Diet-related KABs among urban and rural adults.

Variables	All participants (n=12814)	Urban (n=5061)	Rural (n=7753)	c ²	p-value
Diet-related knowledge					
Chinese diet Pagoda/DGCR	3468 (27.1)	1955 (38.6)	1513 (19.5)	566.73	<0.001
Diet knowledge literacy	4390 (34.3)	1896 (37.5)	2494 (32.2)	8.12	<0.001
Diet-related attitude					
Healthy diet	3109 (24.3)	1313 (25.9)	1796 (23.2)	12.86	<0.001
Diet-related behaviors					
Look for nutrition knowledge	3539 (27.6)	2048 (40.5)	1491 (19.2)	690.72	<0.001
Fruits & vegetables	8444 (65.9)	3484 (68.8)	4960 (64.0)	32.25	<0.001

DGCR: Dietary Guidelines for Chinese Residents

Table 3. Awareness proportion of 17 items regarding dietary knowledge.

Items	Question	Total (n=12814)		Urban (n=5061)		Rural (n=7753)		c ² /t	p-value
		n	%	n	%	n	%		
Q1	Choosing a diet with a lot of fresh fruits and vegetables is good for one's health.	9715	75.8	4036	79.7	5679	73.2	70.52	<0.001
Q2*	Eating a lot of sugar is good for one's health.	9325	72.8	3953	78.1	5372	69.3	120.16	<0.001
Q3	Eating a variety of foods is good for one's health.	9647	75.3	3989	78.8	5658	73.0	56.13	<0.001
Q4*	Choosing a diet high in fat is good for one's health.	9239	72.1	3933	77.7	5306	68.4	130.92	<0.001
Q5	Choosing a diet with a lot of staple foods [rice and rice products and wheat and wheat products] is not good for one's health.	5283	41.2	2156	42.6	3127	40.3	6.50	0.011
Q6*	Consuming a lot of animal products daily (fish, poultry, eggs and lean meat) is good for one's health.	7965	62.2	3310	65.4	4655	60.0	37.41	<0.001
Q7	Reducing the amount of fatty meat and animal fat in the diet is good for one's health.	8894	69.4	3682	72.8	5212	67.2	44.05	<0.001
Q8	Consuming milk and dairy products is good for one's health.	10499	81.9	4241	83.8	6258	80.7	19.63	<0.001
Q9	Consuming beans and bean products is good for one's health.	10658	83.2	4213	83.2	6445	83.1	0.03	0.865
Q10	Physical activities are good for one's health.	9911	77.3	4006	79.2	5905	76.2	15.63	<0.001
Q11	Sweaty sports or other intense physical activities are not good for one's health.	5717	44.6	2400	47.4	3317	42.8	26.66	<0.001
Q12*	The heavier one's body is, the healthier he or she is.	9767	76.2	4042	79.9	5725	73.8	61.29	<0.001
Q13	Eating salty foods can cause hypertension.	8888	69.4	3784	74.8	5104	65.8	115.04	<0.001
Q14*	Refined grains (rice and wheat flour) contain more vitamins and minerals than unrefined grains.	3595	28.1	1343	26.5	2252	29.0	9.56	0.002
Q15*	Lard is healthier than vegetable oils.	7432	58.0	3131	61.9	4301	55.5	51.33	<0.001
Q16*	Vegetables contain more starch than staple foods (rice or wheat flour).	5700	44.5	2579	51.0	3121	40.3	142.04	<0.001
Q17	Eggs and milk are the important sources of high-quality protein.	9036	70.5	3704	73.2	5332	68.8	28.69	<0.001
All awareness		143	1.1	54	1.1	89	1.1	0.18	0.670

*negative item

Table 4. Logistic regression analysis predicting the association between diet-related KABs and self-rated health.

Variables	Poor	Moderate	Good	OR (95% CI) ^a
Diet-related knowledge				
Chinese diet pagoda/DGCR	176 (16.2)	1122 (21.7)	2170 (33.0)	1.11 (1.08, 1.15)*
Diet knowledge literacy	256 (23.5)	1514 (29.3)	2620 (39.9)	1.12 (1.10, 1.15)*
Diet-related attitude				
Healthy diet	941 (86.4)	4761 (92.3)	6180 (94.1)	1.14 (1.09, 1.19)*
Diet-related behaviors				
Look for nutrition knowledge	180 (16.5)	1153 (22.3)	2206 (33.6)	1.11 (1.08, 1.15)*
Fruits & vegetables	649 (59.6)	3174 (61.5)	4621 (70.4)	1.09 (1.07, 1.12)*

^aOR adjusted for age, gender, marital status, education level, work status, and place of residence.

DGCR: Dietary Guidelines for Chinese Residents; OR: odds ratio; CI: confidence interval;

**p*-value < 0.01