Teenager dietary behavior and health literacy in China: influencing factors and coping strategies

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Abstract

Introduction: Understanding health literacy is important for formulating health policies and conducting public health interventions. We aimed to evaluate the status quo and influencing factors of teenager dietary behavior and health literacy in China, to provide insights into the coping strategies of teenager health.

Material and methods: Between March 1, 2021 and May 15, 2021, teenagers in four high schools in Bengbu, China were selected. The Interactive Health Literacy Questionnaire for Chinese Teenagers (IHLQCT) was used for assessing health literacy. Mixed linear models were used to analyze the relationships among dietary behavior patterns, IHLQCT and individual characteristics.

Results: A total of 1920 teenagers were included. The average score of the IHLQCT was (72.45 ±8.99). Mixed linear analyses showed that parents' educational level (β = –0.11, 95% CI: –0.19, 0.05), monthly family income (β = 0.08, 95% CI: 0.02, 0.16), and IHLQCT scores (β = 0.15, 95% CI: 0.10, 0.23) were associated with risky dietary behavior patterns in teenagers (all p < 0.05). Being an only child (β = –0.12, 95% CI: –0.35, –0.09), parents' educational level (β = 0.49, 95% CI: 0.13, 0.95) monthly family income (β = 0.14, 95% CI: 0.08, 0.38), and IHLQCT scores (β = 0.45, 95% CI: 0.24, 0.69) were associated with the protective dietary behavior patterns (all p < 0.05). Being an only child (β = –0.16, 95% CI: –0.41, –0.07), parents' educational level (β = 0.49, 95% CI: 0.11, 0.82), monthly family income (β = 0.17, 95% CI: 0.10, 0.41), risky dietary behavior patterns (β = 0.34, 95% CI: 0.14, 0.83), and protective dietary behavior patterns (β = 0.22, 95% CI: 0.07, 0.51) were associated with the IHLQCT (all p < 0.05).

Conclusions: Teenager dietary behavior is closely associated with health literacy. There are differences in the dietary behaviors of teenagers under different family characteristics in China.

Key words: teenager, diet, behavior, health, care, survey.

Introduction

Health literacy refers to the ability of individuals to obtain, understand, adopt and process health information and services, and make correct judgments and decisions through the health information and services, and maintain and promote their own health [1, 2]. Health literacy is a key factor to measure the overall health level of residents. Low health literacy can increase the prevalence of many types of diseases and affect the quality of public health [3]. Improving the health literacy of

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people in general will help to improve the public's self-care awareness and health care ability, and it plays a positive role in improving the health status of the population [4–6]. Eating habits are important behaviors that determine the dietary structure and nutritional status of individuals, which are closely related to the occurrence, development and prognosis of diseases [7, 8]. Understanding society's health literacy and eating habits will help the government to understand people's conditions, formulate targeted health policies, and help improve the level of public health [9].

Middle school students are in a critical period of growth and development, and their behavioral habits and health at this stage can have an important impact on adulthood [10, 11]. The results of the several national student physique and health surveys [12–14] in China conducted between 1985 and 2018 show that the detection rate of overweight and obesity among students aged 7–22 has increased year by year, which is mainly related to the daily eating behavior of students. Previous studies [15–18] have shown that low health literacy increases the risk of bad health behaviors such as smoking and drinking among adolescents. To this end, this study aimed to understand the dietary behavior patterns of Chinese teenagers aged 10–18 years, to evaluate the related factors affecting dietary behavior patterns and health literacy, thereby providing a scientific basis for formulating dietary behavior interventions to improve teenager health.

Material and methods

Ethics

In this study, all methods were performed in accordance with the relevant guidelines and regulations. This study protocol had been verified and approved by the ethical committee of the First Affiliated Hospital of Bengbu Medical College (approval number: 2018045). Written informed consent was obtained from the included teenagers and their parents.

Sample size calculation

The stratified cluster sampling method was adopted, and the minimum sample size of each stratum was calculated by referring to the sample size calculation method of the Chinese Citizens' Health Literacy Survey [19]: ,

$$N = \frac{\mu_\alpha^2 \times \pi (1 - \pi)}{\delta^2} \times deff$$

where N is the sample size; π is the awareness rate of a certain health knowledge or the formation rate of behavior in the monitoring indicators, $\pi = 50\%$ in this survey; ε is the allowable error, which could be determined according to the val-

ue of the selected rate and other specific circumstances; it was usually controlled within 10–15%; in order to ensure accuracy, this survey took $\varepsilon = 10\%$; $deff$ is the random effect of complex sampling; we took $deff = 1.8$. Considering the loss of respondents, the loss to follow-up rate was calculated as 10%, i.e., an additional N*10% needed to be added. In addition, considering the stratification factors, there were 2 layers for gender and 3 layers for school level with a total of 6 layers, and the final sample size should be at least: $N = 311$ persons/layer × 6 layer = 1866.

Participants

According to the principles of geographical distribution and convenience sampling, between March 1, 2021 and May 15, 2021, teenagers in four junior and senior high schools of Bengbu city, China were selected. The inclusion criteria for participants were that the age of teenagers was between 10 and 18 years, and the children and their parents signed an informed consent form.

Survey content

The following contents and information were collected and analyzed:

(1) General information: On the basis of extensive reading of the literature, we collected the personal information including gender, school type, whether the student was the only child in the family, self-assessment of the family's economic status and parents' educational level;

(2) Health literacy evaluation: The Interactive Health Literacy Questionnaire for Chinese Teenagers (IHLQCT) [20] was used for the evaluation of health literacy. The Cronbach's α coefficient of the questionnaire was 0.84, the split-half reliability was 0.84, and the standard correlation validity was 0.31, indicating good reliability and validity. The survey content of IHLQCT included five parts: basic situation, health knowledge, health concept, health skills and health behavior. Referring to the scoring method of the Chinese Citizens Health Literacy Questionnaire, when the actual score of the overall questionnaire was greater than or equal to 70 points, it indicated that the respondents had high health literacy; otherwise it was rated as low health literacy.

(3) Dietary behavior evaluation: We referred to the 2014 National Student Physical Fitness and Health Survey Questionnaire to evaluate the frequency of dietary behaviors in the past 7 days, including eating breakfast, tofu or soy products, eggs such as hen eggs and duck eggs, meat, aquatic products, milk and dairy products, fresh vegetables and fruits, fried foods, sweets, snacks and frequency of eating out. The frequency of the above eating

behaviors was divided into 5 grades (never = 0, less than 1 time = 1, 1–2 times = 2, 3–5 times = 3, 6–7 times = 4). The Cronbach's α coefficient of the questionnaire on dietary behaviors was 0.82 with good reliability and validity [21].

Survey implementation and quality control

In order to reduce the bias of the survey, the investigators received special training before the survey. We explained the purpose of the survey, the requirements and precautions for completing the questionnaire, emphasizing that the questionnaire was anonymous to reduce students' concerns and ensure the authenticity of the results. The two researchers supervised the whole process of the investigation, collected the questionnaires on the spot, and corrected the problems in time.

Statistical analysis

We used EpiData 3.0 software to input and develop the database. Stata 13.1 software was used for data analysis. The dietary pattern was based on the average daily intake of vegetables and fruits, and the number of days in a week for breakfast, milk, sugar-sweetened beverages, fried foods, high-energy snacks, and eating out. The principal components in factor analysis with $p < 0.05$ were used after correcting the resting factors. All ten dietary items were included in the analysis using the method of maximization of variance orthogonal rotation, and the dietary behavior pattern was determined with an eigenvalue ≥ 1. When the absolute value of the factor loading was ≥ 0.35, it was considered to be a good representative of the principal component, and then to determine the eating behavior patterns of teenagers. We used the rank sum test to compare the differences in factor scores of dietary behavior patterns of teenagers. Mixed linear models were used to analyze the relationship between dietary behavior patterns, IHLQCT and individual characteristics of the respondents. The test level was $\alpha = 0.05$ in this study.

Results

1960 questionnaires were distributed in this study, and a total of 1920 valid questionnaires were obtained. The effective rate of questionnaire recovery was 97.96%. The average score of the IHLQCT was 72.45 ±8.99. The characteristics of included teenagers are presented in Table I.

Two dietary behavior patterns in teenagers were obtained; their cumulative variance contribution rate was 45.16%. The contribution rate of pattern 1 was 23.21%, which was mainly related to sugar-sweetened beverages, fried foods, high-energy snacks, and eating out; it was named as the risky dietary behavior pattern. The contri-

bution rate of pattern 2 was 21.95%, which was mainly related to vegetables, fruits, breakfast, milk; it was named as the protective dietary behavior pattern (Table II).

As presented in Table III, univariate analyses showed that body mass index (BMI) and IHLQCT scores were associated with the risky dietary behavior pattern (all $p < 0.05$). Gender, age, BMI, only child status, parents' educational level, monthly family income (RMB) and IHLQCT scores were associated with the protective dietary behavior pattern (all $p < 0.05$).

As presented in Table IV, mixed linear analyses showed that parents' educational level (β = –0.11, 95% CI: –0.19, 0.05), monthly family income (β = 0.08, 95% CI: 0.02, 0.16), and IHLQCT scores (β = 0.15, 95% CI: 0.10, 0.23) were associated with the risky dietary behavior pattern in teenagers (all $p < 0.05$).

Table I. Characteristics of included teenagers

Characteristics	Cases	Percentage (%)
Gender:		
Male	1036	53.96
Female	884	46.04
Age [years]:		
10–12	518	26.98
13–15	728	37.92
16–18	674	35.10
BMI [kg/m^2]:		
< 18.5	76	3.95
18.5–24	1112	57.92
24–26.9	460	23.96
> 26.9	272	14.17
Only child:		
Yes	1363	70.92
No	557	29.01
Parents' educational level:		
Primary school	340	17.71
Junior high school	881	45.89
Senior high school	538	28.02
University	161	8.38
Monthly family income (RMB):		
≤ 3000	265	13.80
3000–6000	1016	52.92
6000–9000	460	23.96
≥ 9000	179	9.32
IHLQCT scores:		
< 70	710	36.98
≥ 70	1210	63.02

BMI – body mass index, IHLQCT – Interactive Health Literacy Questionnaire for Chinese Teenagers.

As presented in Table V, mixed linear analyses showed that being an only child (β = −0.12, 95% CI: −0.35, −0.09), parents' educational level

Table II. Factor loading matrix of dietary behavior patterns in teenagers

Factors	Risky dietary behavior pattern	Protective dietary behavior pattern
Vegetables	−0.068	0.694
Fruit	0.062	0.771
Breakfast	−0.944	0.498
Milk	0.125	0.556
Sugar-sweetened beverages	0.611	0.017
Fried food	0.803	0.024
High energy snacks	0.619	0.016
Eating out	0.574	−0.020

(β = 0.49, 95% CI: 0.13, 0.95) monthly family income (β = 0.14, 95% CI: 0.08, 0.38), and IHLQCT scores (β = 0.45, 95% CI: 0.24, 0.69) were associated with the protective dietary behavior pattern in teenagers (all $p < 0.05$).

As presented in Table VI, mixed linear analyses showed that being an only child (β = −0.16, 95% CI: −0.41, −0.07), parents' educational level (β = 0.49, 95% CI: 0.11, 0.82), monthly family income (β = 0.17, 95% CI: 0.10, 0.41), risky dietary behavior pattern (β = 0.34, 95% CI: 0.14, 0.83), and protective dietary behavior pattern (β = 0.22, 95% CI: 0.07, 0.51) were associated with the IHLQCT in teenagers (all $p < 0.05$).

Discussions

Health literacy is a comprehensive reflection of health-related abilities. It starts with acquiring health knowledge and takes understanding as

Table III. Univariate analyses on the characteristics and dietary behavior patterns

Characteristics	Risky dietary behavior pattern		Protective dietary behavior pattern	
	$M (P_{25}–P_{75})$	P	$M (P_{25}–P_{75})$	P
Gender:		0.109		0.012
Male	−0.22 (−0.75, 0.36)		−0.07 (−0.19, 0.25)	
Female	−0.21 (−0.81, 0.47)		0.13 (−0.10, 0.58)	
Age [years]:		0.088		0.043
10–12	−0.11 (−0.64, 0.55)		0.27 (−0.04, 0.77)	
13–15	−0.15 (−0.91, 0.67)		−0.14 (−0.24, 0.31)	
16–18	−0.31 (−0.73, 0.09)		0.19 (−0.15, 0.85)	
BMI [kg/m²]:		0.042		0.041
< 18.5	−0.07 (−0.11, 0.34)		−0.24 (−0.62, 0.16)	
18.5–24	0.17 (−0.42, 0.29)		−0.12 (−0.28, 0.05)	
24–26.9	0.45 (0.01, 0.79)		−0.17 (−0.86, 0.34)	
> 26.9	0.53 (−0.11, 0.89)		0.33 (0.08, 0.95)	
Only child:		0.113		0.006
Yes	−0.22 (−0.59, 0.14)		0.09 (−0.15, 0.28)	
No	−0.14 (−0.45, 0.52)		−0.25 (−0.58, 0.07)	
Parents' educational level:		0.083		0.012
Primary school	−0.07 (−0.13, −0.10)		−0.17 (−0.33, 0.14)	
Junior high school	−0.26 (−0.85, 0.12)		−0.13 (−0.53, 0.04)	
Senior high school	−0.18 (−0.36, 0.19)		0.06 (−0.14, 0.39)	
University	−0.04 (−0.15, 0.33)		−0.12 (−0.47, 0.24)	
Monthly family income (RMB):		0.058		0.035
≤ 3000	−0.28 (−0.42, 0.21)		−0.04 (−0.20, 0.15)	
3000–6000	−0.16 (−0.55, 0.17)		−0.17 (−0.44, 0.19)	
6000–9000	−0.23 (−0.96, 0.78)		0.12 (−0.41, 0.37)	
≥ 9000	−0.02 (−0.18, 0.72)		0.25 (0.14, 0.81)	
IHLQCT scores:		0.011		0.021
< 70	0.35 (0.88, 0.29)		−0.03 (−0.19, 0.24)	
≥ 70	0.18 (0.05, 0.74)		0.17 (−0.05, 0.30)	

BMI – body mass index, IHLQCT – Interactive Health Literacy Questionnaire for Chinese Teenagers.

Table IV. Relationship between characteristics and risky dietary behavior pattern in teenagers

Characteristics	β (95% CI)	t	P-value
Gender	0.25 (−0.18–0.42)	0.177	0.109
Age [years]	−0.12 (−0.46, 0.14)	1.183	0.114
BMI [kg/m²]	0.18 (−0.10, 0.44)	4.209	0.071
Only child	−0.13 (−0.38, −0.12)	0.413	0.103
Parents' educational level	−0.11 (−0.19, 0.05)	−2.405	0.018
Monthly family income	0.08 (0.02, 0.16)	2.006	0.009
IHLQCT scores	0.15 (0.10, 0.23)	3.184	0.015

BMI – body mass index, IHLQCT – Interactive Health Literacy Questionnaire for Chinese Teenagers.

Table V. Relationship between characteristics and protective dietary behavior patterns in teenagers

Characteristics	β (95% CI)	t	P-value
Gender	0.15 (−0.04–0.38)	1.207	0.103
Age [years]	−0.11 (−0.63, 0.23)	1.135	0.126
BMI [kg/m²]	0.23 (−0.10, 0.61)	3.116	0.101
Only child	−0.12 (−0.35, −0.09)	2.013	0.012
Parents' educational level	0.49 (0.13, 0.95)	5.226	0.004
Monthly family income	0.14 (0.08, 0.38)	2.163	0.022
IHLQCT scores	0.45 (0.24, 0.69)	2.005	0.036

BMI – body mass index, IHLQCT – Interactive Health Literacy Questionnaire for Chinese Teenagers.

Table VI. Relationship between characteristics and IHLQCT in teenagers

Characteristics	β (95% CI)	t	P-value
Gender	0.22 (−0.19–0.52)	2.005	0.116
Age [years]	0.14 (−0.07, 0.29)	1.021	0.103
BMI [kg/m²]	0.21 (−0.19, 0.74)	2.955	0.085
Only child	−0.16 (−0.41, −0.07)	3.153	0.006
Parents' educational level	0.49 (0.11, 0.82)	2.011	0.012
Monthly family income	0.17 (0.10, 0.41)	1.694	0.009
Risky dietary behavior patterns	0.34 (0.14, 0.83)	1.992	0.036
Protective dietary behavior patterns	0.22 (0.07, 0.51)	2.976	0.018

BMI – body mass index.

a link, and then transforms the acquired health knowledge into health concepts and health skills, and finally achieves the purpose of promoting one's own health through healthy behaviors [22–24]. In this survey, 36.98% of teenagers (IHLQCT ≥ 70 points) were found to have good health literacy. We assessed the effect of subjects' age and sex on the health literacy, and did not find group differences, which may be associated with the small sample size in this study. Previous surveys [25–27] in other areas of China showed that the proportion of middle school students with basic health literacy was between 11.25% and 41.07%. The difference may be associated with different survey areas and different difficulty coefficients and evaluation criteria of survey tools.

The relation between teenager dietary behavior and health literacy must be considered. Adolescence is a critical period of growth and devel-opment, and health during this period can have a profound impact on disease in adulthood [28, 29]. In recent years, the detection rate of obesi-ty among teenagers around the world has been increasing [30]. Studies [31, 32] have shown that poor eating behaviors such as picky eaters/partial eclipse behaviors and eating fried foods are risk factors for obesity. Previous studies [33–35] have shown that adolescents with one risky eating be-havior may also have many other risky eating be-haviors. It is necessary to reduce the occurrence of risky eating behaviors such as favoring sug-ar-sweetened beverages, fried foods, high-energy snacks, and eating out etc. by comprehensively improving the level of students' health literacy. Some researchers [36, 37] have pointed out that improving students' health literacy should be the core goal of school health promotion. Therefore, in the future school health education work, while

imparting health knowledge and health concepts to students, we should pay attention to the cultivation of health skills, so as to comprehensively reduce students' unhealthy eating behaviors and improve students' nutritional status and achieve good health literacy with IHLQCT ≥ 70 points.

In this study, factor analysis was used to conduct dimensionality reduction analysis of dietary behaviors related to chronic non-communicable diseases, which are a class of diseases closely related to bad behavior and lifestyle, such as cardiovascular disease, diabetes, chronic obstructive pulmonary disease, etc. Two main dietary behavior patterns – risky dietary behavior pattern and protective dietary behavior pattern – are reported currently. The risky dietary behavior pattern is characterized by frequent consumption of sugar-sweetened beverages, fried foods, high-energy snacks, and eating out [38, 39]. The protective dietary behavior pattern is characterized by high intake of vegetables, fruits, milk, and good breakfast habits [40, 41]. Due to the differences in dietary assessment methods, the number of food categories, food types and statistical analysis methods, the dietary behavior patterns of children and adolescents obtained by each study are not the same, but the factors of determined dietary behavior patterns have certain similarities [42–45]. For example, risky eating behaviors generally include high-salt or high-fat, grilled foods, while healthy diets generally include green vegetables, and moderate and regular eating habits.

Identifying family characteristics of different dietary behavior patterns is helpful for targeted early intervention [46]. It should be noted that the risky eating behavior pattern and the protective eating behavior pattern are not totally opposing, and teenagers are likely to follow both the protective eating behavior pattern and the risky eating behavior pattern. For example, teenagers may eat a high-salt or high-fat diet, which is later adjusted to a lighter diet under the personal health concept or parents' suggestions. This study revealed that parental education level is positively correlated with the protective dietary behavior pattern, and negatively correlated with the risky dietary behavior pattern. Higher parental education level is one of the key factors for good nutritional health knowledge and diet quality in children [47–49]. Additionally, we found that monthly family income is positively correlated with the two dietary behavior patterns; that is, children of families with high monthly income may follow both the protective dietary behavior pattern and the risky dietary behavior pattern. The higher the family income is, the greater is the purchasing power of the family, which increases not only the possibility of food type but also the quantity choice, thereby reducing children's picky eating and improving their

dietary quality [50, 51]. However, it also provides the possibility to buy more snacks, thereby promoting some children's health problems such as excessive consumption of fried foods, excessive calorie intake, and insufficient vitamin intake. Eating habits such as eating sweets, beverages, and fried foods occur as usual. Previous studies [52–54] have shown that groups with lower socioeconomic status are more likely to have insufficient fruit and vegetable intake, and groups with higher socioeconomic status tend to consume more fat, salt, and processed foods. The results of this study show that the dual risk of dietary behavior patterns of children from families with low parental education and the duality of dietary behavior patterns of children from high monthly income families should be taken into account in dietary behavior interventions.

This study revealed that children from only-child families were more likely to follow a protective eating behavior pattern, but we did not find any relationship with the high-risk eating behavior pattern. Previous studies [55, 56] have pointed out that there is consistency between the only child status and children eating breakfast, and the parents of the only child pay more attention to children's breakfast. Studies [57, 58] have found that the number of siblings is positively correlated with the adherence to the dietary patterns of "protein and fast food", "fruits and vegetables", and "sweet, soft drinks and dairy products". Regarding the relationship between the only child status and risky eating behavior patterns, a previous study [59] showed that the presence of "junk" eating patterns (i.e., high fat and sugar, processed foods, and convenience foods) is positively related to the total number of siblings. Previous Chinese studies [60, 61] have found that growing up in one-child households significantly increases the probability of children being overweight or obese, and children in one-child households eat more high-sugar, high-fat, and high-protein foods. Therefore, for only children, we should focus on tracking and correcting poor eating behaviors to promote adolescent health literacy.

This study has certain limitations that must be considered. Firstly, this study used risky and protective eating behavior patterns as dependent variables to explore related influencing factors. However, the two dietary behavior patterns related to chronic non-communicable diseases are not mutually exclusive, and the influencing factors are not simply inversely related. Secondly, this study is only a cross-sectional survey and we only analyzed the possible related factors, so we cannot identify a causal relationship. Future intervention studies on the identified influencing factors are still needed to further verify the relationship. Finally, this study is only a single regional survey,

and there may be certain dietary habits and regional deviations, so the results should be treated with caution and verified in many areas.

In conclusion, this study found that teenagers have low levels of health literacy, which are closely related to their eating behaviors. More attention should be paid to the differences in the dietary behaviors of teenagers under different family characteristics, and more interventions are needed on the promotion of healthy eating habits of young people, and reduction of their risky dietary habits, thereby improving the health literacy and physical fitness of teenagers.

Acknowledgments

Conflict of interest

The authors declare no conflict of interest.

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