KNOWLEDGE, ATTITUDES AND PRACTICES REGARDING NOROVIRUS INFECTION AND ITS INFLUENCING FACTORS AMONG PRIMARY AND JUNIOR MIDDLE SCHOOL STUDENTS IN CHIZHOU, CHINA

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Abstract. This study aimed to assess knowledge, attitudes and practices (KAP) of norovirus infection and to explore factors influencing KAP among primary and junior middle school students in Chizhou City. A multistage stratified random sampling method was used to select 1,200 students from 8 primary and junior middle schools for an effective questionnaire survey in Chizhou City. A multivariate logistic regression analysis was used to analyze the possible influencing factors. Of 1,176 participants, the average knowledge score of norovirus infection was (9.8 ± 3.6), and the scoring rate was 65.3%. The average attitude score was (11.6 ± 1.2), and the scoring rate was 96.3%. The average practice score was (10.4 ± 1.5), and the scoring rate was 86.9%. The difference in the average scoring rate among the three was statistically significant ($p < 0.001$). The four independent variables including county, education level, sex, and age group statistically correlated with the knowledge score. Primary and junior middle school students in Chizhou City had a good attitude and practice compliance in the prevention and control of norovirus infection. However, norovirus infection control and targeted health promotion of professional knowledge still need further improvement.

Keywords: knowledge, attitude, practice, KAP, health education, influencing factors, norovirus infection

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INTRODUCTION

Norovirus is now considered to be the leading cause of acute gastroenteritis in all age groups and is spread worldwide (Ahmed *et al*, 2014). In 1972, a 27-nm virus particle was isolated from stool samples during an outbreak of acute nonbacterial gastroenteritis in a school in

Nowak (Kapikian *et al*, 1972). Norovirus infection usually has mild symptoms. Diarrhea and vomiting are common. Norovirus infection is characterized by a short incubation period, strong infectivity and multiple transmission routes. The World Health Organization estimated that norovirus infections cause about 35,000 deaths annually worldwide (WHO, 2015). In developed countries, 42-90% pathogens of nonbacterial diarrhea outbreaks were norovirus (Harris *et al*, 2008). From a global perspective, the greatest public health burden from norovirus infection is undoubtedly exacted on developing countries, where diarrheal diseases are among the leading causes of death (GBD 2013 Mortality and Causes of Death Collaborators, 2015; Hall *et al*, 2016). The first case of norovirus infection was reported in China in 1995, since then the disease has erupted in Beijing, Shanghai, Zhejiang, and various other regions. This disease has become a serious concern, threatening public health (Shang *et al*, 2017; Chang *et al*, 2017; Li *et al*, 2016).

The main mode of transmission of norovirus is the fecal-oral route, primarily through direct person-to-person transmission, but also through contaminated water, food, surface, vomit aerosol and other pollutants. Norovirus of the same or different strains can infect the same individual repeatedly (Bucardo *et al*, 2010). Norovirus poses a serious risk of secondary transmission (Cui *et al*, 2017; He *et al*, 2017). Norovirus is widely distributed in the environment and has a strong tolerance to temperature, humidity and other environmental changes. The infection has obvious seasonality. It mostly occurs in autumn and winter, also known as 'winter vomiting disease'. Schools are common settings for norovirus outbreaks in developed and developing countries (Ahmed *et al*, 2013; Matthews *et al*, 2012). However, most studies covered outbreaks in long-term care facilities, hospitals, prisons and nursing homes, with fewer studies covering schools or kindergartens (Greig and Lee, 2009; Harris *et al*, 2010; Greig *et al*, 2011).

Norovirus has caused a heavy economic burden worldwide, but so far no effective drug has been developed to prevent norovirus infection (Hall *et al*, 2016). For this reason, health promotion using health education is considered one of the most effective measures for preventing norovirus infection. In recent years, great progress has also been made in the study of norovirus etiology, transmission routes, disease burden and vaccine. However, few studies have been conducted on the knowledge, attitudes and practices (KAP) of the population, as the KAP information can be used for comprehensively planning the behavior change in health promotion program. It was assumed that the improved KAP level of a population can effectively prevent and control vector-borne diseases. Therefore, this study investigated the baseline status of norovirus infection among primary and junior middle school students considering that it is easier and more convenient to conduct surveys for health promotion using school students. The study then explored the factors influencing KAP in Chizhou, China, thus providing the scientific basis for future health surveillance and prevention of this infection.

MATERIALS AND METHODS

Study samples

This study used a multistage stratified random sampling method. A junior middle school in an urban area

and a primary school in a rural area were selected in each county/district of Chizhou, including Guichi District, Dongzhi County, Qingyang County and Shitai County (Fig 1). Eight junior middle schools and primary schools were selected for this study (Fig 2). Among them, the seventh, eighth and ninth grade students of junior middle schools were randomly chosen as one class. Because of the difficulty in understanding the questionnaire, the fourth, fifth and sixth grade students of primary schools were randomly chosen as another class.

Sample size calculation

Sample size was calculated using the following formula:

$$n = \frac{Z^2 p(1-p)}{d^2}$$

where n is the sample size, Z denotes Z statistic for a level of 95% confidence (equivalent to 1.96), p denotes expected prevalence or proportion (in this case p = 0.44) and d is the precision (5% or 0.05) (Gong *et al*, 2019). Such calculation resulted in a sample size of 494. A pre-survey was conducted among 30 students from an urban junior middle school in Guichi District and 30 students from a rural primary school in Dongzhi County. The awareness rate was 44.0%. The Cronbach coefficient was calculated to be 0.823. Considering the method of stratified sampling in urban and rural areas and the loss of sample size, the sample size was multiplied by 2 and then increased by 10%. Therefore, the required sample size was at least 1087.

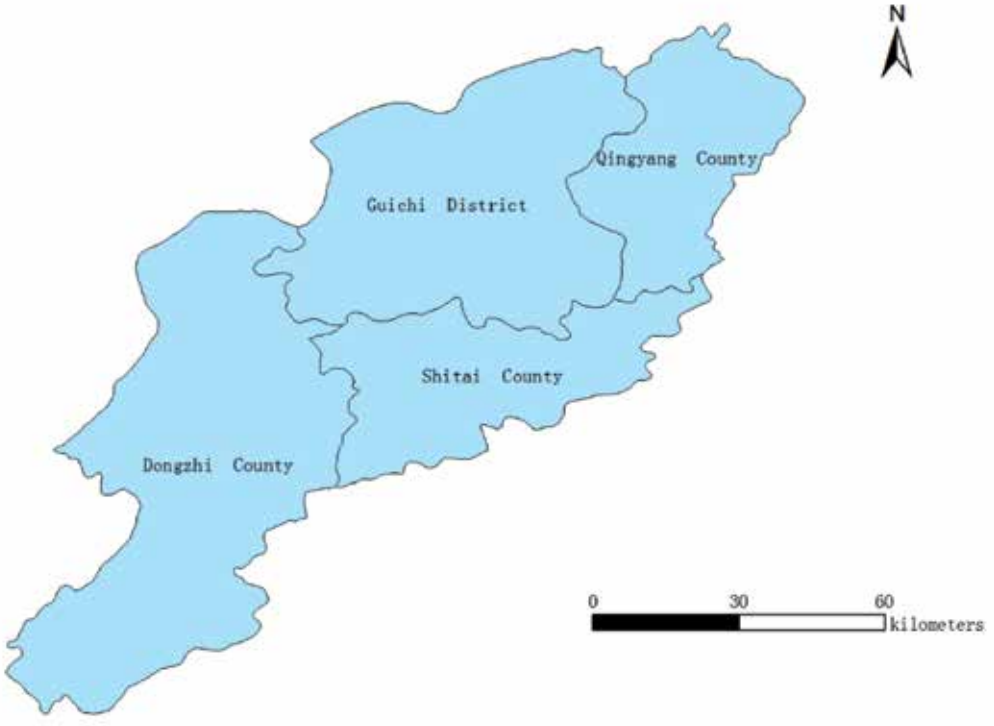

Fig 1-Map of Chizhou City showing the location of the four counties (districts).

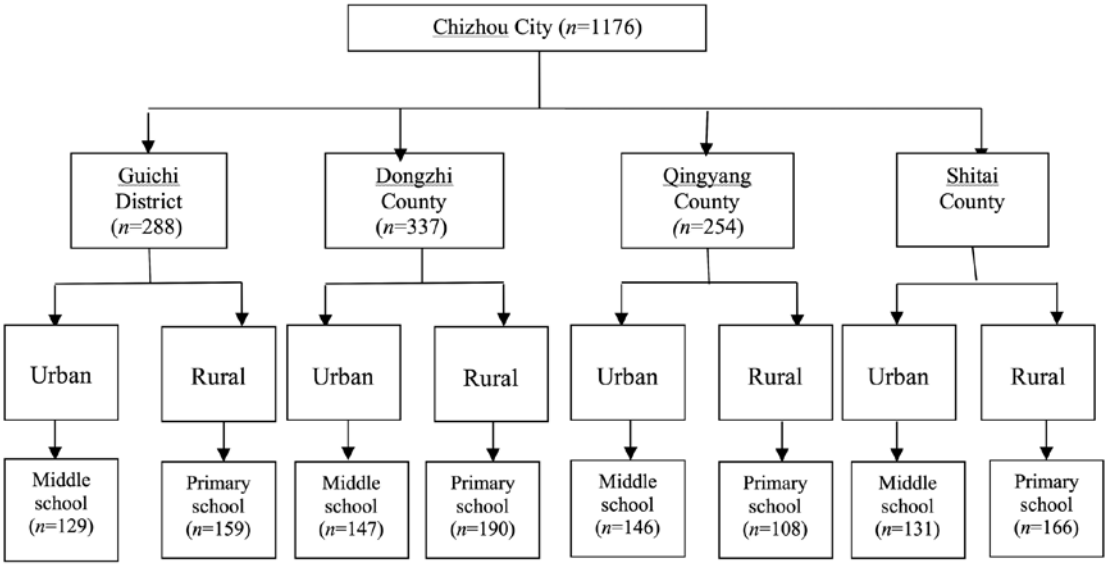

Fig 2-Sampling diagram of the study

A junior middle school in urban area and a primary school in rural area were selected in each county / district of Chizhou and its includes Guichi District, Dongzhi County, Qingyang County and Shitai County. A total of eight junior middle schools and primary schools were selected.

Questionnaire

Referring to the study by Lyu and coworkers in 2018, experts with experience in infectious disease research prepared a questionnaire, which was revised after a preliminary investigation. A questionnaire survey was conducted in Chizhou primary and junior middle schools in April 2019. The contents of the questionnaire mainly followed to the 'technical guidelines for investigation and prevention and control of norovirus infection' (2015 edition) (Chinese CDC, 2015). The contents comprised 21 questions, including the general situation of the respondents, basic knowledge of norovirus infection, route of transmission, etiology, symptoms and signs, living habits, attitude to medical isolation and eating and drinking habits.

Scoring

For the MCQs with one-correct answer questions, the correct or incorrect answers to questions scored 2 or 0, respectively. In addition, for multiple-choice questions, 1 point was scored for each correct answer and 1 point for each 'occasional' answer to practical questions, with no 'often' option. No score was given for a "no" or "disagree" option. The maximum KAP score for knowledge, attitude and practices per participant was 15, 12 and 12, respectively. P_{90} values of KAP scores were calculated; scores equal to and greater than the P_{90} value were defined as good, while those less than the P_{90} value were defined as poor (Gong *et al*, 2019).

Quality control

The investigators were allowed to participate in on-site surveys after passing the unified and strict training. The questionnaires were collected on the spot, and if omission or ambiguity were found in the questionnaires, they were corrected

on the spot. The completed questionnaires were checked by the investigators, and the invalid ones were rejected. The database was established using EpiData 3.1 software (Available from: URL: http://www.pc6.com/softview/SoftView_84540.html), and all questionnaires were recorded by the double-entry method to ensure the accuracy of data.

Statistical analysis

Data were statistically analyzed using the Statistical Package for the Social Sciences (SPSS) version 10.01 (Statistical Product and Service Solutions, Chicago, IL). The chi-square test was used to compare the rates and significant association between the groups. The variables related to the KAP score were screened by a single-factor analysis, and then the influencing factors of the KAP score were determined by single-factor and multi-factor logistic regression analyses. The variables with $p < 0.1$ were included in the multi-factor regression model. The linear correlation was used to analyze the correlation among knowledge, attitude and practices. The significance level (α) was set at 0.05.

Ethics statement

The study was approved by the academic committee of Bengbu Municipal Center for Disease Control and Prevention (2019001). In this study, the informed consent was signed; children aged 14 years or more signed the consent themselves, while the guardians signed on behalf of the children aged below 14 years.

RESULTS

Demographic characteristics

Table 1 shows the demographic characteristics of the study participants. A total of 1,176 valid questionnaires were collected. Of the 1,176 study participants, 624 (53.1%) lived in the city, 337 (28.7%) were from Dongzhi County, 591 (50.3%) were male and 623 (53%) had primary school education. The median age was 13 (9-17) years; majority of the participants were in the 12-14 years-age group (43.0% of the total).

KAP scores for norovirus infection

The KAP scores of primary and junior middle school students in Chizhou City with norovirus infection are given in Table 2. The average knowledge score of

Table 1
Demographic features of the study participants.

Variable	Participants (n=1176)	
	No.	%
Residence		
City	624	53.1
Countryside	552	46.9
County /District		
Guichi District	288	24.5
Dongzhi County	337	28.7
Qingyang County	254	21.6
Shitai County	297	25.3
Sex		
Male	591	50.3
Female	585	49.7
Educational level		
Primary school	623	53.0
Junior middle school	553	47.0
Age groups(year)		
9-11	427	36.3
12-14	506	43.0
15-17	243	20.7

Table 2
KAP scores of primary and junior middle school students in Chizhou City in regards to norovirus infection.

Question	Score		
	setting	$\bar{x} \pm SD$	%
Knowledge score	15	9.8±3.6	65.3
Whether know norovirus	2	1.3±1.0	64.8
Main symptoms	4	2.4±1.2	59.0
Disease severity	2	0.8±0.7	38.6
Whether norovirus infection	2	1.7±0.7	84.7
Mode of Transmission	3	1.8±1.1	60.7
Whether correct handling of vomit	2	1.9±0.5	92.5
Attitudes score	12	11.6±1.2	96.3
Home isolation of cases is necessary	2	1.8±0.6	91.8
Communication with parents is necessary	2	2.0±0.3	98.1
Wash hand before cooking rice is not convenient	2	2.0±0.3	97.7
Whether health education in school is sufficient	2	2.0±0.3	98.4
Morning inspection and midday inspection of primary and junior middle school students is effective to prevent infection	2	1.9±0.5	94.1
Get more knowledge from health education is needed	2	2.0±0.3	97.6
Practices score	12	10.4±1.5	86.9
Wash your hands before eating and after defecating	2	1.7±0.5	87.0
Drink untreated water	2	1.7±0.6	85.0
Eat raw food	2	1.8±0.4	91.4
Eat street food	2	1.3±0.6	65.6
Wash fruit	2	1.9±0.4	94.9
Report the outbreak to the teacher	2	2.0±0.3	97.5

Setting: score setting determined based on the questionnaire; $\bar{x} \pm SD$: average score + standard deviation; %: percentage of correct answers.

norovirus infection in Chizhou primary and junior middle schools was (9.8 ± 3.6), and the scoring rate was 65.3%. The highest knowledge score for the question on 'correctly handling vomit' was 92.5%. The lowest knowledge score for the question on 'severity of disease' was 38.6%. The average attitude score was (11.6 ± 1.2), and the scoring rate was 96.3%. The highest attitude score for the question on 'health promotion' was 98.4%. The lowest attitude score for the question

on 'case isolation at home' was 91.8%. The average practice score was (10.4 ± 1.5), and the scoring rate was 86.9%. The highest practice score for the question on 'reporting the epidemic situation to teachers' was 97.5%. The lowest practice score for the question on 'eating street food' was 65.6%. The average KAP scores of norovirus infection in primary and junior middle schools were statistically significant in Chizhou City ($\chi^2 = 5384.940$, $p < 0.001$).

The correlation analysis of the KAP revealed positive correlations between knowledge and attitude ($r = 0.226$, $p < 0.01$), between knowledge and practice ($r = 0.192$, $p < 0.01$) and between attitudes and practices ($r = 0.181$, $p < 0.01$).

Univariate logistic regression analysis for identifying the risk factors of KAP

The results of the univariate logistic regression analysis are shown in Table 3. The univariate logistic regression analysis revealed residence, county/district, sex, education level and age group as the five independent variables. The dependent variables were knowledge score, attitude score and practice score (score ≥ P_{90} (90% of the total score) = 1, score < P_{90} = 0). The results showed that four independent variables, namely residence, county/district, education and age group, were statistically correlated with knowledge scores. An independent variable, county/district, was statistically correlated with the attitude score. It might be a single-variable influencing factor for KAP. Four independent variables, residence, county/district, education and age group, were statistically correlated with practice scores ($p < 0.05$).

Multivariate logistic regression analysis for identifying risk factors

The results of the binary logistic regression analysis are presented in Table 4. Four independent variables, namely county/district, education level, sex and age group, were statistically correlated with the knowledge score. According to the regression coefficient, the county/district had the highest impact and sex had the lowest impact. An independent variable, namely county/district, was statistically correlated with the attitude score. According to the results of multi-factor analysis, only the county/district was the influencing factor. Two independent variables, namely county/district and education level, were statistically correlated with the practice score. According to the results of binary logistic regression analysis, the county/district was the common influencing factor for KAP.

DISCUSSION

Norovirus infection has become a global public health hotspot in recent years, especially in Asia and other regions (Hall *et al*, 2016). Most people did not know about norovirus infection, nor did they know how to prevent and control related diseases (Santos *et al*, 2017; Teunis *et al*, 2008; Cates *et al*, 2015). Adequate knowledge may lead to appropriate attitudes and good practices (Rui *et al*, 2015). However, previous studies did not target health promotion related to the prevention and control of norovirus infection, and domestic studies on the KAP score of norovirus infection and its influencing factors were still few. This cross-sectional survey aimed to assess KAP of norovirus infection among primary and junior middle school students in Chizhou City, explore its influencing factors and provide a scientific basis for formulating targeted health education strategies. In this survey, samples were collected by

Table 3
Univariate analysis of norovirus infection knowledge, attitudes, and practices score of primary and junior middle school students.

Variable	Knowledge score			Attitudes score			Practices score		
	Good knowledge* *n* (%)	OR (95% CI)	*p*-value	Good attitudes* *n* (%)	OR (95% CI)	*p*-value	Good practices* *n* (%)	OR (95% CI)	*p*-value
Residence									
City	131 (21.0)	1		528 (84.6)	1		167 (26.8)	1	
Countryside	35 (6.5)	0.255 (0.172-0.377)	< 0.001	453 (82.1)	0.832 (0.612-1.132)	0.241	114 (20.1)	0.712 (0.543-0.935)	0.014
County / District									
Guichi District	105 (36.5)	1		256 (88.9)	1		105 (36.5)	1	
Dongzhi County	30 (8.9)	0.170 (0.109-0.266)	< 0.001	303 (89.9)	1.114 (0.669-1.856)	0.679	72 (21.4)	0.474 (0.332-0.675)	< 0.001
Qingyang County	16 (6.3)	0.117 (0.067-0.205)	< 0.001	197 (77.6)	0.432 (0.270-0.692)	< 0.001	35 (13.8)	0.279 (0.181-0.428)	< 0.001
Shitai County	15 (5.1)	0.093 (0.052-0.164)	< 0.001	225 (75.8)	0.391 (0.248-0.615)	< 0.001	69 (23.2)	0.527 (0.368-0.757)	0.001
Sex									
Male	72 (12.2)	1		487 (82.4)	1		141 (23.9)	1	
Female	94 (16.1)	1.380 (0.991-1.921)	0.056	494 (84.4)	1.159 (0.852-1.577)	0.347	140 (23.9)	1.004 (0.768-1.313)	0.976
Educational level									
Primary school	102 (16.4)	1		524 (84.1)	1		195 (31.3)	1	
Junior middle school	64 (11.6)	0.669 (0.478-0.935)	0.018	457 (82.6)	0.899 (0.661-1.223)	0.499	86 (15.6)	0.404 (0.304-0.538)	< 0.001
Age groups (year)									
9-11	94 (22.0)	1		351 (82.2)	1		145 (34.0)	1	
12-14	39 (7.7)	0.296 (0.199-0.441)	< 0.001	434 (85.8)	1.305 (0.918-1.855)	0.138	98 (19.4)	0.467 (0.347-0.629)	< 0.001
15-17	33 (13.6)	0.557 (0.361-0.858)	0.008	196 (80.6)	0.903 (0.603-1.352)	0.620	38 (15.6)	0.361 (0.242-0.538)	< 0.001

* scores equal to and greater than the P90 value were defined as good.

Table 4
Multivariate logistic analysis of norovirus infection knowledge, attitudes, and practices scores of primary and junior middle school students.

Variable	B	SE	Wald	*p*-value	OR (95%CI)
			Knowledge score		
County / District					
Guichi District					1
Dongzhi County	-1.794	0.233	59.184	< 0.001	0.166 (0.105-0.263)
Qingyang County	-2.121	0.292	52.822	< 0.001	0.120 (0.068-0.212)
Shitai County	-2.361	0.297	63.262	< 0.001	0.094 (0.053-0.169)
Educational level	0.87	0.396	4.842	0.028	2.388 (1.100-5.184)
Sex					
Male					1
Female	0.409	0.186	4.825	0.028	1.506 (1.045-2.169)
Age groups (year)					
9-11					1
12-14	-1.747	0.366	22.781	< 0.001	0.174 (0.085-0.357)
15-17	-1.545	0.461	11.231	0.001	0.213 (0.086-0.526)
			Attitude score		
County / District					
Guichi District					1
Dongzhi County	0.108	0.261	0.172	0.679	1.114 (0.669-1.856)
Qingyang County	-0.839	0.24	12.192	< 0.001	0.432 (0.270-0.692)
Shitai County	-0.94	0.231	16.519	< 0.001	0.391 (0.248-0.615)
			Practice score		
County / District					
Guichi District					1
Dongzhi County	-0.785	0.184	18.165	< 0.001	0.456 (0.318-0.654)
Qingyang County	-1.208	0.223	29.446	< 0.001	0.299 (0.193-0.462)
Shitai County	-0.67	0.188	12.748	< 0.001	0.512 (0.354-0.739)
Educational level					
Primary school					1
Junior middle school	-0.881	0.148	35.239	< 0.001	0.414 (0.310-0.554)

B: regression coefficient; SE: standard error; Wald: wald value; OR (95% CI): Odds ratio (95% confidence interval.

multistage stratified random sampling in each county/district of Chizhou City. Strict quality control was maintained for the whole process, and the sample size was enough to represent the population of interest.

The survey showed that the overall attitude score of primary and junior middle school students in Chizhou City was as high as 96.3%, indicating that primary and junior middle school students were in favor of the prevention and control of norovirus infection. The practice scoring rate followed the attitude

scoring rate, indicating the general compliance of primary and junior middle school students. The knowledge scoring rate (65.3%) was the lowest, but higher than the 46.8% in the United States as reported by Cates *et al* (2015). The three lowest knowledge scores of norovirus infection were for the questions on severity of illness, main symptoms and mode of transmission. This study showed that primary and junior middle school students in Chizhou City had less knowledge about norovirus infection, had positive attitudes on norovirus control and needed to further strengthen their behavioral practice.

The survey showed participants with a high knowledge score of norovirus infection had higher attitudes and practice scores. Positive knowledge-attitude, attitude-practices and knowledge-practice correlations were previously reported (Rui *et al,* 2015; Yu *et al,* 2011; Frange *et al,* 2012). Therefore, health promotion should be strengthened to improve the awareness of primary and junior middle school students regarding the KAP level of norovirus infection in Chizhou City.

The multivariate regression analysis showed that the county/district where primary and junior middle school students lived was an important independent influencing factor for the KAP score of norovirus infection. The scores of Guichi District were higher, while those of Shitai County were relatively lower, suggesting that they might be related to the economy of Chizhou City. The more developed the economy, the better developed the health resources. According to the 2018 statistical yearbook of Chizhou City, the Gross Domestic Product of Guichi District and Shitai County was RMB2,793,348 million and RMB261,952 million, respectively (Chizhou City Statistics Bureau, 2017). The education level influenced both knowledge and practice scores; the higher the education level, the lower the scoring rate. This might be related to the heavy academic burden and learning pressure of junior middle school students, which restricted students' attention to other things and their own practice (He and Wang, 2018). In addition, sex and age group also affected the knowledge scores; female students in the lower age group had better knowledge scores, which was consistent with the findings of most studies (Xue *et al,* 2018; Hu, 2015). Girls' compliance was good, and their learning tasks were light when they were young. Therefore, future studies on health promotion should adopt different ways to treat students of different age groups and sex.

Although the present study provided some valuable information and strong evidence for the KAP of norovirus health education, it still had some limitations. Firstly, this was a cross-sectional study; valuable information for targeted health education was provided but the correlation could not be verified. Secondly, the scope of the survey was mainly limited to one city and the study population belonged to only primary and secondary schools in Chizhou City. Hence, the extrapolation of the sample was limited to some extent.

In conclusion, primary and junior middle school students in Chizhou had a good attitude and practice compliance in the prevention and control of norovirus infection. However, their professional knowledge still needed to be further improved. The process of changing from knowledge to practice was influenced by many factors, such as region, education level, age and sex. Therefore, it was necessary to carry out comprehensive health education and health promotion

activities in various forms acceptable to students in primary and junior middle schools so as to continuously improve their knowledge level on norovirus infection, promote the formation of correct attitudes and beliefs and, ultimately, form a good practice to prevent norovirus infection. Health education methods should be improved and the demarcation between knowledge, attitude and practice should be changed.

ACKNOWLEDGEMENTS

The authors would like to thank Mr Lyu Yong of Lu'an centre, Ms Xu Fang of Chizhou centre, TaoLiu of Guichi District Centre, Huawei Zhu of Dongzhi County Centre, Le Du of Qingyang County Centre and Sheng Yin of Shitai County Centre for Disease Control and Prevention. They also thank other relevant personnel for their strong support during this study.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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