Title: Status of 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 understand the status of knowledge, attitudes, and practices (KAP) of norovirus infection among primary and junior middle school students in Chizhou City, explore its influencing factors. A multistage stratified random sampling method was used to randomly select 1200 students from 8 primary and junior middle schools for the effective questionnaire survey in Chizhou City. A multivariate logistic regression analysis was used to analyse the possible influencing factors. Of 1176 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 of 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, their professional knowledge still needed further improvement.

Key words: attitudes, and practices; health education; influencing factors; knowledge; norovirus

Introduction

Norovirus is now considered to be the leading cause of acute gastroenteritis in all age groups and is spread worldwide [1]. In 1972, a 27-nm virus particle was isolated from stool samples during a school outbreak of acute nonbacterial gastroenteritis in Nowak [2]. Norovirus infection usually has mild symptoms. Diarrhoea and vomiting are common. It is characterized by a short incubation period, strong infectivity and multiple transmission routes. From 1995 to 2000, more than 85% of outbreaks of viral gastroenteritis were caused by norovirus [3]. In developed countries, 42%–90% of the pathogens of nonbacterial diarrhoea outbreaks were norovirus [4]. From a global perspective, the greatest public health burden from norovirus infection is undoubtedly exacted on developing countries, where diarrhoeal diseases are among the leading causes of death [5]. The World Health Organization estimated that norovirus infection annually caused 685 million cases of diarrhoea and 212,489 deaths, with 85% of these illnesses and 99% of the deaths occurring in developing countries [6]. In China, since the first case of norovirus infection reported in 1995, the disease has erupted in Beijing, Shanghai, Zhejiang and other regions. Cases and deaths caused by the disease have seriously threatened human health [7-9].

The main mode of transmission of norovirus is faecal–oral route, mainly through direct person-to-person transmission, but also through contaminated water, food, surface, vomit aerosol and other pollutants. Moreover, studies have shown that norovirus carries a risk of persistent infection in immunodeficient patients [10]. Norovirus poses a serious risk of secondary transmission, and may also spread between biological species [11-12]. 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 [13-14]. However, most studies covered outbreaks in long-term care facilities, hospitals, prisons and nursing homes, with less analysis on schools or kindergartens [15-17].

Norovirus has caused a heavy economic burden worldwide, but so far no effective drug has been developed to prevent norovirus infection [6]. For this reason, health education is considered the most effective measure for preventing norovirus infection. In recent years, great progress has also been made in the study of norovirus aetiology, transmission routes, disease burden and vaccine; however, a few studies have been conducted on knowledge, attitudes and practices (KAP) of the population. Therefore, this study investigated the baseline status of norovirus infection among primary and junior middle school students and explored the relevant influencing factors in Chizhou, China, thus providing the scientific basis for determining the core information of health education in the future.

Materials and methods

Setting

A multistage stratified random sampling method was used in this study. 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. A total of eight junior middle schools and primary schools were selected (Fig.1.). Among them, the seventh, eighth and ninety-third grades of junior middle schools randomly chose one class. Owing to the difficulty in

understanding the questionnaire, the fourth, fifth and sixth grades of primary schools randomly chose one class, and the number of students in the class was surveyed.

Sample

The sample size was calculated using the following formula: $n = \frac{Z^2 p(1-p)}{d^2} = 494$, $d = 0.1 \times p$, $Z = 1.96$, $P = 0.44$. (referring to the study by Gong Lei [18], 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.

Questionnaire

Referring to the study by Lyu Yong [19], 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 were mainly according to the 'technical guidelines for investigation and prevention and control of norovirus infection' (2015 edition) [20]. The contents comprised 21 questions, including the general situation of the respondents, basic knowledge of norovirus infection, route of transmission, aetiology, symptoms and signs, living habits, attitude to medical isolation and eating and drinking habits.

Score setting

The correct or incorrect answers to questions scored 2 or 0, respectively, in single-choice questions. In addition, for multiple-choice questions, one point was scored for each correct answer and 1 point was scored for each 'occasional' answer to practical questions, with no 'often' 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 [18].

Quality control

The investigators were allowed to participate in on-site questionnaires after passing the unified and strict training. The questionnaires were collected on the spot, and if problems such as omission and ambiguity were found, they were supplemented and corrected on the spot. The questionnaires were collected and checked, and the unqualified questionnaires were checked out. All questionnaires were recorded by the double-entry method to ensure the accuracy of data.

Statistical analysis

Data were statistically analysed using the SPSS version 10.01 (Statistical Product and Service Solutions, Chicago, IL, USA). The chi-square test was used to compare the rates 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 analyse the correlation among knowledge, attitude and practices. The significance level (α) was set at 0.05.

Ethics statement

Our study was approved by academic committee of Bengbu Municipal Center for Disease Control and Prevention (2019001). In this study, the informed consent was signed, and the children 14 or above signed by themselves, and the children below 14 signed by their guardians.

Results

Demographic features

Table 1 shows the demographic features of the study participants. A total of 1200 points were distributed and 1176 valid questionnaires were collected, with an effective rate of 98%. Of 1176 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; the 12- to 14-year-old age group was the largest (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 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 of ‘correctly handling vomit’ was 92.5%. The lowest knowledge score of ‘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 of ‘propaganda and education’ was 98.4%. The lowest attitude score of ‘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 of ‘reporting the epidemic situation to teachers’ was 97.5%. The lowest practice score of ‘eating vendors’ 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 risk factors

The results of the univariate logistic regression analysis are shown in Table 3. The univariate logistic regression analysis revealed residence, county, sex, education level and age group as the five independent variables. The dependent variables were knowledge score, attitude score and practice score (score $\geq P_{90} = 1$, score $\leq P_{90} = 0$). The results showed that the four independent variables of residence, county/district, education and age group statistically correlated with knowledge scores. An independent variable of the county/district statistically correlated with the attitude score. The four independent variables of residence, county/district, education and age group statistically correlated with practices scores.

Multivariate logistic regression analysis for identifying risk factors

The results of the binary logistic regression analysis are presented in Table 4. The four independent variables of the county/district, education level, sex and age group statistically correlated with the knowledge score. An independent variable of the county/district statistically correlated with the attitude score. The two independent variables of county/district and education level statistically correlated with the practice score.

Discussion

Norovirus infection has become a global public health hotspot in recent years, especially in Asia and other regions [6]. Most people did not know about norovirus infection, nor did they know how to prevent and control related diseases [21-23]. Adequate knowledge can lead to appropriate attitudes, resulting in good practices [24] However, health education related to the prevention and control of norovirus infection was not targeted, and domestic studies on the KAP score of norovirus infection and its influencing factors were still lacking. This cross-sectional survey aimed to understand the status of 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 multistage stratified random sampling in each county/district of Chizhou City. The whole process had strict quality control, and the sample size was enough. Therefore, the results had good representativeness.

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 willing to prevent and control norovirus infection. The practice scoring rate was second, indicating that the compliance of primary and

junior middle school students was general. The knowledge scoring rate (65.3%) was the lowest but higher than that reported by Sheryl C. Cates [23] in the United States in 2015 (46.8%). The three lowest knowledge scores of norovirus infection were for 'severity of illness (38.6%)', 'main symptoms (59.0%)' and 'mode of transmission (60.7%)'. This study showed that primary and junior middle school students in Chizhou City lacked knowledge about norovirus infection, had positive attitudes and needed to further strengthen their behavioural practice. The findings were consistent with the analysis of Zhao Mengli [25] on the KAP of rehabilitation exercise and its influencing factors in patients with coronary heart disease.

The survey showed that participants with a high knowledge score of norovirus infection had higher attitudes and practice scores compared with those with a low knowledge score. Positive knowledge–attitude, attitude−practices and knowledge–practice correlations were reported by Haq et al. [26]. Therefore, the specialty of health education should be strengthened to improve the KAP of norovirus infection in primary and junior middle school students 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 development of culture and health resources was related to unbalanced distribution. According to the 2018 statistical yearbook of Chizhou City, the Gross Domestic Productof Guichi district was 2,793,348 million yuan, while that of Shitai county was 261,952 million yuan [27]. 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 [28]. In addition, sex and age group also affected knowledge scores; female students in the lower age group have better knowledge scores, which was consistent with the findings of most studies [29-30]. Therefore, it was suggested that different ways should be adopted to treat students of different age groups and sex in future studies on health education.

The present study had some limitations. Although the study provided some valuable information and strong evidence for the KAP of norovirus health education, it still had some deficiencies. First, this was only a baseline survey of the KAP of norovirus infection; no systematic and long-term intervention and evaluation were carried out. Therefore, continuous follow-up studies are needed in the future. Second, this was a cross-sectional study. It provided valuable information for targeted health education, but the correlation could not be verified. Third, despite adopting the method of stratified cluster random sampling in the research design and calculating the sample size according to the pre-survey, the scope of the survey was mainly limited to one city and the population was only for primary and secondary schools. Hence, the extrapolation of the sample was limited to some extent.

Conclusions

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 the knowledge level of norovirus infection, especially for the key population, 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.

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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 Score of primary and junior middle school students in Chizhou city with norovirus infection of knowledge, attitudes, and practices

Question	Score		
	setting	$\bar{x}\pm s$	%
Knowledge score	15	9.8±3.6	65.3
Whether know	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 infection	2	1.7±0.7	84.7
Mode of communication	3	1.8±1.1	60.7
Correct handling of vomit	2	1.9±0.5	92.5
Attitudes score	12	11.6±1.2	96.3
Home isolation of cases	2	1.8±0.6	91.8
Communicate with parents	2	2.0±0.3	98.1
Wash your hands before the rice then empress	2	2.0±0.3	97.7
Publicity and education	2	2.0±0.3	98.4
Morning Inspection and Midday Inspection	2	1.9±0.5	94.1
Get knowledge	2	2.0±0.3	97.6
Practices score	12	10.4±1.5	86.9
Wash your hands before the rice then empress	2	1.7±0.5	87.0
Drink raw water	2	1.7±0.6	85.0
Eat raw food	2	1.8±0.4	91.4
Food vendors	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

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，N（%）	OR（95%CI）	*P-value*	Good，N（%）	OR（95%CI） (95%CI)	*P-value*	Good，N（%）	OR（95%CI）	*P-value*
Residence									
City=1	131（21.0）	1.0		528（84.6）	1.0		167（26.8）	1.0	
Countryside=2	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=1	105（36.5）	1.0		256（88.9）	1.0		105（36.5）	1.0	
Dongzhi County=2	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=3	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=4	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=1	72（12.2）	1.0		487（82.4）	1.0		141（23.9）	1.0	
Female=2	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=1	102（16.4）	1.0		524（84.1）	1.0		195（31.3）	1.0	
Junior middle school=2	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 =1	94（22.0）	1.0		351（82.2）	1.0		145（34.0）	1.0	
12-14=2	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=3	33（13.6）	0.557（0.361-0.858）	0.008	196（80.6）	0.903（0.603-1.352）	0.62	38（15.6）	0.361（0.242-0.538）	< 0.001

Table 4 Multivariate Logistic of norovirus infection knowledge, attitudes, and practices score of primary and junior middle school students

Variable	B	SE	Wald	*P*-value	OR（95%CI）
			Knowledge score		
County /district					
Guichi District					1.0
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	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）
			Attitudes score		
County /district					
Guichi District					1.0
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）
			Practices score		
County /district					
Guichi District					1.0
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	-0.881	0.148	35.239	< 0.001	0.414（0.310-0.554）

Figure legends

No.	Captions
Fig. 1.	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.