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Knowledge, Attitudes, and Practices Toward COVID-19 Among Rural Residents of Hebei Province: A Cross-Sectional Survey

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Abstract

Objective: Coronavirus disease (COVID-19) has spread worldwide due to high infectivity. The social sexual environment in rural areas of China and the weak basic medical facilities may affect the treatment and transmission of the disease. The aim of this study was to understand the knowledge, attitudes, and practices (KAP) related to COVID-19 among residents in rural areas experiencing the epidemic and the factors, to provide a basis for further epidemic prevention and control.

Methods: The COVID-19 KAP of rural residents in Hebei Province was collected by the snowball sampling method. The COVID-19 KAP questionnaire was distributed on social platforms such as WeChat and QQ through a network questionnaire.

Results: The overall level of COVID-19 KAP in rural residents was good, but in terms of knowledge, the correct rate of isolation was 73.2%, the correct rates of 2 disinfection items were 72.3% and 77.4%, and the correct rate of hand-washing was 70.7%; 54.5% residents felt panic; 81.0% disinfected household items; and 84.9% washed their hands correctly. Residents still needed to strengthen these aspects. A binary logistic analysis showed that age, education, and participation in training were factors affecting the level of COVID-19 KAP.

Conclusions: This study found that rural residents had good levels of COVID-19 KAP, but there were gaps in specific issues that warrant attention. We advocate training on COVID-19 for rural residents.

Since December 2019, there has been an outbreak of coronavirus disease (COVID-19),[1] which has spread worldwide. COVID-19 is extremely contagious,[2] and the outbreak of the disease has seriously threatened global health and challenged economic and social development.[3] The prevention and control of COVID-19 focus on controlling the source of infection, cutting off the route of transmission, and protecting vulnerable groups. Individuals do their part by taking preventive and control measures, such as wearing masks, handwashing, and isolation, which are essential for controlling the pandemic.[4]

On January 2, 2021, Gaocheng District, Shijiazhuang City, Hebei Province reported the first local confirmed case in a rural area. By January 26, 2021, there had been 931 confirmed cases in Hebei Province. This outbreak occurred with clustered sexual transmission in rural areas; the infected population mainly consisted of rural residents. Rural areas are weak links and key locations in coping with public health emergencies due to the lack of medical facilities, prevention and control measures, and health care personnel.[5] Rural residents have significant shortcomings in risk awareness and level of public health knowledge.[6,7]

Studies have shown that residents' knowledge, attitudes, and practices (KAP) about COVID-19 influence their compliance with preventive and control measures.[4] According to the KAP model, knowledge is the foundation of behavior change, and attitude is the driving force of behavior change.[8] The success or failure of a country's implementation of epidemic prevention measures depends largely on the behavior of residents, and residents' knowledge and attitudes about COVID-19 may influence their compliance with government precautions.[9] Therefore, improving rural residents' knowledge of COVID-19 and cultivating an attitude of active prevention and control of COVID-19 are important for improving rural residents' COVID-19 behavior.

The purpose of this study is to evaluate the current situation of residents' COVID-19 KAP in rural areas during the COVID-19 outbreak, analyze the influencing factors of rural residents' COVID-19 KAP level, and provide a theoretical basis for relevant departments to further epidemic prevention and control and health education in rural areas.

Methods

Study Design and Population

From January 22 to 26, 2021, which was the rising period of new cases of COVID-19 in Hebei Province, the snowball sampling method was used to select residents in rural areas in Hebei Province as the study subjects. The study population included rural residents age 18 years and older who currently live in rural areas of Hebei Province, are able to complete the questionnaire using their own smartphones, and are able to read and understand the questionnaire content. Participation in this survey was anonymous, consensual, and voluntary, with informed consent given by all prospective respondents.

Measurement

Based on the COVID-19 prevention and control guidelines issued by the National Health Commission of the People's Republic China[10] and the Chinese Center for Disease Control and Prevention[11] and combined with relevant domestic and foreign literature,[4,12] a questionnaire on epidemic prevention for rural residents in Hebei Province was finally compiled. The contents included a general data questionnaire (including gender, age, marital status, education level, occupation, living situation, family income, whether to participate in COVID-19 training) and the COVID-19 KAP questionnaire, which was divided into 3 parts to assess knowledge (questions 1–10), attitudes (questions 11–20), and practices (questions 21–30). Responses were scored from 0–30. The higher the score, the better the study subjects' COVID-19 KAP. In this study, we determined that a high-level score was 27 points and above, and a low-level score was less than 27.[12]

Data Collection

Due to the epidemic and epidemic prevention requirements, participants could not be contacted face to face. A network questionnaire (questionnaire star) was used to distribute the questionnaire on social platforms such as WeChat and QQ. Some rural residents who met the inclusion criteria were selected as the initial survey subjects, and then they recommended additional respondents who met the inclusion criteria. This process was continued, which created a snowball effect. The online survey was carried out voluntarily, without involving any identifiable private information. The results showed that the Cronbach's α coefficient was 0.731, and the KMO was 0.780. To ensure the quality of the data, only 1 questionnaire per IP address was allowed. A total of 789 questionnaires were distributed, and 736 valid questionnaires were returned, with a valid recovery rate of 93.3%. All respondents voluntarily completed this questionnaire.

Statistical Analysis

The data were statistically analyzed using SPSS version 22.0 (IBM, Armonk, NY). Descriptive statistics such as frequencies and percentages were used to describe participants' characteristics and their knowledge, attitudes, and behavioral responses to COVID-19. Cross-tabular univariate analyses with chi-square or Fisher's exact tests were used to explore the relationship between basic characteristics of rural residents and COVID-19 KAP levels. The variables with statistical significance in univariate analysis ($P < 0.05$, 2-tailed variables) were the only variables analyzed using binary logistic regression modeling. The significance level was set at 0.05.

Results

Demographic Characteristics of the Studied Respondents

Of the total participants, 71.1% were female, 81.3% were over 30 years old, 66.3% had a junior high school education or less, 60.5% were farmers, 75.8% had an annual income of less than 50 000 CNY, and 53.7% did not participate in COVID-19-related training (Table 1).

COVID-19 Knowledge, Attitudes, and Practices Among Rural Residents

A survey of 736 rural residents in Hebei Province showed that most residents had a good understanding of COVID-19 and the population with the disease (96.1%, 90.5%). Residents had a higher understanding of wearing masks to reduce the transmission of COVID-19 (94.8%), but some residents had certain problems in the choice of masks (14.0%). Residents had a better understanding of public place precautions (84.2%) and cooperated with policies (86.1%). Compared with residents' understanding of masks (94.8%, 86.0%), isolation (73.2%), and disinfection (72.3%, 77.4%), the residents had a poor understanding of handwashing (70.7%) (Table 2).

Rural residents in Hebei Province expressed high recognition of the isolation policy (98.9%, 98.9%) and the requirements for not conducting clustered activities (98.0%), which were practices adopted by rural residents in the face of the epidemic. Residents held highly positive attitudes toward the treatment of the epidemic situation (93.8%) and the future of the epidemic (99.2%). Most residents expressed supportive attitudes toward the government's prevention and control work (99.5%), active reporting of the disease (98.9%), and cooperation with policies and procedures (98.8%). A total of 26.4% of the residents indicated that the outbreak had an impact on their lifestyles; 54.5% indicated that they still felt panicked about the COVID-19 condition around them (Table 3).

The survey showed that 99.2%, 99.5%, and 94.2% of residents actively reduced going out, wearing masks, and choosing private cars over public transportation when they had to go out, respectively; 84.9% of residents washed their hands correctly, 96.1% of residents took protective measures when they sneezed, 86.4% of residents disinfected frozen food and express deliveries, 81.0% disinfected household items, and 98.5% regularly opened windows for ventilation. If suspicious symptoms occurred during the epidemic, 98.6% of residents sought medical attention promptly, and 95.4% of residents actively measured their body temperature (Table 4).

Univariate Analysis of COVID-19 KAP Levels in Rural Residents

The results of the univariate analysis showed that age, education, and participation in relevant knowledge training on COVID-19 were all associated with differences in the level of COVID-19 KAP among rural residents ($P < 0.05$). Gender, occupation, marital status, mode of residence, and annual household income were not associated with the level of COVID-19 KAP among rural residents ($P > 0.05$) (Table 5).

Binary Logistic Regression Analysis of COVID-19 KAP Levels in Rural Residents

Binary logistic regression analysis was performed under the entry-level $\alpha = 0.05$ and the removal level $\beta = 0.10$ with the level of

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Table 1. Basic information of respondents

Characteristic	N	%
Gender		
Female	523	71.1
Male	213	28.9
Age		
≤ 30 years	137	18.6
31-50 years	294	39.9
> 50 years	305	41.4
Education		
Primary school or less	111	15.1
Junior high school	377	51.2
High school or secondary specialized school	221	30.0
College or above	27	3.7
Marital status		
Married	349	47.4
Unmarried	379	51.5
Divorced or other	8	1.1
Residence mode		
Living alone	42	5.7
Living with a spouse	193	26.2
Living with own children	27	3.7
Living with spouse, children, and grandchildren	56	7.6
Living with parents	375	51.0
Other	43	5.8
Occupation		
Farmer	445	60.5
Freelance or individual	254	34.5
Organ and staff	16	2.2
Student	11	1.5
Enterprise staff	8	1.1
Retired	2	0.3
Annual household income		
< 20 000 CNY	303	41.2
20 000–50 000 CNY	255	34.6
50 000–80 000 CNY	92	12.5
> 80 000 CNY	86	11.7
Whether participated in relevant knowledge training on COVID-19		
Yes	341	46.3
No	395	53.7

CNY, Chinese Yuan (currency).

COVID-19 KAP of rural residents (high-level assignment = 1, low-level assignment = 0) as the dependent variable and age, education, and participation in the COVID-19 training as independent variables. Three groups of variables—age, education, and participation in the training on knowledge of COVID-19—were set as dummy variables. The results showed that after controlling for confounding factors, the level of COVID-19 KAP was higher in people ≤ 30 and 31–50 years old than in people over 50 years old (OR = 2.116, 1.666); the level of COVID-19 KAP was higher in respondents with junior high school, high school or secondary specialized school, college and above education levels than in those in primary school or below (OR = 6.523, 6.610, 20.085); and the level of COVID-19 KAP was higher among individuals who had

Table 2. Knowledge of epidemic prevention of new crown among rural residents

Item	Yes (N)	No (N)	Correctness (%)
Are the main manifestations of COVID-19 patients: cough, fever, and fatigue?	707	29	96.1
Have you been in close contact with patients infected with novel coronaviruses and need to be isolated for 14 days?	539	197	73.2
Is clean water disinfection effective in preventing new crowns?	204	532	72.3
Are people with a balanced nutrition and eat a healthy diet susceptible to novel coronaviruses?	70	666	90.5
Does wearing a protective mask at the door reduce the spread of novel coronaviruses?	698	38	94.8
To strengthen self-protection, should you keep more than 1 meter from others in public places?	620	116	84.2
During the epidemic, should it not take less than 15 seconds to wash your hands to prevent infection?	520	216	70.7
Can a cotton mask be used as a daily option to prevent novel coronaviruses?	103	633	86.0
Is insisting on closing doors and windows the correct disinfection method after going home?	166	570	77.4
If you receive a notice from the Chinese Center for Disease Control and Prevention that you are in close contact with the novel coronavirus, is it correct to choose to go ahead and escape from the hardest-hit areas?	102	634	86.1

Table 3. Attitudes of rural residents to epidemic prevention of COVID-19

Item	Yes (N (%))	No (N (%))
Can you understand the suspected cases being quarantined?	728 (98.9)	8 (1.1)
Do you have a supportive attitude about taking isolation measures for people who come in contact with suspected COVID-19 patients?	728 (98.9)	8 (1.1)
Do you have an opposition attitude about people around want to conduct clustered activities during the outbreak?	721 (98.0)	15 (2.0)
Do you not panic if you have a patient with new crown pneumonia who is near you?	335 (45.5)	401 (54.5)
Will the outbreak of COVID-19 not have a large impact on your future behavioral lifestyle?	194 (26.4)	542 (73.6)
Do you think patients with COVID-19 can be effectively treated?	690 (93.8)	46 (6.3)
Do you think there will be an improvement in the form of the outbreak in the future?	730 (99.2)	6 (0.8)
Do you support the prevention and control measures taken by the government?	732 (99.5)	4 (0.5)
If someone around you is infected with the new type of coronavirus pneumonia, will you proactively report it?	728 (98.9)	8 (1.1)
Do you take the initiative to cooperate with the doctor to carry out a relevant flow check when seeking medical treatment?	727 (98.8)	9 (1.2)

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Table 4. Epidemic prevention practices of new crown among rural residents

Item	Yes (N (%))	No (N (%))
Did you reduce the number of times you went out during the outbreak?	730 (99.2)	6 (0.8)
Did you take the initiative to wear a mask when you went out during the outbreak?	732 (99.5)	4 (0.5)
Would you prefer a private car to go out if needed during the outbreak?	693 (94.2)	43 (5.8)
Do you use running water and hand sanitizer/ soap before eating or after going to the toilet?	625 (84.9)	111 (15.1)
Will you take the initiative to measure your own and your family's temperature after fever during the outbreak?	702 (95.4)	34 (4.6)
If you have suspicious symptoms, will you take the initiative to wear a mask and seek medical attention promptly?	726 (98.6)	10 (1.4)
Will you sterilize the outer packaging and then open it after purchasing frozen food or receiving the express?	636 (86.4)	100 (13.6)
Do you routinely sterilize household items (eg, cell phones, keys)?	596 (81.0)	140 (19.0)
Do you cover your mouth and nose with a tissue, handkerchief, or elbow when you sneeze?	707 (96.1)	29 (3.9)
Do you open windows regularly for ventilation during the outbreak?	725 (98.5)	11 (1.5)

participated in relevant knowledge training on COVID-19 than in those who had not (OR = 22.222) (Table 6).

Discussion

The Overall Epidemic Prevention and Control Situation Among Residents in Rural Areas

Through investigation, it was found that rural residents had a high awareness of knowledge related to COVID-19, and the awareness rate of all items was more than 70.0%, indicating that rural residents had good overall attention and an understanding of the pandemic. Residents had a high degree of awareness of the virus, the at-risk population, and mask wearing, which were consistent with the results of related studies.[13] This shows that the vigorous health education information disseminated by relevant government departments about the prevention and control of COVID-19 achieved great results. Rural residents performed well on COVID-19 attitudes except on panic items. Rural residents performed well in COVID-19 practice, and the correct rate of each item was above 70.0%. This shows that most rural residents have positive attitudes toward the prevention and control of COVID-19, give attention to the prevention and control of the epidemic, and have good overall prevention and control practices.

Weak Links in Epidemic Prevention and Control Among Residents in Rural Areas

The source of epidemic prevention knowledge of residents in rural areas is too fragmented and diversified, and there were some false and unconfirmed information, resulting in some blind spots or misunderstandings in residents' comprehension and implementation of relevant knowledge.[14,15] The transmission route of COVID-19 is mainly through respiratory droplets and close contact, and masks are an effective barrier to prevent such transmission.[16,17]

Table 5. Univariate analysis of COVID-19 KAP in rural residents

Characteristic	High level (N (%))	Low level (N (%))	*P*
Gender			
Female	238 (45.5%)	285 (54.5%)	0.105
Male	83 (39.0%)	130 (61.0%)	
Age			
≤ 30 years	85 (62.0%)	52 (38.0%)	0.000
31-50 years	149 (50.7%)	145 (49.3%)	
> 50 years	87 (28.5%)	218 (71.5%)	
Education			
Primary school or below	11 (9.9%)	100 (90.1%)	0.000
Junior high school	168 (44.6%)	209 (55.4%)	
High school or secondary specialized school	121 (54.8%)	100 (45.2%)	
College or above	21 (77.8%)	6 (22.2%)	
Marital status			
Married	141 (40.4%)	208 (59.6%)	0.108*
Unmarried	178 (47.0%)	201 (53.0%)	
Divorced or other	2 (25.0%)	6 (75.0%)	
Residence mode			
Living alone	18 (42.9%)	24 (57.1%)	0.859
Living with a spouse	82 (42.5%)	111 (57.5%)	
Live with your children	13 (48.1%)	14 (51.9%)	
Living with spouse, children, and grandchildren	21(37.5%)	35(62.5%)	
Living with parents	170 (45.3%)	205 (54.7%)	
Other	17 (39.5%)	26 (60.5%)	
Occupation			
Farmer	186 (41.8%)	259 (58.2%)	0.177*
Freelance or individual	123 (48.4%)	131 (51.6%)	
Organ and staff	5 (31.2%)	11 (68.8%)	
Student	5 (45.5%)	6 (54.5%)	
Enterprise staff	1 (12.5%)	7 (87.5%)	
Retired	1 (50.0%)	1 (50.0%)	
Annual household income			
< 20 000 CNY	129 (42.6%)	174 (57.4%)	0.375
20 000–50 000 CNY	116 (45.5%)	139 (54.5%)	
50 000–80 000 CNY	34 (37.0%)	58 (63.0%)	
> 80 000 CNY	42 (48.8%)	44 (51.2%)	
Whether participated in relevant knowledge training on COVID-19			
Yes	268 (78.6%)	73 (21.4%)	0.000
No	53 (13.4%)	342 (86.6%)	

*Fishers exact test; CNY, Chinese Yuan (currency).

There were some problems in rural residents' perception of cotton cloth masks in this study (14.0%). This reminds relevant government departments to focus on details in the process of publicity and education and to explain the best types of masks for prevention of transmission.

Standardized hand washing is the simplest and most economical way to interrupt disease transmission. However, the cognitive effect of knowledge about handwashing among rural residents

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Table 6. Logistic regression analysis of COVID-19 KAP level of rural residents

Independent variable	Reference group		B	SE	Wald	*P*	OR	95% CI
Age	> 50 years	≤ 30 years	0.749	0.306	5.985	0.014	2.116	1.161–3.857
		31–50 years	0.510	0.246	4.292	0.038	1.666	1.028–2.700
Education	Primary school or below	Junior high school	1.875	0.392	22.830	0.000	6.523	3.022–14.077
		High school or secondary specialized school	1.889	0.422	20.059	0.000	6.610	2.892–15.104
		College or above	3.000	0.702	18.286	0.000	20.085	5.078–79.440
Whether participated in relevant knowledge training on COVID-19	No	Yes	3.101	0.209	220.898	0.000	22.222	14.763–33.449

(70.7%) was slightly lower than that of a study in Iran (74.0%).[18] Approximately 84.9% of residents reported washing their hands with flowing water and hand sanitizer/soap before eating or after going to the toilet. This suggests that some rural residents have a weak awareness of hand hygiene and cannot ensure effective cleaning of the hands, which in turn affects the prevention and control of the epidemic.

In the process of fighting the epidemic, individuals who came in close contact with an infected person or had suspicious or mild symptoms were advised to isolate as the main preventive method to block the source of infection and the route of transmission.[19] This survey showed that rural residents had a weak understanding of isolation (73.2%) and may not have isolated for sufficient periods. In addition, this study showed that rural residents had some shortcomings in disinfection knowledge (72.3%, 77.4%) and practices (86.4%, 81.0%). Thus, residents in rural areas have certain problems in mask selection, hand hygiene, isolation, and disinfection, and these links are precisely the key links and measures for epidemic prevention and control. This may be an important reason for the COVID-19 outbreak in rural areas of Hebei Province.

Psychological problems were common among residents during the COVID-19 outbreak,[20,21] and a German study showed that more than half (59.0%) of its respondents reported an increased fear associated with COVID-19. During the current investigation, the epidemic in Hebei was on the rise, and there was an outbreak of rural cluster cases; more than half (54.5%) of rural residents said they still felt panic in the face of COVID-19 surrounding them. This suggests that the relevant government departments should take the necessary measures to determine the psychological problems of rural residents and provide corresponding psychological support, which is very important to effectively prevent and control the spread of the disease and reduce the psychological damage and subsequent psychosocial problems caused by the epidemic.[13,22]

Influencing Factors of Epidemic Prevention and Control Among Residents in Rural Areas

Binary logistic regression analyses revealed that the level of COVID-19 KAP was higher in rural residents with a junior high school degree or more than in those with a primary school degree or less. The higher the participants' level of education, the higher the level of their COVID-19 KAP. This may be because residents with higher education have a higher learning ability, higher mastery of relevant knowledge, and show stronger learning motivation, which is consistent with the relevant research results at home and abroad.[23–25] It is suggested that the relevant departments strengthen publicity and education on COVID-19 for less-educated residents of rural areas.

The level of COVID-19 KAP in rural residents who have participated in the training on epidemic prevention-related knowledge is higher than that in rural residents who have not participated, which has the same results as the investigation by Zheng,[26] and the relevant domestic training plays an important role in the prevention and control of the COVID-19 epidemic, suggesting that the training on epidemic-related knowledge in rural areas should be strengthened to better improve the epidemic prevention.

COVID-19 KAP levels were significantly higher in people ≤ 30 and 31–50 years of age than in people > 50 years of age, indicating that the older the resident was, the lower the level of COVID-19 KAP, which is consistent with the results of previous studies.[27] At present, publicity and education about the COVID-19 epidemic are based on multimedia and multiway publicity. Young people master relevant knowledge at a significantly greater level than do elderly individuals, which may also be related to the relative lack of learning ability and learning willingness among the elderly population, suggesting that the relevant departments should carry out corresponding offline publicity and education in combination with the local population distribution and the characteristics of the elderly population.

Suggestions on Epidemic Prevention and Control in Rural Areas

Systematic education, strengthening the relevant knowledge and beliefs of rural residents

Acquired knowledge and skills do not always translate into healthy behaviors, and it is not enough to improve the mastery of knowledge alone. Effective interventions to improve practice patterns should improve residents' knowledge mastery and attitudes.[28] Therefore, in the late prevention and control of the epidemic situation in rural areas, the relevant departments should cooperate with the grassroots health care staff to provide accurate, clear, continuous, and cutting-edge epidemic-related information for rural residents promptly. They should continuously and systematically carry out health education for rural residents, including relevant information on COVID-19 infection, behavioral norms during the epidemic period, ways to seek medical treatment, and ways to obtain information and psychological intervention. Eventually, the health beliefs of rural residents or patients will be improved, the transformation of individuals from knowledge to practice will be promoted, and their enthusiasm for disease coping will increase.

Supplement the shortboard to ensure that the key measures for epidemic prevention are implemented

Cancel the public health education for population gathering during the epidemic period, replace it with 24-hour telephone or online

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consultation services, or carry out health education and health consultation services through remote consultation centers and health groups.[29] Targeted, separate follow-up health education was conducted for rural residents who could not receive online consultation services to ensure that each resident could obtain health education and receive guidance in behavioral norms such as wearing masks, hand hygiene, isolation, and disinfection for rural residents in epidemic periods. When communicating with residents, attention should be given to the use of language. Professional terms should be avoided in favor of terms that are easy to understand, and the actual effect of communication with rural residents and patients should be considered and ensured.

In addition, we should make full use of the achievements of medical and health informatization construction, safely and efficiently carry out prevention and control of the epidemic situation using isolation, avoid the illegal gathering of groups of people who might transmit the infection, and prevent cross-infection between medical staff and isolated objects.[29] As the main measure to cut off the transmission route, disinfection is an important link in the control of infectious diseases, and people are paying increasing attention to the role of disinfection in the prevention and control of infectious disease epidemics.[30] In the process of health education, the relevant departments should intensify the popularization of disinfection-related contents for rural residents. At the same time, the courier industry should strengthen the disinfection of transported articles and cut off the transmission route. The quality inspection department should strengthen the inspection of frozen food and better ensure the food safety for the people.

This study has some limitations. Due to COVID-19 epidemic limitations, this study adopted a web-based survey approach, and there was some sample loss for people who did not have smartphones. Second, this study was conducted during the rising phase of the pandemic, which may only reflect our participants' response to COVID-19 KAP during the questionnaire collection. Finally, participants were limited to rural residents in Hebei Province, and further research should cover all rural areas of the country.

Conclusion

The outbreak of COVID-19 in rural areas of Hebei Province has given us a warning, that epidemic control in rural areas is an important part of epidemic prevention. This study found that rural residents had good COVID-19 knowledge, positive attitudes, and good practices during the COVID-19 outbreak. The results of this survey can provide a reference for the subsequent improvement of COVID-19 prevention publicity and health education in rural areas. Due to the limitation of sample representativeness, more research is needed to investigate the COVID-19 KAP among Chinese rural residents.

Data availability statement. All the data generated or analyzed during the study are included in this published article. The raw data of this research can be obtained by contacting the authors.

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Author contributions. The first author designed the study, collected and analyzed the data, and recorded the results. The second and third authors supported the first author in all aspects of the study. The fourth, fifth, sixth and seventh authors provided insight on the design, data analysis, and final write-up. All authors read and approved the final manuscript.

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Conflict(s) of interest. None.

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References

1. **Zhu N, Zhang D, Wang W, *et al.*** A novel coronavirus from patients with pneumonia in China, 2019. *N Engl J Med.* 2020;382(8):727-733. doi: 10.1056/NEJMoa2001017
2. **Wang D, Hu B, Hu C, *et al.*** Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. *JAMA.* 2020;323(11):1061-1069. doi: 10.1001/jama.2020.1585
3. **Bogoch II, Watts A, Thomas-Bachli A, *et al.*** Potential for global spread of a novel coronavirus from China. *J Travel Med.* 2020;27(2):taaa011. doi: 10.1093/jtm/taaa011
4. **Pal R, Yadav U, Grover S, *et al.*** Knowledge, attitudes and practices towards COVID-19 among young adults with type 1 diabetes mellitus amid the nationwide lockdown in India: a cross-sectional survey. *Diabetes Res Clin Pract.* 2020;166:108344. doi: 10.1016/j.diabres.2020.108344
5. **Cuadros DF, Branscum AJ, Mukandavire Z, *et al.*** Dynamics of the COVID-19 epidemic in urban and rural areas in the United States. *Ann Epidemiol.* 2021;59:16-20. doi: 10.1016/j.annepidem.2021.04.007
6. **Haischer MH, Beilfuss R, Hart MR, *et al.*** Who is wearing a mask? Gender-, age-, and location-related differences during the COVID-19 pandemic. *PLoS One.* 2020;15(10):e0240785. doi: 10.1371/journal.pone.0240785
7. **Fang H, Chen J, Rizzo JA.** Explaining urban-rural health disparities in China. *Med Care.* 2009;47(12):1209-1216. doi: 10.1097/MLR.0b013e3181adcc32
8. **Li W, Liu J, Yu G, *et al.*** Application of the knowledge-belief-practice model in nursing practice: current status and prospects. *J Nurs Sci.* 2015;30(6):107-110. doi: 10.3870/hlxzz.2015.06.107
9. **Al-Hanawi MK, Angawi K, Alshareef N, *et al.*** Knowledge, attitude and practice toward COVID-19 among the public in the Kingdom of Saudi Arabia: a cross-sectional study. *Front Public Health.* 2020;8:217. doi: 10.3389/fpubh.2020.00217
10. **Knowledge on Prevention and Control of COVID-19**. National Health Commission of the People's Republic China (NHC). Published 2020. Accessed January 14, 2021. http://www.nhc.gov.cn/xcs/kpzs/list_gzbd.shtml
11. **Knowledge World**. Chinese Center for Disease Control and Prevention (CDC). Published 2020. Accessed January 14, 2021. http://www.chinacdc.cn/jkzt/crb/zl/szkb_11803/jszl_2275/
12. **Zhang J, Ma D, Chen L, *et al.*** Investigation and analysis of 14034 college students on COVID-19 and its countermeasures and suggestions. *Journal of Hainan Medical University.* 2020;26(15):1133-1137.
13. **Paul A, Sikdar D, Hossain MM, *et al.*** Knowledge, attitudes, and practices toward the novel coronavirus among Bangladeshis: implications for mitigation measures. *PLoS One.* 2020;15(9):e0238492. doi: 10.1371/journal.pone.0238492
14. **Shimizu K.** 2019-nCoV, fake news, and racism. *Lancet.* 2020;395(10225):685-686. doi: 10.1016/S0140-6736(20)30357-3
15. **Thomas J, Peterson GM, Walker E, *et al.*** Fake news: medicines misinformation by the media. *Clin Pharmacol Ther.* 2018;104(6):1059-1061. doi: 10.1002/cpt.1199
16. **Chu DK, Akl EA, Duda S, *et al.*** Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. *Lancet.* 2020;395(10242):1973-1987. doi: 10.1016/S0140-6736(20)31142-9
17. **Li Q, Guan X, Wu P, *et al.*** Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. *N Engl J Med.* 2020;382(13):1199-1207. doi: 10.1056/NEJMoa2001316

18. **Honarvar B, Lankarani KB, Kharmandar A, *et al.*** Knowledge, attitudes, risk perceptions, and practices of adults toward COVID-19: a population and field-based study from Iran. *Int J Public Health.* 2020;65(6):731-739. doi: 10.1007/s00038-020-01406-2
19. **Xin X, Li SF, Cheng L, *et al.*** Government intervention measures effectively control COVID-19 epidemic in Wuhan, China. *Curr Med Sci.* 2021;41(1):77-83. doi: 10.1007/s11596-021-2321-6
20. **Qiu J, Shen B, Zhao M, *et al.*** A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: implications and policy recommendations. *Gen Psychiatr.* 2020;33(2):e100213. doi: 10.1136/gpsych-2020-100213
21. **Wang C, Pan R, Wan X, *et al.*** A longitudinal study on the mental health of general population during the COVID-19 epidemic in China. *Brain Behav Immun.* 2020;87:40-48. doi: 10.1016/j.bbi.2020.04.028
22. **Moreno C, Wykes T, Galderisi S, *et al.*** How mental health care should change as a consequence of the COVID-19 pandemic. *Lancet Psychiatry.* 2020;7(9):813-824. doi: 10.1016/S2215-0366(20)30307-2
23. **Lu J, Guo X, Han X, *et al.*** The knowledge, attitude and practice about public emergencies and the response capability of residents in Shanghai after the outbreak of coronavirus disease 2019 (COVID-19): a cross-sectional study. *Int J Environ Res Public Health.* 2021;18(9):4814. doi: 10.3390/ijerph18094814
24. **Abdelhafiz AS, Mohammed Z, Ibrahim ME, *et al.*** Knowledge, perceptions, and attitude of Egyptians towards the novel coronavirus disease (COVID-19). *J Community Health.* 2020;45(5):881-890. doi: 10.1007/s10900-020-00827-7
25. **Zhong BL, Luo W, Li HM, *et al.*** Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: a quick online cross-sectional survey. *Int J Biol Sci.* 2020;16(10):1745-1752. doi: 10.7150/ijbs.45221
26. **Zheng J, Zhang Y, Xu Y, *et al.*** Health literacy and demand for health education on novel coronavirus pneumonia epidemic among community residents in Fujian province: an online survey during epidemic outbreak. *Chin J Public Health.* 2020;36:160-164.
27. **Qutob N, Awartani F.** Knowledge, attitudes and practices (KAP) towards COVID-19 among Palestinians during the COVID-19 outbreak: a cross-sectional survey. *PLoS One.* 2021;16(1):e0244925. doi: 10.1371/journal.pone.0244925
28. **Masoud AT, Zaazouee MS, Elsayed SM, *et al.*** KAP-COVIDGLOBAL: a multinational survey of the levels and determinants of public knowledge, attitudes and practices towards COVID-19. *BMJ Open.* 2021;11(2):e043971. doi: 10.1136/bmjopen-2020-043971
29. **Zhang D, Yao M, Wang J, *et al.*** Guidance on the control and prevention of SARS-CoV-2 infection in primary healthcare institutions in rural China (first edition). *Chinese Gen Pract.* 2020;23(7):763-769.
30. **Cui T, Yang G, Ji L, *et al.*** Chinese residents' perceptions of COVID-19 during the pandemic: online cross-sectional survey study. *J Med Internet Res.* 2020;22(11):e21672. doi: 10.2196/21672

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