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Knowledge, attitude and practice of residents in the prevention and control of COVID-19: An online questionnaire survey

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Abstract

Aims: To explore the status quo and the influencing factors of residents' knowledge, attitude and practice (KAP) in the prevention and control of coronavirus disease 2019 (COVID-19), and the difficulties or challenges perceived by residents in their preventive practice.

Design: An online questionnaire survey.

Methods: The self-designed questionnaire was distributed among residents online in February 2020. Descriptive statistics, two independent samples *t*-tests, one-way analysis of variance, Pearson's correlation analysis, multivariate linear regression and content analysis were performed.

Results: A total of 919 valid questionnaires were collected. The scoring rates of residents' KAP were 85.2%, 92.9% and 84.4% respectively. Main factors influencing residents' knowledge included gender and occupation; while those influencing attitude were occupation, family economic level and knowledge; and those influencing practice included place of residence, occupation, with or without chronic disease, knowledge and attitude. Mass media was the primary approach for people to learn the knowledge and information of COVID-19. Difficulties or challenges faced were mainly lack of protective equipments, concerns about the risk of prevention and control, impact on daily life, work and study, lack of knowledge and consensus, psychological problems and information problems.

Conclusion: The attitude of residents towards COVID-19 prevention and control is generally positive. The knowledge and practice have been popularized to a certain extent, but there are still deviations or deficiencies in residents' understanding of certain important knowledge and the adoption of relevant preventive measures. Evidence-based tailored public education initiatives are indicated.

Impact: Findings of this study add important knowledge about residents' understanding, attitude, practice and the influencing factors on COVID-19 prevention and control, which serves as a scientific foundation for optimizing the pandemic public education and decision-making.

KEYWORDS

attitude, COVID-19, knowledge, nursing, practice, residents, survey

Kaihan Yang and Hui Liu have contributed equally to this work.

1 | INTRODUCTION

Up to now, coronavirus disease 2019 (COVID-19) has spread worldwide and has been declared as a public health emergency of international concern and a global pandemic by the World Health Organization [WHO] (2020a). Since specific drugs and vaccines are unavailable, controlling infectious sources and interrupting transmission routes of the virus are regarded as the only reliable ways to control the spread of the disease. Most importantly, the awareness, understanding and adherence of the public to preventive measures recommended by health authorities are the key to the pandemic control (Azlan et al., 2020). This study contributes to the current understanding of the status and associated factors of residents' knowledge, attitude and practice (KAP) on COVID-19 prevention and control. Data gathered from this survey would give scientific evidence for developing targeted interventions to improve relevant capabilities and practices of residents and for optimizing the pandemic management decision-making.

1.1 | Background

Coronavirus disease 2019 is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2; WHO, 2020b). Since the symptom onset of the first patient was identified on 1 December 2019 (Huang et al., 2020), as of 23 September 2020, 235 countries, areas or territories around the world have reported 31,425,029 confirmed cases and 967,164 confirmed deaths from COVID-19 (WHO, 2020c). As far as China is concerned, a total of 90,908 cases have been confirmed (WHO, 2020c). The disease has become a global pandemic due to its high infectiousness, fast transmission and widespread nature.

In China, although currently the pandemic has been effectively controlled, at the time this survey was conducted, our large population base, strong population mobility, high residential density and the time of outbreak exacerbated the spread of the disease. During the Chinese lunar New Year, travel rushes of returning home for the Spring Festival and returning to work after the holiday led to frequent population migrations, which significantly increased the risk of SARS-CoV-2 transmission (Chinazzi et al., 2020; Fan et al., 2020).

Severe acute respiratory syndrome coronavirus 2 spreads rapidly, and outbreaks can grow at an exponential rate; even those infected without symptoms can transmit the virus (WHO, 2020d). Nevertheless, to date, there are still no effective antiviral therapeutics or vaccines available to treat or prevent COVID-19, although some Western, Chinese traditional or home remedies may render comfort and alleviate some symptoms (Harapan et al., 2020). Controlling infectious sources and interrupting transmission routes become the only reliable and effective measures to control the spread of this disease (Tu et al., 2020).

Looking back at the history of major pandemics, the grassroots, including the public, communities and villages, are not only the main forefronts but also critical forces for pandemic control (Leung et al., 2003; WHO, 2020d). Evidence suggests that despite the implementation of national measures to combat the pandemic, such as traffic restriction, closing manufacturing industries, closing schools and even locking down a city, the success or failure of these efforts is largely dependent on public behaviours (Al-Hanawi et al., 2020). Persistent practice of self-prevention and control measures, such as wearing a mask, hand washing, self-isolation and keeping social distance among public residents is fundamental to control the pandemic and prevent its recurrence. This study used an online questionnaire survey with open-ended question to uncover the KAP status quo and the possible influencing factors of residents in the prevention and control of COVID-19 during the rapid ascending stage of the COVID-19 outbreak in China.

2 | THE STUDY

2.1 | Aims

This study aimed to:

1. examine residents' KAP in the prevention and control of COVID-19;
2. identify possible influencing factors, difficulties or challenges perceived by residents in their preventive practice.

2.2 | Design

The study was a cross-sectional electronic survey. Data were collected through a web-link of an online questionnaire with an open-ended question.

2.3 | Participants and questionnaire

2.3.1 | Participants

In this survey, a total of 12 basic information items and 20 questionnaire dimensions were covered, giving rise to 32 variables for statistical analysis. According to the Kendall sample estimation method for multivariate analysis, the sample required should be 10–20 times as high as the number of variables (Wang, 1990). In this regard, the minimum sample size of this survey was calculated to be 320–640. Residents who were aged 18 years and above, understood Chinese and had access to the internet were eligible to participate. Finally, 928 residents completed the online questionnaire.

2.3.2 | Questionnaire

Based on the KAP model (Gochman, 1988) and guidelines for COVID-19 prevention and control issued by the WHO (2020b), the

National Health Commission of the People's Republic China [NHC] (2020), the Center and for Disease Control and Prevention [China CDC] (2020) and the related literature (Biscayart et al., 2020; Riou & Althaus, 2020), this questionnaire entitled *Residents' Knowledge, Attitude and Practice for the Prevention and Control of COVID-19* was developed and validated by expert review.

The questionnaire covered the following six parts:

1. Informed consent: including an introduction of the study, the voluntary, anonymous and confidential nature of participation, guides for filling in the questionnaire, invitation to participate and an informed consent option. Only participants who select 'agree to participate' option can proceed to fill in the rest of the questionnaire.
2. Basic information (12 items): gender, age, occupation and SARS experience, etc.
3. Knowledge of prevention and control: (a) Knowledge contents (12 aspects), such as infectious disease classification, source of infection, route of transmission, transmission rate and doubling time, susceptible people, close contact, incubation period, major symptoms, medical observation time, WHO requirement of home isolation, nearby designated hospital and prevention and control measures, yielding a total of 39 items. The answer options included fill in the blank, single choice and multiple choice. Each correct answer scored 1 and the total score ranged from 0 to 55, with a higher total score indicating a better mastery of knowledge; and (b) Knowledge sources included TV, radio, WeChat, SMS, network news, government announcements, community/village epidemic prevention pamphlet/bulletin board/campaign and others.
4. Attitude of prevention and control: There are five aspects, including awareness of the necessity of prevention and control, perception of the possibility of being infected, willingness to take prevention and control measures, attitude towards eating wild animals and legislation on prohibiting the consumption of wild animals, yielding a total of 13 items. Each item was rated on a 4-point Likert scale and the total score ranged from 13-52, with a higher total score indicating more positive attitude.
5. Practice of prevention and control, such as daily living hygiene, wearing a mask, hand washing, avoiding gatherings, diet, exercise and sleep behaviours, generating a total of 30 items. Except for two dichotomous items, other items were rated on a 4-point Likert scale. The total score ranged from 28-114, with a higher total score indicating better practice.
6. Open-ended question: What difficulties or challenges have you encountered in the prevention and control of the COVID-19 pandemic?

2.4 | Data collection

The survey was conducted in February 2020. First, we uploaded the questionnaire to Wenjuanxing (https://www.wjx.cn), an online questionnaire system widely used in academic study in China. Then, our research team shared the questionnaire link generated by Wenjuanxing to their WeChat (https://weixin.qq.com), the largest Chinese social media platform and invited people in their WeChat to fill in the questionnaire. The link was subsequently forwarded by these contacts to more people in their WeChat to fill in the questionnaire and so on. We also posted the questionnaire link on other widely used social media platforms, including Sina Weibo (https://weibo.com) and QQ (https://www.qq.com) to reach as many residents as possible. IP address restriction technology was adopted to ensure users with the same IP address could only complete the questionnaire once. Two research assistants were responsible for downloading and checking the questionnaire data from Wenjuanxing. Questionnaires with up to 20% invalid entries were excluded.

2.5 | Ethical considerations

The study was approved by the Ethics Committee on Biomedical Research, West China Hospital of Sichuan University (Approval number: 2020.276). Informed consent was obtained from each participant online who was assured of the anonymity and confidentiality, their rights to withdraw from the study at any time and that the data were collected for academic use only.

2.6 | Data analysis

The SPSS software (version 25.0; SPSS Inc.) was used for statistical analysis in this study. Continuous variables were described as means with standard deviations (*SD*), whereas categorical variables were presented as frequencies with percentages. The item scoring rate and the total scoring rate for KAP were calculated by dividing the actual score of an item or total items by the total item/items score and then multiplying by 100%. Two independent samples *t*-tests or one-way analysis of variance (ANOVA) were conducted to evaluate differences among respondents with different socio-demographic epidemic-related characteristics. Pearson's correlation analysis was carried out to examine relationships among KAP. Statistically significant variables identified in univariate analysis and those professionally considered as significant factors, were screened as independent variables, which were then incorporated into the multivariate linear regression equation to further clarify factors influencing KAP. $p < 0.05$ was considered as statistically significant (two-tailed).

Using the Questionnaire Star platform, the keyword frequency table of the open-ended question was generated and keywords with synonyms were cleaned. Afterwards, the views were categorized through keyword navigation and then summarized to extract themes.

2.7 | Validity and reliability

Five experts reviewed the designed questionnaire (two respiratory nursing specialists, two respiratory medical doctors and one nursing

professor who majored in health education). The invited experts met the following criteria: (a) willing to participate; (b) had more than 10 years of relevant professional experience; and (c) had a doctorate or a senior professional title. The content validity index (CVI) for KAP scales were 0.960, 0.892 and 0.970, respectively. Before formal survey, we did a pilot study among 20 residents around researchers to ascertain whether the questionnaire was understandable and examine the reliability as well. The internal consistency Cronbach's alpha coefficients for KAP scales were 0.795, 0.728 and 0.915, respectively.

3 | RESULTS

3.1 | Characteristics of respondents

A total of 928 questionnaires were collected, among which, nine were invalid, as a result, 919 were finally enrolled for data analysis (effective response rate: 99.0%). The survey respondents had a wide coverage from all walks of life, with the main characteristics of females (720 [78.3%]), aged ≤30 years (435 [47.3%]), Han Chinese (861 [93.7%]), living in urban locality (699 [76.1%]), having an undergraduate or associate degree (658 [71.6%]), being married (538 [58.5%]), health professional (294 [32.0%]), having middle family economic level (744 [81.0%]), no chronic disease (829 [90.2%]), no confirmed case in the residential area (586 [63.8%]), having not been to the epidemic area (892 [97.1%]), with SARS experience (699 [76.1%]), being uninfected with COVID-19 (916 [99.7%]) and no COVID-19 infection in the family (917 [99.8%]; Table 3).

3.2 | Scores of KAP

The mean score of knowledge was 46.85 (*SD* 5.423, range 24–55), the total scoring rate was 85.2% and the highest (incubation period) and lowest (transmission rate and doubling time) item scoring rates were 98.2% and 18.9% respectively. The mean score of attitude was 48.31 (*SD* 3.070, range 37–52), the total scoring rate was 92.9% and the highest (necessity of personal prevention on epidemic control) and the lowest (chance of him/herself being infected) item scoring rates were 98.6% and 72.9% respectively. The mean score of practice was 96.26 (*SD* 13.304, range 49–114), the total scoring rate was 84.4% and the highest (wear a mask when going out) and the lowest (take Chinese herbal medicine for nourishing yin, nourishing vitality, tonifying spleen and moistening lung) item scoring rates were 97.3% and 56.0% respectively. The results are depicted in Tables 1 and 2 and Table S1.

3.3 | Univariate and multivariate analyses of factors related to KAP scores

According to the results of two independent samples *t*-tests or one-way ANOVA, in terms of knowledge, differences in the mean scores between residents of different gender, age, place of residence, education level and occupation groups were statistically significant (e.g. female vs. male: 47.15 vs. 45.76, $p = 0.003$; urban vs. rural residents: 47.12 vs. 45.99, $p = 0.007$). With regard to attitude, there were significant differences in the mean scores between residents of different age, place of residence, marital status, occupation, family economic level and SARS experience groups (e.g. urban vs. rural residents: 48.44 vs. 47.91, $p = 0.026$; married vs. unmarried/divorced/widowed residents: 48.61 vs. 47.90, $p = 0.001$; residents without SARS experience vs. with SARS experience: 47.74 vs. 48.50, $p = 0.004$). As for practice, significant differences were identified in the mean scores between residents of different place of residence, education level, occupation, family economic level and chronic disease experience groups (e.g. urban vs. rural residents: 96.97 vs. 94.00, $p = 0.007$; residents without chronic disease vs. with chronic disease: 96.90 vs. 90.31, $p < 0.001$). The results are presented in Table 3. Correlation analyses indicated that KAP were positively correlated with each other, among which, the strongest correlation was identified between attitude and practice ($r = 0.254$).

Based on the result of multivariate linear regression analysis, gender and occupation were the significant influencing factors of knowledge. Females scored significantly higher than males and health professionals scored significantly higher than students, non-health professionals and commercial, service and agricultural personnel. Significant influencing factors of attitude included occupation, family economic level and knowledge. Health professionals scored significantly lower than non-health professionals, public functionaries and commercial, service and agricultural personnel. Family economic level and knowledge were the positive predictors for attitude. As for practice, place of residence, occupation, with or without chronic disease, knowledge and attitude were significant influencing factors. Among them, urban residents, residents without chronic disease and health professionals scored significantly higher than rural residents, residents with chronic disease and non-health professionals respectively. Knowledge and attitude were the positive predictors for practice. The results are shown in Table 3.

3.4 | Information sources, together with the difficulties or challenges encountered

Eleven information sources were identified, among which, six had a use rate of over 50%, including WeChat (93.5%), network news (93.0%), TV (84.8%), government announcements (76.3%), community/village epidemic prevention pamphlet/bulletin board/campaign (68.8%) and SMS (56.4%). The results are displayed in Table S2.

Altogether, 776 residents gave feedback on difficulties or challenges that they perceived in their preventive practice, accounting for 84.4% of total respondents. Six major difficulties or challenges were identified, which were lack of protective equipments (62.9%), concerns about the risk of prevention and control (24.6%), impact on daily life, work and study (23.3%), lack of knowledge and consensus (7.6%), psychological problems (6.2%) and information problems (1.2%). The results are exhibited in Table 4.

TABLE 1 Scores of residents' knowledge and practice on prevention and control of COVID-19 ($N = 919$)

Dimension	Item	Score range	Lowest score	Highest score	*Mean* (*SD*)	Scoring rate (%)
Knowledge						
Incubation period		0–1	0	1	0.98 (0.135)	98.2
Source of infection		0–3	1	3	2.89 (0.330)	96.3
Route of transmission		0–3	1	3	2.83 (0.411)	94.5
Medical observation time		0–1	0	1	0.94 (0.245)	93.6
Close contact		0–3	1	3	2.70 (0.618)	89.9
Major symptom		0–5	1	5	4.45 (0.849)	89.0
WHO requirement of home isolation		0–2	0	2	1.57 (0.575)	78.5
Nearby designated hospital		0–2	0	2	1.56 (0.612)	78.1
Susceptible people		0–5	1	5	3.77 (1.307)	75.3
Classification of infectious disease		0–1	0	1	0.58 (0.493)	58.3
Transmission rate and doubling time		0–2	0	2	0.38 (0.589)	18.9
Prevention and control measures		0–27	3	27	24.20 (3.910)	89.6
Total		0–55	24	55	46.85 (5.423)	85.2
Practice	1. Wear a mask when going out	1–4	1	4	3.89 (0.373)	97.3
	2. Not eat wild animals	1–4	1	4	3.82 (0.634)	95.4
	3. Avoid going to live poultry market	1–4	1	4	3.76 (0.678)	94.0
	4. Cover nose and mouth while cough or sneeze	1–4	1	4	3.75 (0.560)	93.8
	5. Wash hands while going back home, before meals, after using the toilet, or contacting with dirty and contaminated items	1–4	1	4	3.75 (0.550)	93.8
	6. Open window to improve air circulation	1–4	1	4	3.72 (0.539)	93.1
	7. Wear warm clothes to prevent catching a cold	1–4	1	4	3.72 (0.505)	93.0

(Continues

TABLE 1 (Continued)

Dimension	Item	Score range	Lowest score	Highest score	*Mean* (*SD*)	Scoring rate (%)
	8. Avoid going out	1–4	1	4	3.72 (0.578)	92.9
	9. Watch yourself and your family for symptoms such as fever and cough	1–4	1	4	3.71 (0.526)	92.8
	10. Not attend party/gathering	1–4	1	4	3.71 (0.766)	92.8
	11. Pay close attention to government and community reports on the epidemic and the living trajectory of infected people	1–4	1	4	3.70 (0.549)	92.5
	12. Avoid going to crowded places	1–4	1	4	3.67 (0.787)	91.8
	13. Avoid taking public transportation	1–4	1	4	3.64 (0.790)	91.1
	14. Take balanced nutrition diet	1–4	1	4	3.62 (0.605)	90.5
	15. Drink more water	1–4	1	4	3.59 (0.635)	89.8
	16. Keep a good mood	1–4	1	4	3.59 (0.607)	89.7
	17. Keep a good sleep	1–4	1	4	3.44 (0.725)	86.0
	18. Use disposable paper napkin for access to public facilities such as elevator buttons and door handles	1–4	1	4	3.31 (0.985)	82.8
	19. Hang the worn clothes on the balcony or other ventilated place	1–4	1	4	3.27 (0.941)	81.6
	20. Observe body temperature	1–4	1	4	3.18 (0.977)	79.5
	21. Sterilize exposed parts and clothing with alcohol or chlorine-containing disinfectant when returning home	1–4	1	4	3.06 (1.116)	76.6
	22. Close toilet lid when flushing	1–4	1	4	3.05 (1.115)	76.3
	23. Use serving chopsticks or separate meals	1–4	1	4	2.99 (1.128)	74.8
	24. Exercise, such as running on treadmill, indoor yoga, and tai chi	1–4	1	4	2.96 (1.052)	74.0
	25. Wipe furniture surface and household things with alcohol or chlorine-containing disinfectant	1–4	1	4	2.86 (1.134)	71.5
	26. Fill U-shaped sewer pipes in the toilet and kitchen with water	1–4	1	4	2.49 (1.309)	62.3

(Continues

TABLE 1 (Continued)

Dimension	Item	Score range	Lowest score	Highest score	*Mean* (*SD*)	Scoring rate (%)
	27. Seal floor drain with a plastic bag filled with water	1–4	1	4	2.30 (1.292)	57.5
	28. Take Chinese herbal medicine for nourishing yin, nourishing vitality, tonifying spleen and moistening lung	1–4	1	4	2.24 (1.174)	56.0
	29. Review whether you have been to the epidemic area (like Hubei Province of China) during the epidemic, or have contact with infected people	0–1	0	1	0.95 (0.218)	95.0
	30. Isolate at home and seek medical care when you have exposure or symptoms such as fever and cough	0–1	0	1	0.79 (0.411)	78.6
Total		28–114	49	114	96.26 (13.304)	84.4

Note: The item scores of residents' knowledge with regard to prevention and control measures are shown in Supporting Information (Table S1).

4 | DISCUSSION

Coronavirus disease 2019 has brought devastating effects since it was first detected in December 2019. The great communicability and pathogenicity of SARS-CoV-2 make it critical for health authorities to develop effective strategies to manage and educate the public. To formulate effective measures, it is essential to obtain scientific evidence on the current status and the influencing factors of residents' KAP on COVID-19 prevention and control. Since at international level, there was no available measurement tool at the time our survey was conducted, we designed an online questionnaire entitled *Residents' Knowledge, Attitude and Practice for the Prevention and Control of COVID-19* and examined its reliability and validity to ensure the quality of the collected data. Compared with the limited KAP assessment tools for COVID-19 available now (Al-Hanawi et al., 2020; Azlan et al., 2020), items of our questionnaire are inclusive with a more standardized answering format. To our knowledge, this is one of the first studies to investigate KAP of the public on COVID-19 prevention and control at the very early stage of pandemic outbreak.

4.1 | Knowledge and information sources

The total scoring rate of knowledge was 85.2%. Item analysis revealed that the item scoring rates of incubation period, source of infection, route of transmission and medical observation time were all above 90%; meanwhile, the item scoring rates of close contact and major symptoms were both above 85%; the item scoring rates of the WHO requirement of home isolation, nearby designated hospital and susceptible people were over 75%; and among 27 prevention and control measures, 18 had an item scoring rate of over 90%. The above data showed that most residents had a good mastering of COVID-19 prevention and control knowledge, which might be attributable to the great efforts of the whole society attached to COVID-19 prevention and control and the timely publicity and education from government and various units, communities, villages and media. The item scoring rates of infectious disease classification (58.3%), transmission rate and doubling time (18.9%) and some prevention and control measures, including seal floor drain with a plastic bag filled with water (64.4%), take Chinese herbal medicine for nourishing yin, nourishing vitality, tonifying spleen and moistening lung (59.1%) and fill U-shaped sewer pipes in the toilet and kitchen with water (57.1%) were comparatively low, suggesting these are the weak areas to be strengthened.

Based on the regression analysis results, only gender and occupation were the significant predictive factors for knowledge. Health professionals are in an advantageous position to access and assimilate information on COVID-19 prevention and control, it is not difficult to understand that they had a significantly higher knowledge score. Similar result was found in the study of Giao et al. (2020) in Vietnam. The finding of significantly lower knowledge scores among males are in line with previous studies reporting men are less health conscious and more likely to engage in risk-taking behaviours (Cobey et al., 2013; Duell et al., 2018), which may affect their acquisition of

TABLE 2 Scores of residents' attitude on prevention and control of COVID-19 ($N = 919$)

Dimension	Item	Score range	Lowest score	Highest score	*Mean* (*SD*)	Scoring rate (%)
Awareness of the necessity of prevention and control	Necessity of personal prevention on epidemic control	1–4	1	4	3.94 (0.256)	98.6
	Necessity of community prevention on epidemic control	1–4	1	4	3.93 (0.279)	98.3
	Necessity of government decision on epidemic control	1–4	1	4	3.92 (0.308)	98.0
Perception of the possibility of being infected	Possibility of your family members being infected	1–4	1	4	2.95 (0.864)	73.8
	Possibility of yourself being infected	1–4	1	4	2.92 (0.910)	72.9
Willingness to take prevention and control measures	If you have a history of living or travelling in Wuhan, or have a history of close contact with an infected person, take the initiative to report and isolate at home	1–4	1	4	3.84 (0.387)	95.9
	If your family members have a history of living or travelling in Wuhan, or have a history of close contact with an infected person, persuade them to take the initiative to report and isolate at home	1–4	2	4	3.84 (0.379)	95.9
	If your family members have suspected symptoms such as fever and cough, persuade them to take the initiative to isolate themselves and go to see doctor in fever clinic	1–4	2	4	3.83 (0.390)	95.7
	If you have suspected symptoms such as fever and cough, take the initiative to isolate at home and go to see the doctor at a fever clinic	1–4	2	4	3.82 (0.409)	95.4
	Even if it may affect your work and daily life, you will cooperate with the government and community for epidemic prevention and control	1–4	2	4	3.76 (0.448)	94.1
	Even if it may affect your work and daily life, you will carry out self-prevention measures	1–4	2	4	3.76 (0.456)	94.0
Attitude towards eating wild animals		1–4	2	4	3.93 (0.282)	98.2
Attitude towards legislation to prohibit the consumption of wild animals		1–4	2	4	3.88 (0.421)	97.1
Total		13–52	37	52	48.31 (3.070)	92.9

TABLE 3 Univariate and multivariate analyses of factors associated with residents' knowledge, attitude and practice scores in prevention and control of COVID-19 ($N = 919$)

		Knowledge				Attitude				Practice			
Variable	***N* (%)**	***M* (*SD*)**	***t*/*F***	***p***	***β***	***Mean* (*SD*)**	***t*/*F***	***p***	***β***	***Mean* (*SD*)**	***t*/*F***	***p***	***β***
Gender													
Female	720 (78.3)	47.15 (5.213)	−2.965**	0.003	−0.074*	48.38 (3.021)	−1.137	0.256		96.60 (13.079)	−1.497	0.135	
Male	199 (21.7)	45.76 (6.013)				48.10 (3.241)				95.01 (14.049)			
Age (years)													
≤30	435 (47.3)	46.64 (5.581)	5.320**	0.005		48.00 (3.289)	4.574*	0.011		96.44 (13.907)	1.452	0.235	
31–45	312 (33.9)	47.60 (4.685)				48.66 (2.797)				96.84 (12.785)			
≥46	172 (18.7)	46.03 (6.092)				48.48 (2.899)				94.74 (12.610)			
Nationality													
Han	861 (93.7)	46.85 (5.459)	−0.015	0.988		48.33 (3.064)	0.408	0.683		96.13 (13.299)	−1.132	0.258	
Others	58 (6.3)	46.86 (4.908)				48.16 (3.178)				98.17 (13.343)			
Place of residence													
Urban	699 (76.1)	47.12 (5.270)	2.724**	0.007		48.44 (3.007)	2.225*	0.026		96.97 (12.806)	2.705**	0.007	−0.088**
Rural	220 (23.9)	45.99 (5.813)				47.91 (3.236)				94.00 (14.578)			
Education level													
High school and below	72 (7.8)	44.71 (7.102)	6.173**	0.002		48.90 (2.932)	2.171	0.115		92.99 (15.751)	3.360*	0.035	
Undergraduate or associate degree	658 (71.6)	47.04 (5.048)				48.33 (3.059)				96.88 (13.093)			
Graduate	189 (20.6)	47.02 (5.796)				48.03 (3.139)				95.34 (12.851)			
Marital status													
Married	538 (58.5)	46.90 (5.348)	−0.291	0.771		48.61 (2.809)	−3.337**	0.001		96.44 (12.977)	−0.486	0.627	
Unmarried/ divorced/ widowed	381 (41.5)	46.79 (5.535)				47.90 (3.365)				96.00 (13.765)			

(Continues

TABLE 3 (Continued)

Variable	N (%)	Knowledge				Attitude				Practice			
		M (SD)	t/F	p	β	Mean (SD)	t/F	p	β	Mean (SD)	t/F	p	β
Occupation													
Health professional[a]	294 (32.0)	48.62 (4.318)	11.620***	<0.001		48.16 (2.712)	4.536***	<0.001		98.91 (12.598)	3.879**	0.002	
Student	220 (23.9)	46.26 (5.475)			−0.159***	47.72 (3.401)				95.05 (13.884)			
Non-health professional	200 (21.8)	46.14 (5.586)			−0.157***	48.88 (3.087)			0.132***	94.94 (12.599)			−0.069*
Commercial, service and agricultural personnel	132 (14.4)	44.88 (6.437)			−0.210***	48.52 (2.982)			0.089**	94.11 (14.801)			
Retired personnel	40 (4.4)	46.88 (4.636)				48.20 (3.818)				96.20 (12.464)			
Public functionary	33 (3.6)	47.30 (5.247)				49.61 (1.983)			0.094**	97.30 (11.218)			
Family economic level													
Poor	118 (12.8)	46.83 (5.199)	0.748	0.473		47.43 (3.502)	5.724**	0.003	0.081*	92.82 (16.252)	4.578*	0.011	
Medium	744 (81.0)	46.79 (5.522)				48.43 (3.000)				96.79 (12.724)			
Good	57 (6.2)	47.70 (4.500)				48.60 (2.744)				96.39 (13.135)			
With chronic disease or not													
No	829 (90.2)	46.92 (5.435)	1.201	0.230		48.33 (3.069)	0.408	0.683		96.90 (13.131)	4.513***	<0.001	−0.138***
Yes	90 (9.8)	46.20 (5.303)				48.19 (3.097)				90.31 (13.478)			
With confirmed cases in your residential area or not													
No[a]	586 (63.8)	46.89 (5.656)	0.097	0.908		48.42 (3.033)	0.973	0.378		97.02 (12.878)	2.945	0.053	
Yes	159 (17.3)	46.87 (4.798)				48.19 (3.187)				95.52 (13.823)			
Unknown	174 (18.9)	46.69 (5.180)				48.08 (3.085)				94.38 (14.065)			
Have been to the epidemic area (like Hubei Province of China) or not													
No	892 (97.1)	46.87 (5.370)	−0.468	0.640		48.34 (3.053)	−1.368	0.172		96.28 (13.230)	−0.279	0.781	

(Continues

TABLE 3 (Continued)

Variable	N (%)	Knowledge				Attitude				Practice			
		M (*SD*)	*t*/*F*	*p*	*β*	*Mean* (*SD*)	*t*/*F*	*p*	*β*	*Mean* (*SD*)	*t*/*F*	*p*	*β*
Yes	27 (2.9)	46.37 (7.061)				47.52 (3.567)				95.56 (15.827)			
Have experienced SARS													
No	220 (23.9)	46.38 (5.305)	1.475	0.140		47.74 (3.516)	2.911**	0.004		95.50 (13.550)	0.970	0.332	
Yes	699 (76.1)	47.00 (5.455)				48.50 (2.895)				96.50 (13.226)			
Infected with COVID-19													
No	916 (99.7)	–	–	–	–	–	–	–	–	–	–	–	–
Yes	3 (0.3)	–				–				–			
Family members Infected with COVID−19													
No	917 (99.8)	–	–	–	–	–	–	–	–	–	–	–	–
Yes	2 (0.2)	–				–				–			
Knowledge								0.170***				0.224***	
Attitude												0.248***	

Note: *β*, standardized coefficient; *p*, *p* value of univariate analysis.

[a]Reference group.

*$p < 0.05$.

**$p < 0.01$.

***$p < 0.001$.

TABLE 4 Difficulties or challenges encountered by residents in epidemic prevention and control ($N = 776$)

Theme	View	*N* (%)
Lack of protective equipments		488 (62.9)
	Cannot buy protective equipment (masks, alcohol, disinfectant, gloves, etc.)	283 (36.5)
	Lack of protective equipment (masks, disinfectant, goggles, etc.)	191 (24.6)
	Amount of protective equipment cannot meet the work needs of medical staff	14 (1.8)
Concerns about the risk of prevention and control		191 (24.6)
	Worry about others' lack of awareness of protection will endanger their own safety	64 (8.2)
	Worry about having a diagnosed patient or someone in the incubation period nearby	53 (6.8)
	Worry about insufficient local government control	30 (3.9)
	Worry about others concealing their illness	17 (2.2)
	Worry about insufficient community control (such as insufficient publicity of prevention and control knowledge, cleaning/disinfection of public areas, and management of migrant population)	9 (1.2)
	Worry about others' unexpected visit during epidemic period	8 (1.0)
	Worry about insufficient prevention and control conditions, lack of necessary prevention and control facilities, and cross infection at work units	5 (0.6)
	Worry about the incapability of the old and children to take effective preventive measures	3 (0.4)
	Worry about having bought fake masks	2 (0.3)
Impact on daily life, work and study		181 (23.3)
	Inconvenience in going out	81 (10.4)
	Inconvenience to buy daily necessities (vegetable and other daily supplies)	43 (5.5)
	Lack of daily necessities (for instance supermarket supplies are in short supply)	19 (2.4)
	Less work opportunity or no work, affecting family income	15 (1.9)
	The need to work in the epidemic, no one at home to take care of the old and children	5 (0.6)
	Limited transportation options (unwilling to take public transportation such as subway and bus)	8 (1.0)
	School delay, affecting study	7 (0.9)
	Inconvenience to seek medical care and to have routine pregnancy check-up	3 (0.4)
Lack of knowledge and consensus		59 (7.6)
	Unsuccessful in persuading family members to take prevention and control measures (for instance children want to go out to play, some family members do not disinfect and clean after returning home from outside)	26 (3.4)
	Unsuccessful in persuading the elderly to take prevention and control measures (for instance the elderly do not wear masks)	20 (2.6)
	Lack of knowledge of self-prevention and control (inability to distinguish the common cold and the COVID-19 symptoms such as fever and dry cough)	11 (1.4)
	Unsuccessful in persuading the neighbours to take prevention and control measures	2 (0.3)
Psychological problems		48 (6.2)
	Boredom arises from prolonged isolation at home	22 (2.8)
	Feeling nervous and panic when seeing the epidemic-related reports and patient pictures	16 (2.1)
	Fear of being infected with COVID-19 whenever there is any discomfort present	9 (1.2)
	Cannot find a psychological counselling channel	1 (0.1)
Information problems		9 (1.2)
	Lack of access to transparent and authentic information	6 (0.8)
	Inability to identify the authenticity of information	3 (0.4)

health-related knowledge. Thus, in the popularization of COVID-19 prevention and control knowledge, attention needs to be directed to the male and non-health professionals, especially for the commercial, service and agricultural personnel.

For information sources, mass media was the primary source for residents to acquire knowledge, indicating that mainstream media (such as WeChat and network news) played a significant role in disseminating the prevention and control knowledge. It is reported that

the integrity of early warning system and the public's timely access to information will directly affect their capacity to respond to a public health emergency (Liu, 2016). So, it is essential to strengthen the development and management of mass media and offer timely, accurate, scientific and accessible information (Beierle, 2004; Caplan, 2010).

4.2 | Attitude

The total scoring rate of attitude was 92.9% and among 13 attitude items, 84.6% (11 items) were scored above 90%, revealing a positive attitude towards COVID-19 prevention and control and a sense of personal and social responsibility, which were important factors for controlling the pandemic. Similar results were found in studies during the SARS outbreak. Zhou et al. (2004) and Chen et al. (2003) reported that 97.9% residents in Qingdao province and 70.1% residents in Guangdong province were confident that SARS could be controlled. A positive attitude towards COVID-19 prevention and control was also identified among residents in Saudi Arabia and Malaysia (Al-Hanawi et al., 2020; Azlan et al., 2020). With respect to risk perception, although 97.1% respondents had not been to the epidemic area (like Hubei province), the scoring rates of items 'possibility of family members being infected' and 'possibility of him/herself being infected'" were 73.8% and 72.9%, respectively, indicating that they had a relatively good perception of the danger related to the epidemic. In contrast, Leung et al. (2003) found that 30.1% Hong Kong residents believed that they were more likely to contract SARS.

With regard to influencing factors, regression analysis found that family economic level and knowledge were significant positive predictors for attitude. Knowledge is primarily evidenced in literature as a positive influencing factor of attitude, which fits the KAP model. Residents with a lower economic level had significantly lower attitude score, which is similar to the findings of other KAP studies (Liu, 2018; Trucchi et al., 2020). Unexpectedly, the knowledge score among health professionals was significantly higher than that among non-health professionals and commercial, service and agricultural personnel, but their attitude scores were significantly lower. Although, in our correlation analysis, a significant positive correlation was confirmed between knowledge and attitude, indicating except for knowledge, there are other factors influencing attitude. It is worth to mention a significantly higher attitude score among married residents was identified in univariate analysis, which is in line with the finding of a KAP study about birth defects among rural reproductive people (He, 2012). The authors explained that the result might be related to the change of married people's family role and their higher sense of family responsibility. However, in our multivariate analysis, marital status was not a significant influential factor, which is consistent with the finding of a KAP study on COVID-19 among Saudi Arabian residents (Alahdal et al., 2020). It is also interesting to find that age, place of residence and SARS experience were significant influencing factors for attitude in univariate analysis, but not in multivariate analysis, suggesting that compared with knowledge and economic condition, the influence of these factors might be relatively small. More studies are warranted to confirm the above findings and residents with a lower economic and knowledge level should be the focus for attitude intervention.

4.3 | Practice

Based on item analysis, 20 of the 30 practice items had an item scoring rate of over 80% and the total scoring rate of practice was 84.4%, indicating that residents of our study had a comparatively satisfactory performance on COVID-19 prevention and control. The findings are consistent with those of the study during SARS outbreak (Li et al., 2006) and current KAP studies on COVID-19 among Saudi Arabia and Malaysia residents, however, behaviours assessed in our study being more comprehensive, 30 verses 5 (Al-Hanawi et al., 2020) and 3 (Azlan et al., 2020). Compared with knowledge and attitude, the total scoring rate of practice was relatively low, which is like the findings of a KAP study among healthcare workers (Zhang, 2017). These results suggest that there is still a gap between the acquisition of knowledge and the transformation into behaviour and more efforts are warranted to explore the action path mechanism between the two and other possible factors influencing behaviour transformation of residents under the threat of a severe infectious disease like COVID-19.

Items with the lowest scoring rates indicated that the implementation of uncommon prevention and control measures should be strengthened; for instance, to fill U-shaped sewer pipes in the toilet and kitchen with water and to seal floor drain with a plastic bag filled with water. It is worth to mention the largest community SARS outbreak in 2003 occurred in Amoy Gardens in Hong Kong. The transmission route finally found was the sewage system in the building (Wong et al., 2003). Recent studies on COVID-19 reported the detection of viable SARS-CoV-2 in stools of patients (Wang et al., 2020; Wu, Guo, et al., 2020) and virus RNA had been found in sewage (Ahmed et al., 2020). The above literature, together with the weakness areas of preventive practice identified from our study suggest that public efforts for interrupting faecal–oral and environmental transmission routes need to be specially addressed. Moreover, the scoring rate of the item 'take Chinese herbal medicine for nourishing yin, nourishing vitality, tonifying spleen and moistening lung' was also comparatively low (56.0%). As traditional Chinese medicine has achieved significant preventive and therapeutic effect in SARS and COVID-19 epidemics (Academy & of Chinese Medical Sciences [CACMS], 2020; Hu et al., 2020; Luo et al., 2020), education on the appropriate preventive use of traditional Chinese herbal medicine is recommended.

Regression analysis revealed that place of residence, occupation, with or without chronic disease, knowledge and attitude were significant predictors for practice. Thus, it is suggested to strengthen the interventions for COVID-19 preventive practices among rural residents, non-health professionals and residents with chronic diseases.

4.4 | 4 Difficulties or challenges

After taking full consideration of the interactions between KAP, together with their influencing factors, this study set an open-ended question for respondents to put forward their views based on their own experience, so as to further explore the possible influencing factors of pandemic prevention and control. As found from our survey results, 84.4% of residents stated that there were different kinds of difficulties or challenges. Among them, the greatest challenge was the lack of protective equipments (62.9%), especially for masks and disinfectants at the early stage of pandemic prevention. The emergence of COVID-19 caused a large increase in demand for medical masks and sanitizers in many countries and supplies were short, especially during the early period of disease outbreak (Wu, Huang, et al., 2020). Besides, some medical staff (1.8%) reported that the protective equipment could hardly satisfy their need, indicating that the supply of protective gears needs to be resolved. Secondly, 24.6% of residents expressed their concerns about the risk of prevention and control, including the fear that the insufficient protection awareness or behaviour of other residents would endanger their own safety; and inadequate prevention and control efforts of local governments, communities and work units, such as insufficient cleaning and disinfection of public places in residential neighbourhoods and cross-infection in the workplace. Although higher risk perception is beneficial to behaviour change, exceeding the perception threshold may bring psychological load (Leung et al., 2003). It is suggested that the individual prevention effort of residents be coordinated and unified with those of governments, communities and working units. In the meantime, attention needs to be paid to guide the public's appropriate management of risk perception and turn it into the motivating factor for preventive action. Thirdly, about a quarter (23.3%) of residents reported that their daily life, work and study were affected, especially in terms of transportation, purchase of necessities and household income. These issues might be related to the unconventional measures used, such as strictly controlling the flow of people and delaying the resumption of work by enterprises. Improper handling of these issues might become an obstacle to the adoption and solidification of prevention practice, suggesting that social support services, such as public transportation plan, construction of the supply chain for daily living necessities and orderly resume work, needs to be optimized. Furthermore, 7.6% of residents believed that there was a lack of knowledge and consensus on prevention and control, which mainly included the ineffective persuasion on the family members, older people and the neighbours to take prevention measures and the incapability to distinguish a common cold from COVID-19. Also, 6.2% of residents reported psychological problems, like boredom caused by prolonged isolation at home, nervousness and panic resulted from epidemic reports, which is much lower than the rate reported by Roy et al. (2020). They found 16.7% of Indian population had anger, restlessness or worry during COVID-19 pandemic. Their survey population is similar to ours, also with most respondents being healthcare professionals and from urban area, the reasons for the different result deserves further exploration. Additionally, a small minority of residents (1.2%) mentioned information problems, such as lack of access to transparent and authentic information and inability to identify the authenticity of information. Gerberding (2003) reported that the use of internet facilitated information exchange and problem-solving during SARS. However, Scanfeld et al. (2010) found that the public can be misled or psychologically affected by inaccurate health information disseminated through social media. Thus, targeted strategies, including online psychological counselling, instruction on critical evaluation of information, promotion of the public's electronic health literacy, are indicated.

4.5 | Limitations

Certain limitations should be noted in this study. First, to ensure a timely survey, we preliminarily validated the survey tool through expert review. Although its CVI and Cronbach's alpha coefficients are acceptable, further standard validation measure is required. Second, as the questionnaire acceptance area was mainly the urban area and medical institution or school where the questionnaire issuer located; our sample may over-represent urban residents, health professionals, females and those with higher education levels. Generalization of results needs to be cautious. Third, this study was carried out at the ascending stage of the pandemic, which might only reflect the KAP of our participants on COVID-19 prevention and control during the questionnaire collection period. Changes with the development of pandemic and the passage of time need to be explored through longitudinal studies. Fourth, to avoid the recruitment of excessive items in the questionnaire and too-long response time, only socio-demographic, epidemic-related factors, SARS experience, knowledge and attitude were surveyed as the influencing factors. Nonetheless, data concerning the difficulties and challenges from open-ended question supplemented the results.

5 | CONCLUSION

This study preliminarily explored the knowledge, attitude, practice, together with the influencing factor, perceived difficulties or challenges of residents in the prevention and control of COVID-19. Findings from our study can give scientific reference for policy makers to optimize pandemic management decision-making and for improving the subsequent publicity and education on COVID-19 prevention, especially for community healthcare professionals to identify priority needs, determine target populations and design more tailored public education programmes. Due to the sample limitation, further studies, including expanding the research scope and survey populations, especially the rural residents, are needed to support our findings. Moreover, at the critical time of COVID-19 pandemic, internet becomes the most important channel for residents to obtain relevant information, exploring the influence of other

important factors, such as internet accessibility and e-health literacy of residents in COVID-19 KAP study is warranted.

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CONFLICT OF INTEREST

No conflict of interest has been declared by the authors.

AUTHOR CONTRIBUTIONS

XJ were responsible for the study design. KY, HL, LM, SW, YT, FZ, ZL and YS performed the data collection and data analysis. KY and HL were responsible for the drafting of the manuscript. XJ supervised the study and made critical revisions to the paper for important intellectual content. All authors agreed on the final manuscript.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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