Research Paper

Knowledge of COVID-19 and its prevention among rural residents in Fuqing, China

Xiaojun Liu [a], Shanshan Du [b], Ruimei Feng [b], Lingjun Yan [b], Yimin Huang [a, **],
Weimin Ye [b, c, *]

[a] Department of Health Management, School of Public Health, Fujian Medical University, Fuzhou, China
[b] Department of Epidemiology and Health Statistics & Key Laboratory of Ministry of Education for Gastrointestinal Cancer, Fujian Medical University, Fuzhou, China
[c] Department of Medical Epidemiology and Biostatistics, Karolinska Institutet, Stockholm, Sweden

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ABSTRACT

Objectives: Rural areas are the weakest place for epidemic prevention and control, yet few studies have specifically conducted surveys in rural areas. The purpose of this study is to assess rural residents' knowledge of the COVID-19 and its prevention in China.

Methods: A cross-sectional survey study containing 1,426 samples was conducted in Fuqing, China to assess rural residents' knowledge of the COVID-19 and its prevention. Logistic regression was used to identify potential differences in participants' knowledge of COVID-19 and its prevention and control in different population subgroups.

Results: The mean and median of residents' knowledge of COVID-19 was 5.53 and 6 points, respectively. The mean and median of residents' knowledge related to self-protection against COVID-19 was 10.34 and 11 points, respectively. Older adults (AOR_{45-59} = 2.26, 95% CI 1.20 to 4.27; AOR_{60-69} = 3.13, 95% CI 1.63 to 5.98; $AOR_{\geq 70}$ = 4.68, 95% CI 2.35 to 9.33) were more deficient in knowledge of COVID-19. Those who were better educated and with a higher average annual household income were less likely to be deficient in the knowledge of COVID-19 and knowledge of self-protection against COVID-19. Moreover, those who were single, divorced, or widowed (AOR = 1.67, 95% CI 1.13 to 2.46) were more deficient in the knowledge of self-protection against COVID-19.

Conclusions: Our study suggests that when facing a pandemic like COVID-19, the key is to inform the public to understand simple and effective self-protection measures. Therefore, we call on the governments to give priority to publicity and education on self-prevention measures for the targeted populations and regions. This is most evident among the vulnerable groups like those who were unmarried, elderly, and those with low education or low income. Similar suggestions may be of use in other countries as well.

What is known?

- The COVID-19 pandemic is the most severe public health crisis for all countries and regions of the world.

- Previous studies in relation to the knowledge of the COVID-19 are mainly focused on the general population, which lack specificity, such as the particular circumstances (knowledge level of the COVID-19) at the rural areas in the fight against COVID-19.
- Rural areas are the most vulnerable and particularly important for the COVID-19 pandemic prevention and control.

* Corresponding author.
** Corresponding author.
E-mail addresses: xiaojun_liu@fjmu.edu.cn (X. Liu), dushanshan1007@163.com (S. Du), ruimei_feng@163.com (R. Feng), lingjun_yan@fjmu.edu.cn (L. Yan), hym@fjmu.edu.cn (Y. Huang), weimin.ye@ki.se (W. Ye).
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What is new?

- In the present study, respondents from rural communities received lower scores in the knowledge of COVID-19 than the knowledge of self-protection for COVID-19.
- Our study showed that those aged 45—59, 60—69, and 70 or above were more deficient in knowledge of COVID-19, and those who were better educated and with a higher average annual household income were less likely to be deficient in the knowledge of COVID-19.
- Those who were married, better educated, and those with a higher average annual household income were less likely to be deficient in the knowledge of self-protection against COVID-19.
- When facing a pandemic like COVID-19, the key is to inform the public to master simple and effective self-protection measures.

1. Introduction

Currently, there is no doubt that the COVID-19 pandemic is the most severe public health crisis for all countries and regions of the world [1—3]. From the central government to the local governments at all levels in the mainland of China adopt strong preventive measures [4,5]. Through various channels, Chinese governments at all levels carried out various forms of publicity on epidemic prevention policies, public health education and health promotion for all the people living in the mainland of China. Chinese people obtained a lot of health-related information to cooperate with the national epidemic prevention work, and at the same time, individuals themselves greatly reduced the risk of being infected with the virus. Almost all Chinese people were called upon and advocated for engaging in health-protective behaviors, including keeping social distance, wearing surgical masks, enhancing ventilation, washing hands more frequently and using disinfectants, etc. [6]. These measures have succeeded in helping China to better control the spread of the epidemic [7—9].

To know what the COVID-19 is and the main self-protection measures that could prevent this disease is very important. There are already many related studies in relation to the knowledge, attitudes, and practices (KAP) of the COVID-19 [10—12]. These studies were more focused on the general population and lacked specificity [13], such as the particular circumstances (knowledge level of the COVID-19) at the rural areas in the fight against COVID-19. Especially in the mainland of China, people living in rural areas where residents tend to be older and less educated are much more difficult to promote health education [14]. Moreover, it is impossible to ignore the fact that China Mainland has a large number of farmers, and rural areas are the most vulnerable areas and particularly important for the COVID-19 pandemic prevention and control. However, little is currently known about the knowledge of COVID-19 and its prevention and control among rural residents in China.

Therefore, with the normalization of the COVID-19 pandemic prevention and control, we conducted this survey to get a better understanding of rural residents' knowledge of the COVID-19 pandemic and the main self-protection measures could prevent themselves from COVID-19 in Fuqing, China. Fuqing is a coastal city located in southeast China with over 670,000 rural residents. Nowadays, the majority of COVID-19 cases in China were mainly imported from abroad. Fuqing has a large number of rural residents working abroad, which means there is an uncertain risk of the epidemic in this region. Because there may be people returning from working abroad at any time, in this case, this study may help us to figure out the most important aspect of COVID-19 pandemic prevention and control for rural residents. The other objective of this study is to understand which populations are least knowledgeable about COVID-19 and its self-containment measures. Findings from this study may provide clues and baseline information for local government to develop or adjust more effective and practical measures and strategies with regard to the COVID-19 pandemic prevention and control to prevent or reduce the risk of an outbreak rebounding.

2. Methods

2.1. Study design

We utilized a population-based cross-sectional design. From late May to late June 2020, this study was conducted in the rural communities in Fuqing, China. Since few related studies had been specifically conducted surveys in rural areas, and this is a population-based cross-sectional study, we, therefore, planned to investigate at least 1,000 valid samples. Convenience sampling was used to get more enrollments during the specific period of data collection time. In order to facilitate the implementation of the questionnaire survey and to increase sample size and diversity, we conducted the survey at 25 rural places where we had established our cohort research bases. Our initial plan was to collect at least 40 valid samples in every place where there was a cohort study site. We finally collected 1,426 valid samples, with a minimum of 51 valid samples and a maximum of 68 valid samples from each survey place.

2.2. Respondents and procedure

The recruitment of participants was nested in the Fujian Cohort Study Project, and all the residents participating in the cohort study who were adults aged 18 years or above could be considered potential objects for this study. Meanwhile, the target populations were required to hold a local household registration or should have lived in the community for at least half a year. The potential participants were fully informed of the content and aim of this survey through face-to-face interviews. Only those willing to participate voluntarily and signed the informed consent form were considered our final respondents in the survey. Given the different education levels of the rural respondents, we adopted a face—to—face interview to collect the data. The investigators are all from the Fujian Cohort Research Center of Fujian Medical University, and all investigators have received orientation training for this survey.

2.3. Measurements

The questionnaire was designed by public health experts from Karolinska Institutet, Wuhan University, and Fujian Medical University for the specific needs of this study. The self-administered questionnaires were completed by asking the following three parts.

2.3.1. Part 1: Characteristics of the survey participants

Characteristics of the survey participants, including participants' gender, age, height, weight, education level, marital status, number of people living together, average annual household income (Chinese Yuan, CNY), and self-rated health status.

2.3.2. Part 2: Knowledge related to COVID-19

There were twelve specific questions in Part 2 that inquired about rural residents' knowledge of COVID-19. For example, participants were asked to choose the right answer about when and where the first COVID-19 case was reported, what does the WHO named it, typical symptoms of COVID-19, how COVID-19 spreads, and other instances. A correct answer was given a score of 1 and an incorrect answer was scored with a 0. The scores varied from 0 to

12 points. This part is mainly to understand whether rural residents know what the COVID-19 is. These questions exhibited good internal consistency reliability in the present sample with a Cronbach's α coefficient of 0.81.

2.3.3. Part 3: Knowledge related to self-protection against COVID-19

There were twelve specific questions in Part 3 inquiring about rural residents' knowledge related to self-protection against COVID-19. For example, participants were asked to judge whether the main self-protection measures are correct, like wearing a mask over the nose and mouth in outdoor settings, avoiding close contact, avoiding crowds and poorly ventilated spaces, washing hands often and disinfecting frequently, and so on. A correct answer was given a score of 1, and an incorrect answer was scored with a 0. The scores varied from 0 to 12 points. This part is mainly to find out whether rural residents know how to protect themselves from COVID-19. These questions exhibited good internal consistency reliability in the present sample with a Cronbach's α coefficient of 0.85.

2.4. Statistical analysis

By listening to the original survey recordings, the investigators checked the questionnaires completed every day to ensure the completeness, accuracy, and logical reasonableness of the information. And then, the investigators used EpiData software version 3.1 to enter the data. The data processor collected all the data in the EpiData software every day and checked the logical errors again. The Statistical Package for the Social Sciences (SPSS) version 22.0 was used for all statistical analyses, and the α level was set at two-sided P-values of 5% to determine statistical significance. Characteristics of the survey participants were initially calculated as frequencies and proportions. The average scores of participants' knowledge of COVID-19 and its prevention and control were reported as mean and standard deviation, and medians and modes were also presented.

According to the 80/20 rule (also known as Pareto principle) [15], participants' knowledge of COVID-19 and its prevention and control were classified into medium-to-high and low groups. We believe that these 20% of rural residents with the lowest score are the target population that should be especially focused on for public health education and intervention. Then, we applied binary logistic regression to identify potential differences in participants' knowledge of COVID-19 and its prevention and control in different population subgroups. The results are presented as crude odds ratios (COR) and adjusted odds ratios (AOR) with 95% confidence intervals (CI) obtained from univariate and multivariate logistic regression models, respectively.

2.5. Ethical consideration

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethics Review Committee of Fujian Medical University (IRB number: 2020-074). Informed consent was obtained from each participant. Participants were assured in the consent form that the collected data would be reported as aggregate findings, and the responses would be kept private.

3. Results

3.1. Demographic characteristics of the study sample

The general demographic characteristics of the survey participants are shown in Table 1. A total of 1,426 rural residents participated in our study, among whom 629 were males (44.11%) and 797 females (55.89%). Participants younger than 45 years, 45−59 years, 60−69 years, and 70 years or older accounted for 21.74%, 32.12%, 30.65%, and 15.50% of the total sample size, respectively. Most of the respondents (58.06%) had a recommended BMI (18.50−23.99). Residents' education level in rural China is expected to be low, where 62.97% of participants only had an education level of primary school or lower. Most respondents (85.13%) were married, and 40.53%, 30.29%, and 20.97% of participants were living with 2−3, 4−5, and 6 or more people. About 24.40% of the participants had an average annual household income of less than 10,000 China Yuan (CNY), 25.95% between 10,000 and 29,999 CNY, 27.98% between 30,000 and 59,999 CNY, and 21.67% greater than 60,000 CNY, respectively. More than half of rural residents (59.75%) self-rated their health status as very good/good. Survey results showed that the mean and median of rural residents' knowledge of COVID-19 was 5.53 and 6 points, respectively, and it ranged from 0 to 12 points. The mean and median of rural residents' knowledge related to self-protection against COVID-19 was 10.34 and 11 points, respectively, and the participants had a minimum score of 3 and a maximum of 12.

3.2. Rural residents' knowledge of COVID-19

Participants who scored 0−3 on knowledge of COVID-19 were classified into the low score group. The results of logistic regression analysis are shown in Table 2. In terms of the participants' knowledge of COVID-19, both univariate and multivariate analysis showed that those aged 45−59 (COR = 6.60, 95% CI 3.71 to 11.77; and AOR = 2.26, 95% CI 1.20 to 4.27), those aged 60−69 (COR = 11.28, 95% CI 6.37 to 19.96; and AOR = 3.13, 95% CI 1.63 to 5.98), and those aged 70 or above (COR = 17.16, 95% CI 9.43 to 31.20; and AOR = 4.68, 95% CI 2.35 to 9.33) were more deficient in knowledge of COVID-19 as compared with those individuals aged 45 or younger. When compared with the least educated, those who had a middle school educational background (COR = 0.09, 95% CI 0.05 to 0.15; and AOR = 0.14, 95% CI 0.08 to 0.24), and those who had a high and/or vocational school educational background or higher (COR = 0.44, 95% CI 0.02 to 0.10; and AOR = 0.10, 95% CI 0.04 to 0.24) were less likely to be deficient in the knowledge of COVID-19. The results also show that people with different average annual household incomes had different levels of knowledge related to COVID-19. Compared to those with an average annual household income less than 10,000 CNY, respondents with an average annual household income between 10,000 and 29,999 CNY (COR = 0.54, 95% CI 0.39 to 0.74; and AOR = 0.71, 95% CI 0.50 to 0.99), between 30,000 and 59,999 CNY (COR = 0.43, 95% CI 0.31 to 0.58; and AOR = 0.84, 95% CI 0.56 to 0.95), and greater than 60,000 CNY (COR = 0.17, 95% CI 0.11 to 0.25; and AOR = 0.48, 95% CI 0.29 to 0.80) were less likely to be deficient in the knowledge of COVID-19.

3.3. Knowledge related to self-protection against COVID-19

Participants who scored less than 10 points on knowledge related to self-protection against COVID-19 were classified into the low score group. Table 3 illustrates the knowledge of self-protection for COVID-19 among rural residents in different population subgroups. Both COR and AOR obtained from univariate and multivariate analysis showed that those who had a middle school educational background (COR = 0.50, 95% CI 0.36 to 0.70; and AOR = 0.50, 95% CI 0.35 to 0.73), and those who had a high and/or vocational school educational background or higher (COR = 0.39, 95% CI 0.25 to 0.58; and AOR = 0.41, 95% CI 0.25 to 0.69) were less likely to be deficient in the knowledge of self-protection against

Table 1
Characteristics of the survey participants ($n = 1,426$).

Characteristics	Categories	Frequency (n)	Percentage (%)
Sex	Male	629	44.11
	Female	797	55.89
Age (year)	<45	310	21.74
	45–59	458	32.12
	60–69	437	30.65
	≥70	221	15.50
BMI (kg/m^2)	Underweight (<18.50)	64	4.49
	Normal (18.50–23.99)	828	58.06
	Overweight (24.00–27.99)	417	29.24
	Obese (≥28.00)	117	8.20
Education level	Primary school or lower	898	62.97
	Middle school	311	21.81
	High/vocational school or higher	217	15.22
Marital status	Married	1,214	85.13
	Others (single, divorced, widowed)	212	14.87
Number of people living together	Living alone	117	8.20
	2–3	578	40.53
	4–5	432	30.29
	≥6	299	20.97
Average annual household income (CNY)	<10,000	348	24.40
	10,000–29,999	370	25.95
	30,000–59,999	399	27.98
	≥60,000	309	21.67
Self-rated health status	Very good/good	852	59.75
	Fair	449	31.49
	Very poor/poor	125	8.77

Table 2
Logistic regression analysis for the factors associated with participants' knowledge of COVID-19.

Variable(s)	Medium-to-high (scored 4–12)	Low (scored 0–3)	COR (95% CI)	AOR (95% CI)
	$n = 1,052$ (73.77%)	$n = 374$ (26.23%)		
Sex				
Male	498 (79.17)	131 (20.83)	1	1
Female	554 (69.51)	243 (30.49)	1.67 (1.31–2.13)***	1.25 (0.94–1.67)
Age				
<45	296 (95.48)	14 (4.52)	1	1
45–59	349 (76.20)	109 (23.80)	6.60 (3.71–11.77)***	2.26 (1.20–4.27)*
60–69	285 (65.22)	152 (34.78)	11.28 (6.37–19.96)***	3.13 (1.63–5.98)**
≥70	122 (55.20)	99 (44.80)	17.16 (9.43–31.20)***	4.68 (2.35–9.33)***
BMI				
Underweight	47 (73.44)	17 (26.56)	1	1
Normal	608 (73.43)	220 (26.57)	1.00 (0.56–1.78)	1.04 (0.53–2.04)
Overweight	312 (74.82)	105 (21.18)	0.93 (0.51–1.69)	0.97 (0.48–1.95)
Obese	85 (72.65)	32 (27.35)	1.04 (0.52–2.07)	1.05 (0.48–2.33)
Education level				
Primary school or lower	547 (60.91)	351 (39.09)	1	1
Middle school	294 (94.53)	17 (5.47)	0.09 (0.05–0.15)***	0.14 (0.08–0.24)***
High/vocational school or higher	211 (97.23)	6 (2.77)	0.44 (0.02–0.10)***	0.10 (0.04–0.24)***
Marital status				
Married	907 (74.71)	307 (25.29)	1	1
Others	145 (68.40)	67 (31.60)	1.36 (0.99–1.87)	0.86 (0.55–1.34)
Number of people living together				
Living alone	69 (58.97)	48 (41.03)	1	1
2–3	397 (68.69)	181 (31.31)	0.66 (0.44–0.98)*	0.93 (0.54–1.59)
4–5	360 (83.33)	72 (16.67)	0.29 (0.18–0.45)***	0.76 (0.43–1.36)
≥6	226 (75.59)	73 (24.41)	0.46 (0.29–0.73)**	1.01 (0.55–1.83)
Average annual household income (CNY)				
<10,000	203 (58.33)	145 (41.67)	1	1
10,000–29,999	267 (72.16)	103 (27.84)	0.54 (0.39–0.74)***	0.71 (0.50–0.99)*
30,000–59,999	306 (76.69)	93 (23.31)	0.43 (0.31–0.58)***	0.84 (0.56–0.95)*
≥60,000	276 (89.32)	33 (10.68)	0.17 (0.11–0.25)***	0.48 (0.29–0.80)**
Self-rated health status				
Very good/good	657 (77.11)	195 (22.89)	1	1
Fair	323 (71.74)	126 (28.06)	1.31 (1.01–1.71)*	0.89 (0.67–1.20)
Very poor/poor	72 (57.60)	53 (42.40)	2.48 (1.68–3.66)***	1.17 (0.76–1.81)

Note: Data are n (%), unless otherwise indicated. *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$. COR = crude odds ratios. AOR = adjusted odds ratios.

Table 3
Logistic regression analysis for the factors associated with participants' knowledge of self-protection for COVID-19.

Variable(s)	Medium-to-high (scored ≥10)	Low (scored <10)	COR (95% CI)	AOR (95% CI)
	n = 1,088 (76.30%)	n = 338 (23.70%)		
Sex				
Male	477 (75.83)	152 (24.17)	1	1
Female	611 (76.66)	186 (23.34)	0.96 (0.75—1.22)	0.81 (0.62—1.06)
Age				
<45	261 (84.19)	49 (15.81)	1	1
45—59	359 (78.38)	99 (21.62)	1.47 (1.01—2.14)*	0.98 (0.63—1.53)
60—69	313 (71.62)	124 (28.38)	2.11 (1.46—3.05)***	1.35 (0.84—2.15)
≥70	155 (70.14)	66 (29.86)	2.27 (1.49—3.45)***	1.34 (0.78—2.29)
BMI				
Underweight	49 (76.56)	15 (23.44)	1	1
Normal	633 (76.45)	195 (23.55)	1.01 (0.55—1.83)	1.03 (0.55—1.93)
Overweight	318 (76.26)	99 (23.74)	1.02 (0.55—1.89)	1.09 (0.57—2.09)
Obese	88 (75.21)	29 (24.79)	1.08 (0.53—2.20)	1.09 (0.52—2.28)
Education level				
Primary school or lower	641 (71.38)	257 (28.62)	1	1
Middle school	259 (83.28)	52 (16.72)	0.50 (0.36—0.70)***	0.50 (0.35—0.73)***
High/vocational school or higher	188 (86.64)	29 (13.36)	0.39 (0.25—0.58)***	0.41 (0.25—0.69)**
Marital status				
Married	944 (77.76)	270 (22.24)	1	1
Others	144 (67.92)	68 (32.08)	1.65 (1.20—2.27)**	1.67 (1.13—2.46)*
Number of people living together				
Living alone	79 (67.52)	38 (32.48)	1	1
2—3	432 (74.74)	146 (25.26)	0.70 (0.46—1.08)	1.02 (0.61—1.72)
4—5	349 (80.79)	83 (19.21)	0.49 (0.31—0.78)**	0.85 (0.49—1.49)
≥6	228 (76.25)	71 (23.75)	0.65 (0.41—1.04)	0.96 (0.54—1.71)
Average annual household income (CNY)				
<10,000	261 (75.00)	87 (25.00)	1	1
10,000—29,999	274 (74.05)	96 (25.95)	1.05 (0.75—1.47)	1.33 (0.93—1.09)
30,000—59,999	299 (74.94)	100 (25.06)	1.00 (0.72—1.40)	1.56 (1.00—2.32)
≥60,000	254 (82.20)	55 (17.80)	0.65 (0.45—0.95)*	0.79 (0.77—0.99)*
Self-rated health status				
Very good/good	650 (76.29)	202 (23.71)	1	1
Fair	355 (79.06)	94 (20.94)	0.85 (0.65—1.12)	0.73 (0.55—0.98)*
Very poor/poor	83 (66.40)	42 (33.60)	1.63 (1.08—2.44)*	1.21 (1.05—1.86)*

Note: Data are n (%), unless otherwise indicated. *P < 0.05, **P < 0.01, ***P < 0.001. COR = crude odds ratios. AOR = adjusted odds ratios.

COVID-19 as compared with those had a primary school educational background or lower. Compared to those with an average annual household income less than 10,000 CNY, respondents with an average annual household income greater than 60,000 CNY (COR = 0.65, 95% CI 0.45 to 0.95; and AOR = 0.79, 95% CI 0.77 to 0.99) were less likely to be deficient in the knowledge of self-protection against COVID-19. Compared to those were married, those who were single, divorced, or widowed (COR = 1.65, 95% CI 1.20 to 2.27; and AOR = 1.67, 95% CI 1.13 to 2.46) were more deficient in the knowledge of self-protection against COVID-19. In terms of the participants' self-rated health status, compared to people who self-rated themselves as being in very good/good health conditions, individuals with a fair health conditions were less likely to be deficient in the knowledge of self-protection against COVID-19 (AOR = 0.73, 95% CI 0.55 to 0.98), while those who self-rated their health status as very poor/poor (COR = 1.63, 95% CI 1.08 to 2.44; and AOR = 1.21, 95% CI 1.05 to 1.86) exhibited a lower score in the knowledge of self-protection against COVID-19.

4. Discussion

Many previous related studies have shown that it is very important for the masses to know the basic knowledge and information of a specific disease or public health event like the COVID-19 pandemic [16—19], which is critical for better limiting, preventing and controlling the spread of the diseases [20]. Indeed, in the process of fighting against any kind of infectious disease, it is very important to know what exactly the disease is, including its biological feature, route of transmission, incubation period etc. In the present study, respondents from rural communities received lower scores in the knowledge of COVID-19 than the knowledge of self-protection for COVID-19. In other words, knowing "how to do" to protect oneself against COVID-19 is more important than knowing "what it is," which unlike another study during the outbreak of SARS which pointed out that it is vital that every resident should be equipped with accurate SARS knowledge to prevent disease.

In this study, age was the main factor related with the participants' knowledge of COVID-19. The findings indicate that the elderly from rural communities had little accurate knowledge of COVID-19, including the most common symptoms of COVID-19, infection sources, and route of transmission etc. Interestingly, however, participants' age was not associated with the knowledge of self-protection for COVID-19. The findings suggest that the elderly from rural communities with limited knowledge of COVID-19 were well aware of "how to do" to protect themselves from the COVID-19, which was consistent with the findings from other relevant studies [13,21,22]. Moreover, consistent with the findings reported by many previous related studies [23,24], our study also showed that the education level of the respondents was a key factor associated with the knowledge of COVID-19, as well as the knowledge of self-protection against COVID-19. This could be explained by comparing with lower-educated people, those with higher levels of education have broader channels to learn related knowledge and stronger learning capabilities. In real life, well-educated individuals may usually have better socio-economic

status and more social participation, and thus are easier to grasp more related information and knowledge of COVID-19 [25—27]. Indeed, the current study revealed that the average annual household income of the respondents was associated with the knowledge of COVID-19 and its prevention and control. The lower-income people knew less about what COVID-19 is, and the highest-income people had the better knowledge of "how to do" to self-protect against COVID-19. This is understandable due to the fact that education level and income are generally positively correlated with each other.

As a matter of fact, there is a large number of people with low levels of education from rural communities in China, especially the rural elderly, and it is really difficult for them to understand even the basic knowledge about COVID-19. That is the reason why, in the process of China's fight against COVID-19, both the central government and local governments disseminate the information about how to protect oneself against COVID-19 concisely and straightforwardly, such as using village broadcasts and patrol cars to continuously broadcast the slogans, and even raising banners in the village to remind villagers to keep social distance, wear face masks, disinfect frequently, wash hands more frequently, etc. [28,29]. By informing the masses about knowledge on "how to do" to prevent COVID-19, starting from each village and community, 1.4 billion Chinese people follow the government's policies and leadership and cooperate with the governments to fight the COVID-19 epidemic, which effectively laid an important foundation for China to win the war against the COVID-19 epidemic. Therefore, our study suggests that it may be a better strategy for government policy-makers to pay more attention to telling the public "how to do" to fight the epidemic instead of "what it is" in similar severe infectious diseases in the future. Besides, the government is supposed to make targeted use of various methods, such as television, social media, broadcasting and banners to disseminate the information in accordance with the different sociodemographic backgrounds, like age, education level, income, etc. of the target population [30,31].

One of the major findings from this study is that compared to married people, the single/divorced/widowed tend to be more deficient in the knowledge of self-protection against COVID-19. This may be due to the fact that people with partners may talk more frequently about health-related events and share the latest related knowledge and measures of self-protection against COVID-19 to each other during the special period of the severe epidemic prevention and control. Moreover, married individuals may remind and supervise their partners to take some relevant measures. In China, there is a high degree of aging in rural areas, the empty-nest or widowed older adults, whose children may work in the big city because of financial burdens and do not have time to spend with their parents. In the post-epidemic period, the village committee should continuously remind these people to take basic protective measures in daily life, such as paying attention to disinfection, opening windows for ventilation, washing hands frequently, etc.

Although China has achieved great victories in fighting against COVID-19, in some areas, there is still a lack of attention to some vulnerable groups. This study will become a starting point to draw the public's attention to the particular circumstances in the rural areas in the fight against COVID-19. Meanwhile, there are some limitations in our study. For example, we did not add a study to compare urban and rural areas. Besides, only knowledge in the KAP model is considered, while attitudes and practices are not analyzed. Therefore, more research is needed to focus on rural community-dwelling residents based on knowledge, attitudes and practices.

5. Conclusions

To some extent, this paper represents the first study addressing the public's knowledge of COVID-19 and its prevention among residents living in rural communities in the context of post-pandemic era. Our study has clearly shown that the respondents from rural communities received lower scores in the knowledge of COVID-19, but gained good knowledge related to self-protection against COVID-19. We believe that when being faced with a pandemic like COVID-19, the key is to inform the public to master simple and effective self-protection measures, that is, to know "how to do" rather than to know "what it is". This may be one of the important reasons for China's success in fighting the epidemic. Therefore, with the normalization of epidemic prevention and control, we call on the local, regional, and even national governments in China to give priority to publicity and education of knowledge related to the self-prevention measures for the targeted populations and regions. This is most evident among the vulnerable groups like unmarried, elderly, and those with low education or low income. Similar suggestions may be of use in other countries as well.

CRediT authorship contribution statement

Xiaojun Liu: Methodology, Formal analysis, Writing- original draft, Writing-review & editing, Funding acquisition. **Shanshan Du:** Methodology, Software, Validation, Visualization, Writing-review & editing. **Ruimei Feng:** Data curation, Investigation, Writing-review & editing. **Lingjun Yan:** Data curation, Investigation, Writing-review & editing. **Yimin Huang:** Conceptualization, Methodology, Supervision, Project administration, Writing-review & editing. **Weimin Ye:** Conceptualization, Methodology, Supervision, Project administration, Writing-review & editing, Funding acquisition.

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Data availability statement

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Declaration of competing interest

The authors declare they have no conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijnss.2022.02.003.

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