

Food Safety Knowledge, Attitudes, and Self-Reported Practices Among Medical Staff in China Before, During and After the COVID-19 Pandemic

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Purpose: To compare food safety knowledge, attitudes, and self-reported practices among medical staff in China before, during, and after the COVID-19 pandemic.

Patients and Methods: The questionnaire was anonymous. All respondents were Chinese medical personnel. A Chi-square contingency table was used to compare the knowledge and attitudes of Chinese medical staff before, during and after COVID-19. R statistical software (v4.0.0) was used for analysis.

Results: A total of 1431 valid responses (57.3% from female respondents) were included in our analysis. Medical professionals were geographically distributed as follows: eastern China, 55.5%; central China, 19.7%; western China, 24.1%; Hong Kong, Macau, or Taiwan, 0.05%. Medical professionals reported that they paid greater attention to food safety after the COVID-19 pandemic compared with before the epidemic. Self-reported knowledge of and attitudes toward food safety among medical staff were significantly different before, during, and after the COVID-19 pandemic (both $P < 0.001$).

Conclusion: After the COVID-19 pandemic, medical professionals paid increasing attention to food safety, which is a clinically important change. Because medical professionals can influence public understanding of food safety, their increased attention to this subject may enable them to promote food safety knowledge more actively in their work. This may in turn promote a better understanding of food safety and protect the health of the general public.

Keywords: food safety, medical staff, COVID-19, questionnaire

Introduction

At the end of 2019, an outbreak of an infectious, acute respiratory disease caused by a novel SARS-CoV-2 variant (COVID-19) broke out in Wuhan, China. This outbreak severely affected the normal work and life of residents, threatened the health of the general population, and posed severe challenges to China.^{1,2} The first reports suggested that the emergence of COVID-19, which led to a pandemic, probably resulted from human consumption of domestic animals or wild captive animals, such as bats, snakes, marmots, or civet cats.³⁻⁵ Although it has not been proven that the spread of COVID-19 was caused by food, food safety has once again become a focus of attention in public health. In an online survey in the Philippines, which included a total of 751 people, suggested that both government and nongovernmental organizations should work together to

ensure that the general public are sufficiently educated in important food safety concepts and effective methods of handling food at home, thus becoming advocates of safer food practices.⁶

In addition, particularly during the COVID-19 pandemic, traceability of food products, which enables their recall or withdrawal if deemed unsafe, has a vital role in ensuring food quality and safety. The Internet of Things (IoT) provides tools to monitor environmental conditions, product quality, and product availability in food production, thus augmenting traceability. A retrospective solution maximizes food safety, reducing the amounts of bacteria, fungi, and parasites in the frozen meat supply chain during the COVID-19 pandemic.⁷ At the same time, medical professionals on the front line of the COVID-19 pandemic⁸ are required to perform high-risk tasks that expose them to sources of infection.⁹ In the face of COVID-19 pandemic, the dissemination of food safety concepts among the general public is therefore important.¹⁰ Implementing human resource management strategies will improve mental health, job satisfaction, productivity, motivation, and workplace health and safety among medical staff during the COVID-19 pandemic¹¹ and improve the attitudes of the general population towards food safety.

The acceptance of food safety principles also reflects general views on disease risk, as well as the general public's attitudes and behavior patterns in the context of health, which are critical to the success of immunization programs, including for COVID-19. Good personal nutrition, which is influenced by an individual's understanding of healthy eating concepts, may also reduce risk of infection and improve disease prognosis.¹² Previous studies have shown that clinical specialists are an important source of food safety knowledge for patients, and communication between specialists and patients may therefore improve patients' awareness of food safety. Individuals who believe they are at risk are more likely to listen to the dietary and food safety advice of medical professionals.¹³ However, medical staff will also have varying levels of knowledge on food safety, which in turn may limit the understanding of those in their care.^{14,15} At the same time, it is necessary to emphasize fact-based, people-oriented, and collaborative responses among global media outlets with regards to reporting on COVID-19, encouraging them to prioritize reporting on core public health issues, including methods of effectively attenuating or preventing the spread of COVID-19.¹⁶ This

should include information on food safety. Given the importance of food safety in ensuring good public health, it is essential to know to what extent the pandemic has affected understanding of this topic among medical professionals, and which factors affect their acceptance of food safety concepts. This information is crucial for the future dissemination of food safety knowledge in China after the COVID-19 pandemic.

Previous studies have shown that public health organizations and initiatives and social media have an indispensable role in providing accurate health information during the COVID-19 pandemic,¹⁷ which may include food safety. Improving knowledge, attitudes, and behaviors among medical professionals on this subject may provide benefits to society as a whole by enhancing their food safety knowledge.

In this study, we therefore investigated food safety knowledge, attitudes, and behavior patterns among Chinese medical professionals before, during and after the COVID-19 pandemic. We analyzed the roles of these high-risk groups in providing food safety education and the extent to which COVID-19 has affected their food safety knowledge, attitudes, and behavior patterns on food safety.

Materials and Methods

Study Design

We conducted an online survey Questionnaire Star (Changsha Ranxing Information Technology Co., Ltd., Hunan, China), China's largest online survey platform, which opened at 13:34:31 on July 28th, 2021, and closed at 19:22:05 on August 10th, 2021. Similar to Qualtrics, SurveyMonkey, or CloudResearch in Europe and the United States, Questionnaire Star provides online questionnaire design and survey functions suitable for research institutions, enterprises, and individuals. An anonymous cross-sectional online survey was conducted using a stratified random sampling method. Personal information from more than 2.6 million respondents was confirmed in the Questionnaire Star sample database. Therefore, it was possible to provide an authentic, diverse, and representative sample.

Target Population

This study targeted Chinese medical professionals living in China. A randomized sampling procedure, in which participants were stratified by age and location, was used

to match the Chinese adults included in the Questionnaire Star sample base.

Questionnaire Content Design

Demographic information, including age, gender, region, and income, were collected from respondents, in addition to the main content of the questionnaire ([Supplementary Material 1](#)). The questionnaire had three sections on food safety knowledge before, during, and after the pandemic, respectively. The contents of each part of the survey (as written) are as follows:

Food safety is a serious problem for patients with weakened immune functions (such as confirmed COVID-19).

(1) Many of my patients may be at risk owing to poor food safety.

(2) It is important to ensure that patients receive food safety education.

(3) Food safety education is a part of the duties of doctors and nurses.

(4) I want to understand the risks associated with poor food safety for my patients.

(5) My patients are more interested in learning and being educated about food safety now than they were before the COVID-19 pandemic.

(6) I am willing to have a short (3 minutes) conversation with my patients to help them understand food safety concepts.

(7) Educating patients on food safety will reduce food-borne illness.

(8) My patients are better able to follow the food safety advice I provide on preventing foodborne illness now than they were before the COVID-19 pandemic.

(9) I am satisfied with the general knowledge of food safety education.

(10) I am more willing to give advice on food safety now than I was before the COVID-19 pandemic.

(11) My patients consider me a valuable resource for food safety education.

(12) In the post-COVID-19 era, a complete management system must be established for food safety.

(13) In the post-COVID-19 era, a complete emergency response plan must be established.

(14) In the post-COVID-19 era, a complete food traceability system must be established.

Respondents were stratified into those from western, central, and eastern regions of China, and further stratified according to economic level.

Statistical Analysis

We compared whether the epidemic has affected the extent of differences in attitudes and perceptions of food safety among Chinese medical professionals and what factors have influenced their acceptance of food safety knowledge. Chi-square tests were used to analyze the differences between groups. Frequencies were expressed as percentages. Differences with an associated $P < 0.05$ were considered statistically significant. Statistical analyses were conducted using R statistical software (v3.6.1; <http://www.Rproject.org>).

Results

Demographic Information

A total of 1451 individuals responded to the questionnaire. 20 invalid responses (which lacked basic information or contained incorrect data) were eliminated, leaving a total of 1431 valid responses from medical professionals that were included in the study ([Table 1](#)). Respondents of our questionnaire were from Eastern China (55.5%), Central China (19.7%), Western China (24.1%), and Hong Kong, Macau, and Taiwan (0.05%) ([Figure 1](#)). Men and women accounted for 57.3% and 42.7% of respondents, respectively. Most respondents (96.44%) were aged between 18 and 60 years. [Figure 2](#) shows that more medical professionals actively pay attention to food safety as a result of the COVID-19 pandemic, which therefore had an impact on food safety knowledge.

Knowledge of Food Safety Among Medical Professionals

Differences in the knowledge of food safety between the three periods (before, during and after the COVID-19 pandemic) were all significantly different ($P < 0.001$) ([Table 2](#)). A greater number of medical professionals agreed that food safety is a serious issue for patients with weakened immune functions (such as confirmed COVID-19) after the COVID-19 pandemic, and that many patients may face risks associated with food safety, with 127 in agreement before and 189 in agreement after the COVID-19 pandemic.

The number of people in agreement with several other statements also increased after the pandemic compared with before, including: “many of my patients may be at risk for food safety” (109 before versus 155 after); “it is important to ensure that patients receive food safety education” (398 before versus 595 after); “food safety

Table 1 Sociodemographic Characteristics of Medical Staff Samples

	N (1431)
Gender	
Male	610(42.62%)
Female	821(57.38%)
Age	
18–30	355(24.80%)
31–40	578(40.39%)
41–50	343(23.96%)
51–60	86(6.00%)
61–70	18(12.57%)
71–80	51(3.56%)
Residential area	
Eastern China	795(55.56%)
Central China	282(19.70)
Western China	346(24.17)
Hong Kong, Macau and Taiwan	8(0.57%)
Income (RMB)	
0–20,000	330(23.06%)
20,000–50,000	159(11.11%)
50,000–150,000	575(40.18%)
150,000–500,000	352(24.59)
>500,000	15(1.06%)

education is a part of the duties of doctors and nurses” (109 before versus 155 after); “I want to understand the risks of food safety for my patients” (123 before versus 174 after); “my patients are more interested in understanding and being educated about food safety than before the COVID-19 epidemic” (100 before versus 130 after); “educating patients on food safety will reduce foodborne illness” (190 before versus 279 after); “my patients are better able to follow the food safety advice I provide on preventing foodborne illness now than they were before the COVID-19 pandemic” (89 before versus 127 after).

Attitudes of Medical Professionals Towards Food Safety

Differences in the attitude towards food safety between the three periods (before, during and after the COVID-19 pandemic) were all significantly different ($P < 0.001$) (Table 3). Medical professionals were more satisfied with the general knowledge of food safety education after the pandemic compared with before. Compared with before the COVID-19 outbreak, there was an increased willingness to provide advice on food safety; an increased

number of medical professionals agreed that patients consider medical professionals a valuable resource for food safety education; more respondents agreed that a complete management system and traceability system must be established for food safety after the COVID-19 pandemic; a greater number agreed that a complete emergency response plan for food safety should be established after the COVID-19 pandemic; and more medical professionals reported that they were willing to have a short conversation (3 min) with patients to help them understand food safety concepts.

Discussion

The COVID-19 pandemic has changed people’s perceptions of food safety. For example, Iran’s health experts have recommended solutions to attenuate and prevent the spread of COVID-19.¹⁸ As the main disseminators of food safety, the food safety knowledge, attitudes, and self-reported behaviors of medical professionals may substantially affect public knowledge and attitudes towards food safety. Therefore, we conducted this study to better understand food safety knowledge, attitude, and self-reported behaviors of medical professionals before, during and after the pandemic.

In this study, statistically significant differences were found in both knowledge of and attitudes toward food safety among medical professionals before, during, and after the epidemic ($P < 0.001$). In the wake of COVID-19, medical professionals are increasingly focused on food safety knowledge, which is a clinically important change: these professionals are an important source of food safety knowledge for the general public, and active concern about food safety may lead to more active promotion of food safety knowledge in their work, thus improving public understanding of food safety, and protecting the health of the population.

Food safety has long been the subject of research worldwide,^{19,20} and it is acknowledged to be an important national security issue.²¹ During the COVID-19 era, a large number of studies have shown that virulence, individual susceptibility, and immunity are key determinants of susceptibility to disease following exposure to the COVID-19 virus.²² Good personal nutrition may reduce the risk of infection and improve disease prognosis.²³ The Chinese Nutrition Society and Chinese Medical Association have published a series of dietary nutrition recommendations and guidelines for the prevention and treatment of COVID-19,^{24,25} which are intended to guide

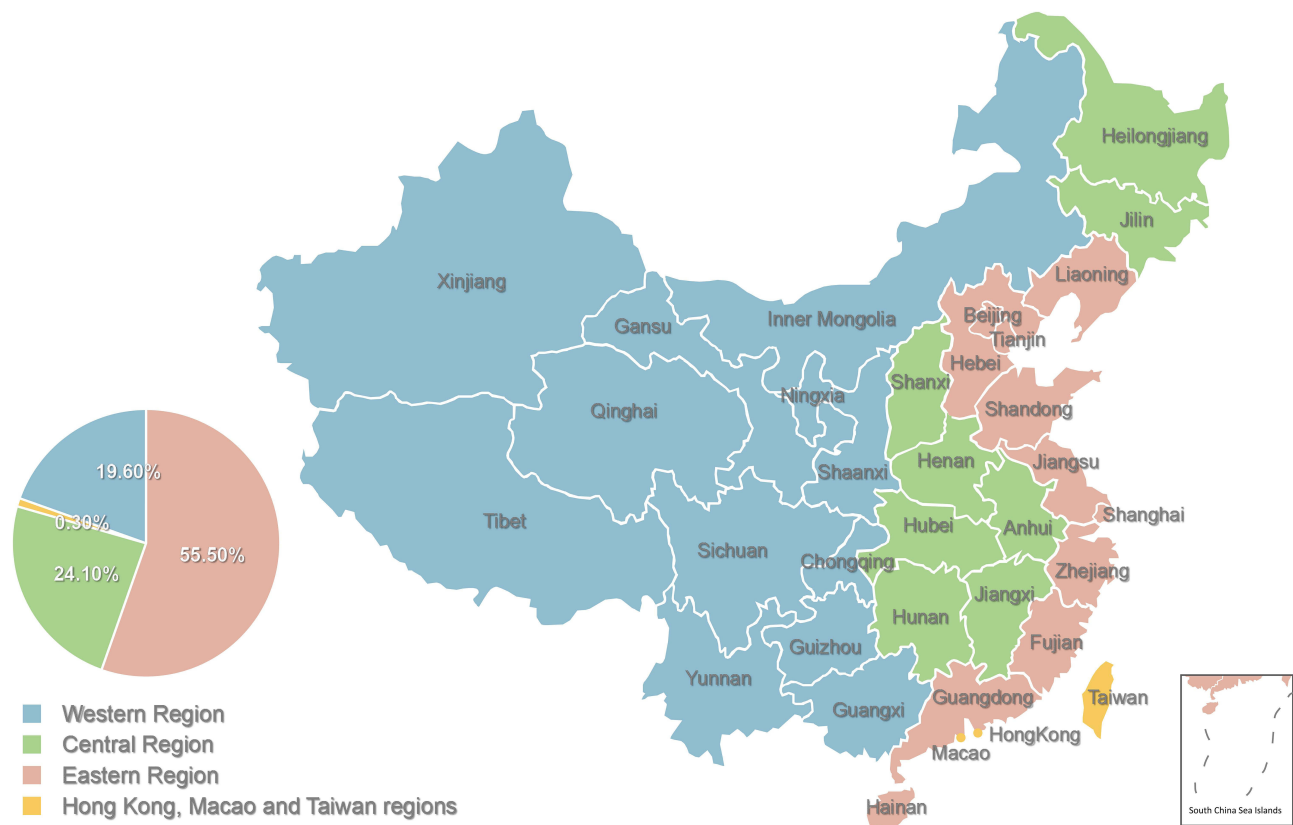


Figure 1 The respondents of our questionnaire came from Eastern Region, Central Region, Western Region, Hong Kong, Macau and Taiwan, China.

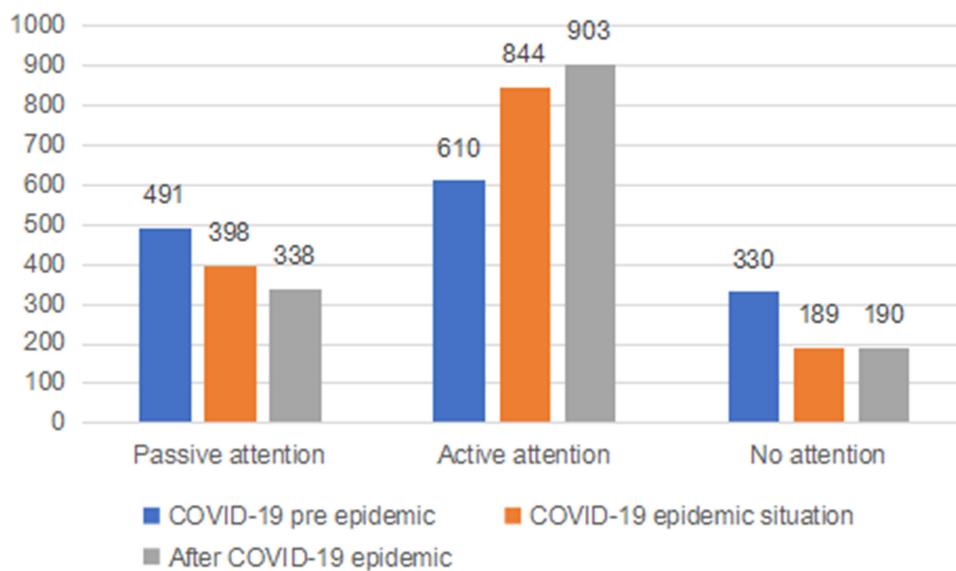


Figure 2 Distribution of number of people paying attention to food safety knowledge before and after the COVID-19 epidemic.

the public to eat healthily, thereby bringing food safety, nutrition, and healthy lifestyle into the public consciousness.²⁶ Our questionnaire demonstrates that increasing numbers of medical professionals agree that it

is important to ensure patients receive food safety education. According to our medical professionals, their patients are more interested in understanding and receiving food safety education after the pandemic compared with before

Table 2 Comparison of Differences in Perceptions of Food Safety Before and After the COVID-19 Epidemic (p-value^A: Comparison Before and During the COVID-19 Epidemic, p-value^B: Comparison After the COVID-19 Epidemic and During the COVID-19 Epidemic)

	Before the COVID-19 Epidemic			During the COVID-19 Epidemic			After the COVID-19 Epidemic			p-value ^A	p-value ^B
	Passive attention	Active attention	Not paying attention	Passive attention	Active attention	Not paying attention	Passive attention	Active attention	Not paying attention		
Food safety is a serious problem for patients with weakened immune function (such as confirmed COVID-19)											
Strongly agree	71	137	42	56	181	13	48	189	13	<0.001 ($\chi^2=24.5$)	<0.001 ($\chi^2=20.2$)
Agree	320	360	170	248	513	89	214	546	90		
Neutral or no answer	75	73	105	75	98	80	60	116	77		
Disagree	24	37	11	18	49	5	15	49	8		
Strongly disagree	1	3	2	1	2	2	1	3	2		
Many of my patients may be at risk for food safety											
Strongly agree	67	109	31	47	145	15	40	155	12	<0.001 ($\chi^2=18.7$)	<0.001 ($\chi^2=24.1$)
Agree	330	391	196	274	537	106	225	587	105		
Neutral or no answer	71	70	76	61	103	53	587	102	55		
Disagree	23	39	25	58	59	13	58	16	58		
Strongly disagree	0	1	2	1	1	2	1	32	2		
Ensure that patients receive food safety education											
Strongly agree	92	182	52	57	245	24	53	252	21	<0.001 ($\chi^2=31.7$)	<0.001 ($\chi^2=33.6$)
Agree	356	398	199	293	558	112	240	595	118		
Neutral or no answer	38	27	68	49	37	47	37	51	45		
Disagree	4	3	9	4	4	4	7	5	4		
Strongly disagree	1	0	2	1	0	0	1	0	2		
Food safety education is part of the duties of doctors and nurses											
Strongly agree	73	123	44	46	170	24	34	181	25	<0.001 ($\chi^2=28.7$)	<0.001 ($\chi^2=19.8$)
Agree	312	390	199	246	541	114	218	573	110		
Neutral or no answer	60	46	57	62	66	35	52	76	35		
Disagree	41	46	23	40	59	11	30	65	15		
Strongly disagree	5	5	7	4	8	5	4	8	5		

I want to understand the risks of food safety for my patients Strongly agree Agree Neutral or no answer Disagree Strongly disagree	70 371 40 9 1	123 428 48 10 1	40 236 45 7 2	42 303 43 8 2	166 607 56 4 1	25 125 34 4 1	38 257 35 7 1	174 652 62 14 1	21 126 36 5 2	<0.001 ($\chi^2 = 11.2$)	<0.001 ($\chi^2 = 20.1$)
My patient is more interested in understanding and receiving food safety education than before the COVID-19 epidemic Strongly agree Agree Neutral or no answer Disagree Strongly disagree	43 325 91 31 1	100 387 79 42 2	34 187 77 30 2	37 240 91 30 0	125 558 104 54 3	15 101 52 19 2	33 200 79 26 0	130 598 116 56 3	14 101 52 21 2	<0.001 ($\chi^2 = 18.7$)	<0.001 ($\chi^2 = 10.4$)
Educating patients on food safety will reduce foodborne illness Strongly agree Agree Neutral or no answer Disagree Strongly disagree	132 333 20 6 0	190 398 15 7 0	71 218 36 4 1	92 278 21 7 0	268 550 18 8 0	33 121 32 2 1	84 231 17 6 0	279 591 24 9 0	30 127 30 2 1	<0.001 ($\chi^2 = 20.1$)	<0.001 ($\chi^2 = 11.6$)
My patients are better able to follow the food safety advice I provided to prevent foodborne illness than before the COVID-19 epidemic Strongly agree Agree Neutral or no answer Disagree Strongly disagree	54 340 70 26 1	89 410 80 29 2	28 212 68 18 4	39 266 70 23 0	121 585 93 42 3	11 111 55 8 4	34 221 62 21 0	127 623 107 43 3	10 118 49 9 4	<0.001 ($\chi^2 = 14.7$)	<0.001 ($\chi^2 = 17.2$)

Table 3 Comparison of Attitudes Towards Food Safety Before, After and During the COVID-19 Epidemic (p-value^A: Comparison Before and During the COVID-19 Epidemic, p-value^B: Comparison After the COVID-19 Epidemic)

	Before the COVID-19 Epidemic			During the COVID-19 Epidemic			After the COVID-19 Epidemic			p-value ^A	p-value ^B
	Passive Attention	Active Attention	Not Paying Attention	Passive Attention	Active Attention	Not Paying Attention	Passive Attention	Active Attention	Not Paying Attention		
I am satisfied with the general knowledge of food safety education											
Strongly agree	32	62	20	19	85	10	20	86	8	<0.001 ($\chi^2 = 22.7$)	<0.001 ($\chi^2 = 18.6$)
Agree	323	422	211	255	586	115	209	632	115		
Neutral or no answer	67	55	62	61	78	45	54	86	44		
Disagree	69	68	35	63	92	17	55	96	21		
Strongly disagree	0	3	2	0	3	2	0	3	2		
I am more willing to advise on food safety than before the COVID-19 outbreak											
Strongly agree	48	94	28	35	122	13	27	130	13	<0.001 ($\chi^2 = 9.7$)	<0.001 ($\chi^2 = 10.7$)
Agree	359	442	224	279	631	115	236	669	120		
Neutral or no answer	63	57	62	64	68	50	57	81	44		
Disagree	19	15	14	19	20	9	17	20	11		
Strongly disagree	2	2	2	1	3	2	1	3	2		
My patients consider me as a valuable resource for food safety education											
Strongly agree	40	68	31	30	58	17	26	94	19	<0.001 ($\chi^2 = 18.7$)	<0.001 ($\chi^2 = 22.7$)
Agree	320	400	193	246	1	102	204	603	106		
Neutral or no answer	92	98	73	81	92	54	74	140	49		
Disagree	37	44	30	39	565	14	32	65	14		
Strongly disagree	2	0	3	2	128	2	2	1	2		
A complete management system must be established for food safety in the post-COVID-19 era											
Strongly agree	154	235	96	112	328	45	98	343	44	<0.001 ($\chi^2 = 14.7$)	<0.001 ($\chi^2 = 11.9$)
Agree	312	354	196	258	492	112	216	529	117		
Neutral or no answer	23	19	36	26	22	30	22	29	27		
Disagree	1	2	1	1	1	1	1	1	1		
Strongly disagree	1	0	1	1	0	1	1	0	1		

Food safety must establish a complete emergency response plan in the post-COVID-19 era	Strongly agree	169	238	98	124	334	47	110	350	45	<0.001 ($\chi^2 = 18.0$)	<0.001 ($\chi^2 = 20.4$)
	Agree	300	355	196	250	492	109	207	528	116		
	Neutral or no answer	18	15	34	21	17	29	17	23	27		
	Disagree	3	2	1	3	1	2	4	1	1		
	Strongly disagree	1	0	1	0	0	2	0	1	1		
Food safety must establish a complete traceability system in the post-COVID-19 era	Strongly agree	194	257	109	144	361	55	125	379	56	<0.001 ($\chi^2 = 18.7$)	<0.001 ($\chi^2 = 14.7$)
	Agree	283	336	184	239	464	100	202	497	104		
	Neutral or no answer	12	12	34	14	14	30	11	20	27		
	Disagree	1	4	1	0	4	2	0	5	1		
	Strongly disagree	0	1	2	1	1	2	0	2	2		
I am willing to have a short conversation (three minutes) with my patients to understand food safety	Strongly agree	44	95	31	32	121	17	27	127	16	<0.001 ($\chi^2 = 9.7$)	<0.001 ($\chi^2 = 15.4$)
	Agree	378	441	228	288	639	120	243	684	120		
	Neutral or no answer	56	55	53	63	63	38	53	71	40		
	Disagree	130	19	16	15	21	12	15	21	12		
	Strongly disagree	0	0	2	0	0	2	0	0	2		

the pandemic; in addition, more medical professionals agreed that food safety education can reduce food-borne illnesses and that their patients are better able to follow food safety recommendations to prevent food-borne illnesses after compared with before the COVID-19 epidemic. This also fits well with the guidelines and recommendations.^{24,25}

One study in the USA showed that the incidence of foodborne disease is at a high level.²⁷ The severity of these diseases in high-risk groups implies that food safety education is an important part of prevention. Doctors with high-risk patients are therefore particularly important as food safety educators. Our results showed that a greater number of medical professionals agreed that food safety is a serious problem for patients with weakened immune functions (including confirmed COVID-19) after compared with before the COVID-19 pandemic, and that many patients may face risks associated with food safety. Patients are more likely to listen to suggestions from medical professionals regarding their diet and food ingredients when they have recently been exposed to disease, or believe that they are in danger. In one study, patients were shown to believe that the main reason why doctors might not provide nutritional advice is because the risk is low,²⁸ however, at the same time, they regard doctors as the main source of food safety information. Compared with before the COVID-19 pandemic, more medical professionals reported that they were willing to have a short conversation with patients to help them understand food safety concepts in this study. One important obstacle that may prevent medical professionals from providing patients with education on their diet is a lack of appropriate health information. This includes interest in and expectations of dietary changes, noncompliance with recommendations, lack of nutritional knowledge, lack of available time, lack of impact on patients, lack of interest in the impact of diet on health, and lack of recommendations, treatments, or preventative measures for nutrition-related diseases.^{28–30}

The results of targeted food safety education activities in a foreign country (countries outside the mainland) indicate that food safety education should be targeted to patients with the highest risks of serious consequences from foodborne diseases, increasing the role of doctors as food safety educators and verifying the role of doctors. Food safety educators value patients and increase their comfort by providing food safety information to their patients.³¹ In response to the COVID-19 pandemic, food

safety services may also adopt phone-based screening and classification in the primary healthcare system to reduce unnecessary contact and spread.³² The COVID-19 pandemic has focused greater attention on food safety.³³ In addition, in the post-COVID-19 era in China, understanding the risks of food safety hazards is essential to avoid potential negative health consequences of the food supply chain.³⁴ The results of this study show that increasing numbers of medical professionals agree that they are satisfied with the general knowledge of food safety education compared with before the pandemic; in addition, a greater number agreed that they were willing to provide food safety advice. According to an increasing number of medical professionals, patients consider them to be a valuable source of food safety education. Increasing numbers of health professionals agree that complete management and traceability systems and a complete emergency response plan for food safety must be established after the COVID-19 epidemic. Domestic research in China also shows that food safety education is also very important.³⁵ Overall, the global COVID-19 pandemic has made Chinese people pay more attention to food safety,³⁶ a finding that is supported by our study; in response to the ongoing COVID-19 pandemic, greater global attention should therefore be paid food safety.

Conclusion

Medical professionals are important sources of food safety information, particularly during the global COVID-19 pandemic, providing direct support to patients. This creates opportunities to spread information and advice on food safety in the general population; our study indicates that more medical professionals agree with and are willing to take responsibility for food safety education in this context.

Data Sharing Statement

All the data and materials mentioned in the manuscript are available.

Ethics Approval and Consent to Participate

Information about the purpose of the study, nature of voluntary participation, and risks associated with participation are presented in the information section of the survey. This study was approved by the ethics committee of Affiliated Hospital of Hangzhou Normal University. Informed consent was obtained from all

participants. Throughout the study, the information was kept confidential, and anonymous data were recorded. This study was carried out according to the Declaration of Helsinki.

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Disclosure

The authors report no conflicts of interest in this work.

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