Abstract

Aim To analyze the level of knowledge, attitudes, practice and risk perception about COVID-19 among Chinese residents one and a half years after the pandemic.

Methods A cross-sectional study was carried out with both online and paper questionnaires. We included a variety of covariates that was characteristics-related factors such as age, gender, education level, retired status, as well as that was closely associated with risk perception of COVID-19.

Results Participants (n = 3588), 53.49± 18.88 years old, from two provinces of China answered the questions, of which 44.7% were males, 52.03% received high school and above education. More than 90% of participants had adequate background knowledge about COVID19 and agreed or even strongly agreed with many attitude items related to the government's role in diagnosis, treatment, and dealing with COVID-19 infections. About three fifths of the participants reported the fear of contracting the COVID-19, but only a minority of them (18.63%) felt they were more susceptible than others. Respondents with the age less than 45 years-old were more likely to fear of contracting the virus than those with older than 45 years-old (adjusted OR=1.464, 95% CI 1.196 to 1.794, P=0.0002). High education level (adjusted OR=1.503, 95% CI 1.187 to 1.904, P=0.0007), and not retried (adjusted OR=1.679, 95% CI1.354 to 2.083, P<0.0001) were associated with higher perception of susceptibility to infection than others. Moreover, not retired respondents had significantly reduced practice score (adjusted OR=1.554, 95% CI 1.261 to 1.916, P<0.0001). Age, retired or not, and education level is also associated with knowledge, attitude and practice level.

Conclusion Our findings suggest that public generally have the trust in the COVID-19 vaccine and the government towards COVID-19 in China. We recommend that high-risk groups of communities, such as elders and patients with chronic diseases should be more regarded in the outbreaks. Health education campaigns combined with workplace preventive intervention should be aimed at improving COVID-19 knowledge and belief in order to encourage more optimistic attitudes and maintain safe practices.

Keywords COVID-19; Attitudes; Knowledge; Risk perception

Introduction

COVID-19 is one of the major public health threats with the fastest spread, the widest reach of infection and the most difficult to prevent and control in the past hundred years. In January 2020, the World Health Organization (WHO) declared it as a world pandemic of global public health significance (WHO 2020). Within the past 3 years, the emergence of novel variants of the COVID-19 viruses, had resulted in an increase in transmissibility, changes to greater disease severity, notable reduction in neutralization by antibodies generated and thus decreased response to treatments and vaccines(Fernandes et al. 2022). By the mid-December 2022, COVID-19 pandemic had affected more than 640 million people across 216 countries and territories, with more than 6 million deaths worldwide (WHO 2022). Although it is possible to maintain a normal working and living order in most areas of China, China is still under great pressure to prevent the epidemic from being brought in from abroad and reigniting from within.

The effectiveness of controlling the pandemic is highly dependent on people's adherence to behavioral preventive measures(Norman et al. 2020; Zhong et al. 2020), which can be influenced by their knowledge, attitude, and practice toward COVID-19 to a great extent. Individuals' knowledge and perceive risk about the disease, their attitudes and beliefs about preventive measures of the virus, and their trust in health department of government have been reported to be significantly associated with the practice of infection prevention (Chen et al. 2020; Ferdous et al. 2020). Conversely, inadequate knowledge of COVID-19 and standardized preventative measures may influence attitudes and practices of people and directly increase their risk of infection(Zhang et al. 2021; Zhang and Ma 2020). Hence, this study aimed to evaluate the knowledge, attitudes, practices and perception about COVID-19 infection among the general Chinese population, thus to assess the compliance and outcome of epidemic prevention measures, and to provide scientific basis for next step of epidemic control and health education in China. The novelty of this study is that the current study was conducted when COVID-19 in China has entered the stage of regular prevention and control.

Subjects and Methods

Study setting and population

This descriptive cross-sectional study was carried out in Henan and Zhejiang provinces of China in October 2021. Henan and Zhejiang provinces are located in the central and southeast regions of China, respectively, with varied development of economy and technology. We collected the data through both online and paper questionnaires. Online survey used an online applet for conducting survey studies, and paper questionnaire was through community-based survey, both of which were done by a team comprised of well-trained graduate students majoring in life science, clinicians and university researchers. Sample size was calculated by applying the single population proportion formula. Given 50% proportion (since there are no similar previous studies conducted on this topic), 95% of confidence interval level and margin of error (5%) and 10% non-response rate, a minimum sample size of 422 participants would be needed.

Survey Questionnaire

The questionnaire consisted of four parts, which were based on previous publications(Faasse and Newby 2020; Saqlain et al. 2020): the demographic backgrounds of the participants, their knowledge, attitudes, practice (KAP) and risk perceptions related to COVID-19. To be specific, (1) descriptive characters included: age, sex, residence, education, nationality, retired or not, infection of people around and vaccination; (2) fifteen questions of knowledge and preventive measures covered the main general information, mode of transmission, and ways of disease prevention, and each question was answered by either yes or no; (3) the attitudes section consisted of ten questions assessing individuals' attitudes of COVID-19 as a preventable and controllable disease (four items), and towards regulations taken by the Chinese Government to overcome the virus (six items), with the response to each item recorded on the 5-point Likert scale as follows: strongly disagree, disagree, undecided, agree, strongly agree; (4) the risk perception section involved the following two questions: "I am afraid of being infected with COVID-19", and "I am more susceptible to COVID19 virus infection compared with others". The corresponding causes of each question could be answered by either a "yes" or "no". The Cronbach's alpha value for the reliability of the questionnaire was within acceptable range. The validity and acceptability of the questionnaire had been tested in a pilot study before the questionnaire was used for this study.

Ethical Consideration

The ethical committee of Soochow University approved the study protocol (no. 2021-023). Confidentiality of the study participants' identities was maintained throughout the study by making the participants' information confidential and asking participants to give truthful answers. This was voluntary and non-compensated participation. The study was conducted according to the Declaration of Helsinki by the World Medical Association.

Covariates

We included a variety of covariates that was characteristics-related factors such as age, gender, education level, retired status, as well as that was closely associated with risk perception of COVID-19, i.e. favorable COVID-19 knowledge score, COVID-19 attitudes level, and two factors (1st factor: Myself, friends or family had been diagnosed with COVID-19; 2nd factor: Have you been vaccinated against COVID-19?).

Statistical Analysis

Continuous variables were expressed as mean ± standard deviation (SD) for normally distributed data and median (interquartile range, IQR) for non-normally distributed data. Categorical variables were presented as numbers (percentages). Binary multivariable logistic regressions analyses were performed to assess participants' risk perception of COVID-19. Binary logistic regression model was utilized to analyze the factors associated with the knowledge, attitude and practice level of COVID19 for unadjusted and adjusted data. A score $\leq P_{50}$ of knowledge, attitude and practice were identified as a positive event for knowledge, attitude and practice, respectively (i.e., OR>1, poor knowledge, poor attitude and poor practice of COVID-19, respectively). Similarly, factors associated with the positive events for fearing of contracting and being more susceptible in the risk perception portion were also analyzed via binary logistic regression model. The dependent variable was created including only the two questions: (1) I am afraid of being infected with COVID-19, (2) I am more susceptible to COVID19 virus infection compared with others. The unadjusted and adjusted odds ratio (OR) and 95% confidence interval (95% CI) were computed and p-values <0.05 were considered statistically significant. All statistical analyses were performed using Statistical Analysis System (SAS) version 9.4 (SAS Institute, Cary, NC, USA).

Results

Characteristics of survey respondents

A total of 3588 participants took part in the study and responded to all the survey questions. The basic characteristics of the studied population were shown in Table 1. The mean age was 53.49± 18.88 years old, and 44.7% of the participants were males. More than half of them (52.03%) had attained high school or above education, 32.72% had primary school or below education, only 15.25% graduated from junior high school. Most respondents (61.61%) lived in Henan province, and others (38.11%) were in Zhejiang province. The great majority (96.92%) of participants were of Han ethnicity. The proportion of participants in work was 59.69%, while the rest (40.31%) were retired. Only 0.89% of respondents reported themselves, their friends or family members had been diagnosed with COVID-19. And a total of 96.17% survey participants have been vaccinated against COVID-19. The median of knowledge, attitude and practice score were 10, 45 and 9, respectively. Regarding risk perception, about 59.9% of participants reported that they were afraid of being infected with COVID-19, but only 18.63% stated that they were more susceptible to COVID-19 infection as compared to others.

Knowledge, attitudes and practice about COVID-19

The correct rate of answers to participants' knowledge about COVID-19 general information, ways of spread, and common symptoms were shown in Table 2. Correct answers were identified for most items by the majority of participants with a significant high correct ratio (more than 90%). The least correct answers were related to the following question: "COVID-19 is transmitted by dealing with domestic animals?" where only 53.85% correctly identified that COVID-19 cannot be transmitted by dealing with domestic animals, also only 56.43% of participants correctly identified that antibiotics were not the drug of choice for treating COVID-19. About half of the participants thought that COVID-19 was always fatal and transmitted through arthropods. There were 72.02% respondents who correctly knew that COVID-19 was unlikely transmitted through eating contaminated food.

In regards to attitude level of COVID-19, although the majority of our participants considered COVID-19 as a severe disease, they agreed that this disease could be

prevented. The vast majority of respondents agreed that infection control standard precaution could protect against COVID-19 (92.06%). Only 25.23% of people agreed that COVID-19 cases would increase. More than 90% of participants agreed or even strongly agreed with many attitude items related to the government's role in diagnosis, treatment, and dealing with COVID-19 infections, considering that the government could overcome the COVID-19 problem and were confident in the information disseminated by the Ministry of Public Health (MOPH) in China about COVID-19.

The practices of personal protection were correctly identified by the majority of participants (more than 90%) except the faulty understanding about washing nose with a salty solution as 74.41% identified that it had no role in COVID-19 prevention. And, the vast majority of the participants had avoided crowdedness in public places (99.2%) and direct contact with others (93.7%) in recent days.

Risk perception of COVID-19

The most common statements accepted by participants as the causes of perception of fearing of COVID-19 infection were the following: "the disease is highly transmissible" (88.64%), "the disease may be fatal" (80.30%), "fear of transmission of infection to their family" (71.26%), "COVID-I9 new disease with unknown treatment" (47.47%), "fear of entering COVID-19 isolation hospitals" (45.62%) (Figure 1). The most common reasons stated by the respondents justifying their higher susceptibility to COVID-19 infection than others were: "it is a new emerging disease with limited data about it" (60.66%), "the personal protective equipment (PPE) is not always available" (56.48%), "workplace circumstances is suitable for transmitting COVID-19 infection as its crowdedness" (56.33%) and "ill ventilation" (42.32%) (Figure 2).

Risk factors associated with perception and KAP of COVID-19

The relation between the characteristics -related factors and the risk perception of COVID-19 was demonstrated in Table 3. Age, educational level, vaccination, attitudes level significantly predicted a respondent's fear of contracting the COVID-19 when the OR was unadjusted. When the OR was adjusted, these factors above as well as sex

remained as significant predictors of fear about contracting the COVID-19. Respondents with the age less than 45 years-old were about 1.5 times significantly more likely to be fearing of contracting the virus than those with more than 45 years-old (adjusted OR=1.464, 95% CI 1.196 to 1.794, P=0.0002). Women were more afraid of contracting the COVID-19 than men (adjusted OR=1.224, 95% CI 1.063 to 1.408, P=0.0048). The odds of fearing of contracting the virus were about 1.9 times and 1.7 times significantly more likely among respondents with junior high school and high school or above than those with primary school or below, respectively (adjusted OR=1.885, 95% CI 1.486 to 2.315, P<0.0001; adjusted OR=1.730, 95% CI 1.422 to 2.104, P<0.0001). Also, respondents who had not been vaccinated against COVID-19 or had high attitudes score might have reduced fear of contracting the virus (adjusted OR=0.563, 95% CI 0.395 to 0.802, P=0.0015; adjusted OR=0.495, 95% CI 0.430 to 0.570, P<0.0001).

Similarly, the predictors of perception of higher susceptibility to infection than others were: younger age (adjusted OR=2.019, 95% CI 1.587 to 2.569, P<0.0001), higher education level (adjusted OR=1.503, 95% CI 1.187 to 1.904, P=0.0007), not retried (adjusted OR=1.679, 95% CI1.354 to 2.083, P<0.0001), high knowledge score level about COVID-19 (adjusted OR=1.554, 95% CI 1.298 to 1.862, P<0.0001), while high attitude score was associated with lower perception of susceptibility to infection than others (adjusted OR=0.616, 95% CI 0.517 to 0.734, P<0.0001).

We further analyzed the relation between the characteristics -related factors and the KAP of COVID-19 (Figure3). In fully adjusted model, high school or above and not retired, not thinking as more susceptible to the COVID-19 than others were associated with higher knowledge level. Younger age (less than 45 years old) was associated with higher attitude score, while high school or above, not retired, not fearing of contracting the COVID-19, and not more susceptible to the COVID-19 than others was associated with lower attitude score. Similarly, not retired, not been vaccinated against COVID-19, not fearing of contracting the COVID-19 was associated with lower practice level, not felt more susceptible to the COVID-19 than others, while felt not susceptible to the COVID19 level was associated with higher practice level was associated with reduced practice score.

Discussion

Our current findings showed that the Chinese residents had adequate background knowledge about COVID19 and held an optimistic attitude toward the government and control of the disease. Participants with a relatively high level of education and younger, in particular women had lower risk perception towards COVID-19.

The public knowledge and prevention awareness of COVID-19 has reached a high level at present, compared with the report of Li et al., which they demonstrated that Chinese people only had a moderate level of knowledge about COVID-19 at the beginning of COVID-19 outbreak (from 2 February to 9 February, 2020) (Li et al. 2020). Almost all participants in our study had a good understanding of the virus spread route, symptoms, consequences, treatment, incubation time and the most susceptible populations. But about half respondents wrongly believed that the host of the virus can be domestic animals and arthropods and that antibiotics are effective treatment available for the virus. Compared with other similar studies in India (Dkhar et al. 2020) and America (Ferdous et al. 2020), the level of knowledge among the respondents in our study is higher, which was quite comparable to the findings reported in another study performed in China (Xu et al. 2020).

Although the COVID-19 pandemic in China has entered the stage of regular prevention and control, there are still outbreaks and sporadic outbreaks in some areas (Ni et al. 2021). Thus, either good knowledge or favorable attitudes are particularly important for the prevention and control of the current epidemic. Our results revealed an overall positive attitude of participants towards COVID-19 as a preventable disease, despite the vast majority of the participants (90.92%) believed that COVID-19 is a severe disease. Most of the respondents were optimistic about the government's control measures and treatment of COVID-19 patients in hospital. Similarly, according to the study by Zhong et al. (Zhong et al. 2020), 97.1% of the respondents had confidence that China can win the battle against COVID-19. The citizens from Malaysia (Mohamed et al. 2021) and Vietnam (Van Nhu et al. 2020) also showed favorite attitudes towards overcoming the virus. But public in Pakistan had much less faith in their government about fighting against the pandemic, even no more than half people were optimistic that COVID-19 will finally be successfully controlled (Ladiwala et al. 2021). It is worth mentioning that in some countries wearing a mask was not compulsory for the general population (Feng et al. 2020; Javid et al. 2020). Even some healthcare workers believed

the role of face mask in the prevention of the disease to be moderate to poor (Kumar et al. 2020).

The greater perception of severity, and susceptibility to acquiring the virus, the more taking of preventive measures (Pérez de Celis-Herrero and Cavazos-Arroyo 2021). Risk perception of public could help to reduce the infection rate (Ye and Lyu 2020). In our survey, about three fifths of the participants reported the fear of contracting the COVID-19, but only a minority of them (18.63%) felt they were more susceptible than others. At the start of the epidemic (March 2020), 40.3% of participant met screening criteria for generalized anxiety disorder, that is, people in China experienced high levels of anxiety with the COVID-19 at that time (Ni et al. 2021). But the suitable risk perception can serve as a useful tool to promote increased preparedness. It may also explain the unexpected high uptake rate of vaccination and excellent compliance with preventive measures and regulations in China.

Regarding factors associated with risk perception, we found an association between high levels of education and higher levels of fear. Wolf et al. (Wolf et al. 2020) observed an association between high education level and high susceptibility, which was consistent with our current study. Another study also reported no difference by education level in risk perception (Salimi et al. 2020). Considering that educational attainment are often used as proxy measures of socioeconomic status and knowledge level; in our study more educated participants had higher adequate knowledge, and poor knowledge was one predictor of higher perception to infection than others, suggesting that health education for people with lower educational levels needs to be strengthened, which was in line with findings from other countries worldwide (Fawzy and AlSadrah 2022; Poddar et al. 2022). In addition, in our study the vaccination uptake of participants was 96.17%, however, ones who had not been vaccinated is less concern about infecting COVID-19. Our acceptance rate of vaccination was much better than UK (Sherman et al. 2021), Malaysia (Mohamed et al. 2021) and Arabia (Al-Mohaithef and Padhi 2020). And this comes in accordance with another study conducted in China (Wang et al. 2020). It was reported that the predicted vaccination uptake of the optimal vaccination scenario was 84.77% (Leng et al. 2021). Thus our findings suggest that public generally have the trust in the COVID-19 vaccine and the government in China.

In our study, it is reasonable that for those with higher education, not retired, and not thinking as more susceptible to the COVID-19 than others had high knowledge level. It was indicating that those well educated, not retired had received good knowledge for COVID-19. We further found that young subjects possessed good attitude for COVID-19, which is consistent with previous studies(Ghuloum et al. 2022). In contrast, we found those with higher education and not retired had poor attitude. Thig might be owing to that they obtained multiple information about COVID-19, and associate it with their life. Likewise, we further found that not retired, not been vaccinated against COVID-19, not fearing of contracting the COVID-19 was associated with lower practice level, suggesting these are the key population in order to improve practice level of COVID-19. Our studies suggest that those not retired, had low attitude and practice level, therefore, individual prevention should combined with workplace adjustments, such as working remotely, ventilation, staggered shifts and changing works hours to enable social distance in workplace, which might be beneficial to improve protection of working population(Cummings et al. 2022).

Our study had its own strengths and limitations that need to be addressed. It was one of the few studies on the KAP among Chinese general public, when COVID-19 in China has entered the stage of regular prevention and control. Additionally, it collected the data through both online and paper questionnaires, and paper questionnaire was through community-based survey, therefore it included more infrequent internet users than the studies only asked online. However, limitations should be mentioned. Firstly, it was a cross-sectional study, therefore, the data obtained and the results based on this data are merely representative of the survey time and do not incorporate long-term modifications to the pandemic phase. Secondly, participants were only recruited in Zhejiang and Henan provinces, our results might be influenced by selection bias. Consequently, when generalizing the findings of this research to the general population, extreme caution is required.

In conclusion, it was encouraging that the level of knowledge, attitudes, practices and perception toward COVID-19 infection among Chinese population remained consistently high, one and a half years after outbreak of this diseases as revealed by this survey. Although the epidemic is basically at a plateau, with the combined efforts of the Chinese authorities and all Chinese residents, China will hopefully win the battle

against COVID -19 in the near future by preventing cases imported from abroad and treating occasional new confirmed cases at home in a timely manner.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethics Approval

The ethical committee of Soochow University approved the study protocol, with a research registry number of 2021-023.

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Figure legends

Figure 1 The reasons for “I am afraid of being infected with COVID19 virus”.

Figure 2 The reasons for “I am more susceptible to be infected with COVID19 as compared to others”.

Figure 3 Factors associated the knowledge, attitude and practice level of COVID19. Binary logistic regression model was utilized to analyze the factors associated with the knowledge, attitude and practice level of COVID19 for unadjusted and adjusted data. Adjust for age, sex, education level, retired status, the answer of two COVID-19 questions (1.Myself, friends or family had been diagnosed with COVID-19; 2.Have you been vaccinated against COVID-19.), the risk perception of COVID-19 (1. Fear of contracting the COVID-19; 2. More susceptible to the COVID-19 than others.) .