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KAP-COVID$_{GLOBAL}$: a multinational survey of the levels and determinants of public knowledge, attitudes and practices towards COVID-19

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ABSTRACT

Objective The adherence to public health recommendations to control COVID-19 spread is influenced by public knowledge, attitudes and practices (KAP). We performed this cross-sectional study to assess the levels and determinants of public KAP towards COVID-19 in a large, multinational sample.

Design Cross-sectional study (survey).

Setting The questionnaire was distributed to potential respondents via online platforms.

Participants 71 890 individuals from 22 countries.

Methods We formulated a four-section questionnaire in English, followed by validation and translation into seven languages. The questionnaire was distributed (May to June 2020) and each participant received a score for each KAP section.

Results Overall, the participants had fair knowledge (mean score: 19.24±3.59) and attitudes (3.72±2.31) and good practices (12.12±1.83) regarding COVID-19. About 92% reported moderate to high compliance with national lockdown. However, significant gaps were observed: only 68.2% knew that infected individuals may be asymptomatic; 45.4% believed that antibiotics are an effective treatment; and 55.4% stated that a vaccine has been developed (at the time of data collection). 71.9% believed or were uncertain that COVID-19 is a global conspiracy; 36.8% and 51% were afraid of contacting doctors and Chinese people, respectively. Further, 66.4% reported the pandemic had moderate to high negative effects on their mental health. Female gender, higher education and urban residents had significantly ($p \leq 0.001$) higher knowledge and practice scores. Further, we observed significant correlations between all KAP scores.

Conclusions Although the public have fair/good knowledge and practices regarding COVID-19, significant gaps should be addressed. Future awareness efforts should target less advantaged groups and future studies should develop new strategies to tackle COVID-19 negative mental health effects.

Strengths and limitations of this study

- Besides our large sample size (of both individuals and countries), such comparative study can help international organisations focus their efforts on countries and population groups with less developed public knowledge, attitudes and practices (KAP) against COVID-19.
- In addition, we analysed the association between KAP and demographic factors, history of COVID-19, as well as the correlation between different scores and scales of mental health effects and compliance to lockdown. However, this study is not without limitations.
- First, as a cross-sectional study, the temporal relevance of our findings may change with time or implementation of large-scale prevention measures.
- Second, the elderly population (most vulnerable to COVID-19) only represents 3.9% of our sample. This is probably related to the online distribution of the questionnaire, which is likely to draw younger populations. The requirement of access to electronic devices and the internet may have limited the reach based on wealth and literacy.
- Third, as a self-reported questionnaire, respondents may have opted towards socially desired choices rather than their actual KAP. Fourth, due to variations in the population size of the included countries, our fixed minimum sample size may have been less representative of more populous nations as India, Brazil and the USA.

INTRODUCTION

Starting in China in December 2019, SARS-CoV-2 (the causative agent of COVID-19) has spread to almost every country worldwide.[1] As of 16 February 2021, over 110

million confirmed cases have been reported globally with more than 2,4 million deaths.[2] The disease is transmitted by respiratory droplets. After an incubation period of 2–14 days, patients may develop fever, cough, dyspnoea, fatigue and sore throat or are commonly asymptomatic.[3 4] The main cause of death is fatal pneumonia and respiratory distress. Adults with chronic diseases and those over 65 years of age are the most vulnerable.[5] Although various drugs are under trial, the management remains mainly supportive. Therefore, prevention measures as mass vaccination, social distancing, face masks and public awareness campaigns are key players in controlling the pandemic.[6]

However, there is lack of data on the awareness and practices of different populations and their influence on COVID-19 burden. Multiple cross-sectional studies have been conducted in many countries, for example, an early questionnaire was developed by Zhong *et al*[7] in China, and it was later applied in other countries as Italy,[8] India,[9] Malaysia,[10] Pakistan[11] and Colombia.[12] Another survey in the USA revealed that a large portion of the public lacked critical knowledge about COVID-19 and were not changing their daily routine and hygiene practices as per the recommendations of health authorities.[13] However, when coupled with extensive governmental awareness efforts, the public awareness on COVID-19 can be significantly improved as revealed by recent studies from Saudi Arabia[14] and Nigeria,[15] which would reduce infection rates and alleviate the medical and economic burdens of the disease.

The success of prevention efforts is tied to public adherence and the latter has been linked to public knowledge, attitudes and practices (KAP).[16 17] A large-scale, horizontal evaluation of KAP towards COVID-19 across different countries is lacking. Plus, this evaluation was not performed in most low–to-middle income countries. In the present multinational survey, we aimed to assess the levels of public KAP in different countries towards COVID-19 and to determine the factors that could influence public practices in this regard. Our findings may have implications for public awareness efforts worldwide.

MATERIALS AND METHODS

Study design and participants

We conducted a multinational, cross-sectional study to assess public KAP towards COVID-19 in 22 countries using an online self-administered questionnaire during the period of 10 May to 25 June 2020. The study was conducted and reported in consistence with the Strengthening the Reporting of Observational Studies in Epidemiology checklist (online supplemental appendix 1). Any citizen of the included countries above the age of 18 who agreed to fill the questionnaire was eligible to participate. There were no demographic restrictions on participation.

Sampling

We used a convenience sampling method for data collection. The sample size was calculated for each country using the equation: $n=z^2P(1-P)/d^2$.[18] Under a 95% CI, 50% response distribution and 0.05 margin of error, a sample of 384 participants was considered as a minimum sample to represent large populations. However, due to the limitations of convenience sampling and online surveying, we empowered our sample by including a design effect (DE) factor in the equation. According to previous studies, the minimal acceptable DE for convenience-sampled studies is 2.[19 20] Therefore, an adjusted minimum sample of 768 (384×2) participants was considered for each country.

Questionnaire development

The questionnaire was developed using the frequently asked questions on the WHO and Centers for Disease Control and Prevention websites in addition to the previously published national surveys of COVID-19/other pandemics awareness.[7 21–23] Experts from the departments of Community Medicine & Public Health and Internal Medicine (division of infectious diseases) at Fayoum University (Fayoum, Egypt) formulated the questionnaire. The questionnaire was revised by the departments' heads for face validity, relevance, comprehensiveness and clarity of each section, and some details were improved.

The final four-section questionnaire included:

- Sociodemographic data: that collected participants' age, gender, country, residence (urban/rural), educational level, whether they or a family member/friend had been diagnosed (by a medical doctor) with COVID-19.
- Knowledge about COVID-19: consisted of 28 questions about COVID-19 mode of transmission, vulnerable groups for infection, symptoms, treatment, prevention measures and mortality rate. The answer to each question was Yes/No/I don't know choices, except for the question about the mortality rate. Cronbach's alpha values for the knowledge assessment section were 0.76, 0.55, 0.70, 0.60, 0.75, 0.70, 0.60 and 0.64 for English, Arabic, French, Indonesian, Nepali, Pakistani, Sinhala and Portuguese languages, respectively.
- Attitudes towards COVID-19: consisted of eight questions assessing optimism about the current situation; responsible public health attitudes; stigma against symptomatic individuals, healthcare professionals and Chinese people; and whether the participant believes in conspiracy theories about the disease. The possible answers to each question were Agree/Uncertain/Disagree. Cronbach's alpha values for the attitudes assessment section were 0.60, 0.60, 0.77, 0.60, 0.66, 0.64, 0.72 and 0.60 for English, Arabic, French, Indonesian, Nepali, Pakistani, Sinhala and Portuguese languages, respectively.
- In addition, participants were asked to rate their fear of infection and the negative impact of the pandemic on their mental health on a scale from 1 to 10.
- Practices regarding COVID-19: included 14 questions describing different practices regarding coughing and sneezing, hand washing, wearing masks and contact with people. The available answers to each

question were Yes/Sometimes/No. In addition, the participants were asked to rate their overall compliance with the lockdown or the measures applied by their country on a scale from 1 to 10. The Cronbach's alpha values for the practices assessment questionnaire were 0.77, 0.67, 0.66, 0.66, 0.67, 0.55, 0.68 and 0.55 for English, Arabic, French, Indonesian, Nepali, Pakistani, Sinhala and Portuguese languages, respectively. The full version of the questionnaire can be found in tables 1–4.

The questionnaire was developed in English and was then translated into the native languages of the included countries (Arabic, French, Indonesian, Nepali, Portuguese, Pakistani and Sinhala). For each language, two bilinguals initially performed forward translation, then another bilingual performed a backward translation; the translated versions were compared and checked until a final draft was agreed on. We checked the internal consistency of the questions in each section by calculation of Cronbach's alpha using the data of the first 150 responses from each language; these 150 responses were not included in the final analysis.

Data collection and handling

We recruited collaborators between 20 April and 1 May 2020 in a snowball fashion. The recruited collaborators were given an orientation session about the nature of the study and the data collection strategy. We assigned a central investigator from each country to monitor the data collection process to ensure the adequate contribution of all collaborators (≥100 participants) and to avoid over-representation of some cities over others within each country. Each collaborator was granted access to view their responses only, while the central investigator had access to all responses of the country. All collaborators are listed in online supplemental appendix 2.

On 10 May, we started data collection using Google Forms, distributed on social media platforms (repeated posting on Facebook, Twitter, WhatsApp and LinkedIn), online websites, blogs and contact with non-governmental organisations and academic institutions in the included countries. Each participant was allowed to answer the survey only once and no duplicates were included. After the data collection, we used Microsoft Excel for data cleaning. The results of each country were translated automatically to English and were combined in one datasheet for analysis.

The correct responses to knowledge questions were given a score of 1, while incorrect/I don't know answers were given a score of 0 (hence knowledge maximum score was of 28). The knowledge score of each participant was classified based on the modified Bloom's cut-off points into poor (<60%: <16.8), fair (60%–79%: 16.8–22.1) and good (≥80%: 22.2–28). In terms of attitudes, the proper attitude was given a score of +1, the improper attitude was given a score of −1 and uncertain was given a score of 0 (hence a maximum positive attitudes score of 8). Regarding practice questions, the

Table 1 Demographic characteristics and COVID-19-confirmed infection rates among survey respondents

Demographics	Count (%) (n=71 890)
Age mean±SD (years)	27.64±9.78
≤30 years	53 048 (73.8)
31–50 years	16 073 (22.3)
>50 years	2769 (3.9)
Gender	
Male	28 449 (40)
Female	42 601 (60)
Country	
Algeria	4900 (6.81)
Brazil	839 (1.16)
Egypt	6830 (9.49)
Ghana	1847 (2.56)
India	1464 (2.04)
Indonesia	4444 (6.18)
Iraq	2092 (2.92)
Ireland	1026 (1.43)
Jordan	5882 (8.20)
Lebanon	3380 (4.70)
Libya	4300 (6.00)
Morocco	1755 (2.44)
Nigeria	3449 (4.80)
Nepal	2657 (3.70)
Palestine	5993 (8.33)
Pakistan	1723 (2.40)
Saudi Arabia	1616 (2.24)
South Africa	1979 (2.75)
Sri Lanka	1793 (2.50)
Sudan	4381 (6.09)
Syria	6576 (9.14)
UK	2160 (3.00)
USA	804 (1.12)
Education	
High school	7577 (10.54)
Undergraduate	44 436 (61.80)
Graduated	16 269 (22.65)
Prefer not to say	3608 (5.01)
Residency	
Urban	57 653 (80.2)
Rural	14 237 (19.8)
Have you had a confirmed infection with COVID-19?*	
Yes	1326 (1.84)
No	70 559 (98.16)
Do you know a friend or a family member who had a confirmed COVID-19 infection?*	
Yes	9935 (13.82)
No	61 952 (86.18)

The presented data are count (valid %) unless otherwise specified.
*Confirmed infection was explained to participants as having diagnosis by a licensed healthcare professional.

Table 2 Answers to knowledge questions about COVID-19 among survey respondents

	Yes	No/I don't know
COVID-19 is a serious disease.	58 121 (80.8)	13 769 (19.2)
Regarding the mode of transmission of the virus		
Eating wild animals (eg, bats)	37 829 (52.6)	34 061 (47.4)
Droplet transmission	65 126 (90.6)	6764 (9.4)
Contact with infected surfaces then putting your hand on your face, mouth or nose	68 819 (95.7)	3071 (4.3)
The most vulnerable group to infection is		
Children (0–18 years)	32 973 (45.9)	38 917 (54.1)
Adults (18–50 years)	29 448 (41.0)	42 442 (59.0)
Elderly (more than 50 years)	64 736 (90.0)	7154 (10.0)
Adults with chronic diseases	67 282 (93.6)	4608 (6.4)
The clinical symptoms of COVID-19 include		
Fever	68 565 (95.4)	3325 (4.6)
Fatigue	57 076 (79.4)	14 814 (20.6)
Dry cough	66 882 (93.0)	5008 (7.0)
Myalgia	50 672 (70.5)	21 218 (29.5)
Stuffy nose	21 127 (29.4)	50 763 (70.6)
Runny nose	23 449 (32.6)	48 441 (67.4)
Sneezing	14 094 (19.6)	57 796 (80.4)
Shortness of breath	68 589 (95.4)	3301 (4.6)
Diarrhoea	35 293 (49.1)	36 597 (50.9)
Asymptomatic	49 057 (68.2)	22 833 (31.8)
Regarding treatment of COVID-19		
There is effective cure for it.	53 148 (73.9)	18 742 (26.1)
The treatment is symptomatic only.	51 140 (71.1)	20 750 (28.9)
Antibiotics are an effective treatment.	32 628 (45.4)	39 262 (54.6)
There are various drugs under trial.	58 231 (81.0)	13 659 (19.0)
A vaccine has been developed.	39 798 (55.4)	32 092 (44.6)
Regarding prevention of COVID-19, which of the following is effective?		
Wearing medical masks	67 365 (93.7)	4524 (6.3)
Avoiding crowded places	70 509 (98.1)	1380 (1.9)
Isolation of infected individuals	70 551 (98.1)	1338 (1.9)
Healthy diet and avoiding high-fat-containing diet	18 159 (25.3)	53 730 (74.7)
To what extent does COVID-19 cause death?	Less than 15%: 42 522 (59.1)	Wrong answers: 29 368 (40.9)

Data are presented as count (%).

correct practice was given a score of 1, (sometimes) was given a score of 0.5 and incorrect practice was given a score of 0 (hence a maximum practices score of 14). The participants' responses to scale questions (from 1 to 10) were classified as low (1–3), moderate (4–7) or high (8–10).

Statistical analysis

We used SPSS (V.24, IBM) for data analysis. Quantitative outcomes (eg, scores) were presented as mean±SDs. Associations were analysed using the independent samples t-test and one-way analysis of variance (ANOVA) with post hoc Hochberg test, while the correlation between different scores was assessed using Pearson correlation tests. We used Tableau software (Seattle, Washington) for geographical map presentation.

Patient and public involvement

It was not appropriate or possible to involve patients or the public in the design, or conduct, or reporting, or dissemination plans of our research.

Table 3 Answers to attitude questions about COVID-19 among survey respondents

	Positive attitude	Uncertain	Negative attitude
Do you believe that COVID-19 is a global conspiracy?	20 191 (28.1)	32 559 (45.3)	19 140 (26.6)
Do you believe that COVID-19 pandemic will finally end?	34 053 (47.4)	30 851 (42.9)	6986 (9.7)
Do you believe that your country will be able to control COVID-19 situation soon?	32 526 (45.2)	28 603 (39.8)	10 760 (15.0)
Since the outbreak, I seek more medical information about COVID-19 to keep updates.	59 215 (82.4)	9090 (12.6)	3585 (5.0)
Since the outbreak, I follow the recommendations to deal with the pandemic.	66 609 (92.7)	4350 (6.1)	931 (1.3)
Since the outbreak, I am afraid to contact anyone with ordinary influenza symptoms.	55 788 (77.6)	10 236 (14.2)	5866 (8.2)
Since the outbreak, I am afraid of contacting any doctors except for the utmost necessity.	45 475 (63.2)	13 292 (18.5)	13 123 (18.3)
Since the outbreak, are you afraid of eating in Chinese restaurants or contact Chinese people?	35 243 (49.0)	15 356 (21.4)	21 291 (29.6)

Data are presented as count (%).

RESULTS

Demographic characteristics and COVID-19 infection rates

The present sample comprised 71 890 respondents from 22 countries around the globe. The mean age of all participants was 27.64±9.78 years and 42 601 (59.3%) were females. The majority lived in African and Asian countries, enrolled in/graduated from college education and were living in urban settings. Among those surveyed, 1326 (1.84%) reported having been diagnosed with COVID-19 while 9935 (13.82%) reported knowing a friend or a family member who had been diagnosed with COVID-19 (table 1).

Public knowledge regarding COVID-19

The mean knowledge score among all respondents was 19.24/28±3.59 (fair). Of them, 14 221 (19.8%), 45 087 (62.7%) and 12 582 (17.5%) had poor, fair and good knowledge levels, respectively. The majority of

Table 4 Answers to practice questions about COVID-19 among survey respondents

	Proper practice	Sometimes	Wrong practice
When coughing or sneezing, do you			
Cover your mouth and nose with a tissue?	62 946 (87.6)	6749 (9.4)	2195 (3.1)
Throw away the used tissue into the bin?	66 291 (92.2)	2731 (3.8)	2868 (4.0)
Turn your face away from the surrounding people?	67 664 (94.1)	2303 (3.2)	1923 (2.7)
As for your hands, you wash them			
Before touching your eyes and nose.	52 267 (72.7)	14 516 (20.2)	5107 (7.1)
After covering the nose while sneezing.	56 198 (78.2)	9994 (13.9)	5698 (7.9)
After coming from outside.	67 791 (94.3)	2815 (3.9)	1284 (1.8)
Using soap and water.	68 337 (95.1)	2299 (3.2)	1254 (1.7)
Using concentrated alcohol.	39 729 (55.3)	16 862 (23.5)	15 299 (21.3)
Regarding wearing a face mask, you			
Wear a face mask in crowded places.	58 939 (82.0)	5082 (7.1)	7869 (10.9)
Wear a face mask outside in general (not crowded).	37 364 (52.0)	12 371 (17.2)	22 155 (30.8)
Never use a face mask.	46 829 (65.1)	12 813 (17.8)	12 247 (17.0)
Regarding the preventive measures from infection, you			
Avoid contact with an infected person.	69 776 (97.1)	1037 (1.4)	1077 (1.5)
Avoid touching and shaking hands.	61 981 (86.2)	7044 (9.8)	2865 (4.0)
Avoid going to crowded places.	63 201 (87.9)	6684 (9.3)	2005 (2.8)

Data are presented as count (%).

respondents agreed that COVID-19 is a serious disease (80.8%); correctly identified droplet transmission (90.6%) and contact with surfaces covered with infected droplets (95.7%) as the mode of transmission; correctly identified elderly subjects (90%) and adults with chronic disease (93.6%) as the vulnerable groups to COVID-19 infection; and the majority could identify the correct prevention measures against COVID-19 infection. However, we detected some critical knowledge gaps, for example, only 68.2% knew that infected individuals may be asymptomatic. Regarding treatment, 73.9% stated that there is an effective cure for COVID-19, 45.4% stated that antibiotics are an effective treatment and 55.4% stated that a vaccine has been developed (at the time of data collection), while only 59.1% identified the correct mortality rate for COVID-19 (table 2).

Data analysis showed that demographic factors influenced knowledge scores, being significantly higher (≤0.001) in females, urban residents, those with higher education or who knew a family member or a friend who had a confirmed diagnosis with COVID-19 disease. Interestingly, those who reported a confirmed COVID-19 diagnosis before had a lower knowledge level. The one-way ANOVA test showed that the mean knowledge levels differed across the surveyed countries (p<0.001), with the highest mean scores from Brazil, Egypt, Jordan, Sudan and Syria and the lowest mean scores from Indonesia, Nigeria, Pakistan and India (online supplemental appendix 3).

Public attitudes towards COVID-19

The mean attitudes score towards COVID-19 among the surveyed respondents was 3.72/8±2.31. Some positive attitudes were observed, for example, the majority of respondents (>80%) stated that since the outbreak, they seek updated medical information and recommendations about COVID-19. However, 71.9% believed or were uncertain that COVID-19 is a global conspiracy; >50% were uncertain or not optimistic that the pandemic will finally end or that their government will be able to control COVID-19 situation; 36.8% were uncertain or afraid of contacting doctors except for utmost necessity; and 51% were afraid or uncertain about contacting Chinese people and eating in Chinese restaurants (table 3). When the respondents were asked to rate their fear of getting COVID-19, 20 021 (27.8%), 33 752 (46.9%) and 18 117 (25.2%) reported low, moderate and high levels of fear, respectively. Further, 47 712 (66.4%) reported that the pandemic had moderate to high negative effects on their mental health.

Similar to knowledge levels, the overall attitude score was significantly higher in females (p=0.002) or those who knew a family member or a friend with a confirmed COVID-19 diagnosis (p=0.003). However, those with previous COVID-19 diagnosis had less positive attitude scores (p<0.001) compared with those without COVID-19 diagnosis history. Further, the overall attitudes score, fear of getting COVID-19 and the negative mental health impact varied by country (online supplemental appendix 3, figure 1A,B).

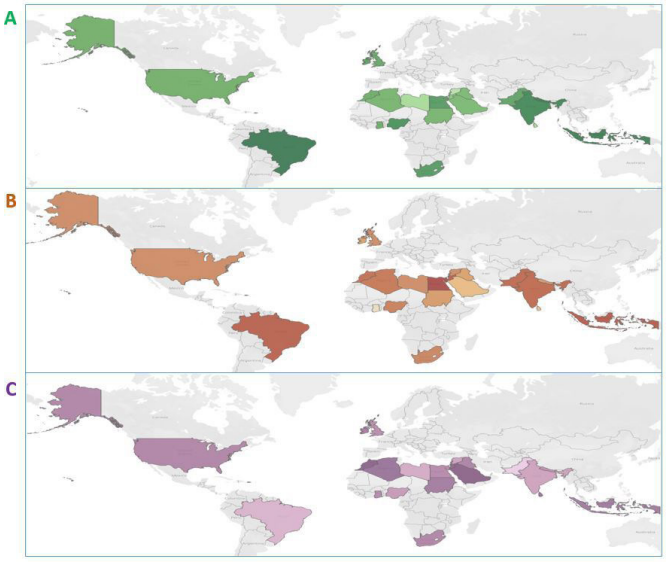

Figure 1 Geographic representation of (A) fear of getting COVID-19, (B) negative mental health effects of COVID-19 pandemic, and (C) compliance with governmental lockdown/traffic ban across the 22 countries. The colour gradient (from light to dark) in every map represents country scores (from low to high).

Public practices regarding COVID-19

The mean practices score (12.12/14±1.83) and answers to individual questions showed good practices towards COVID-19. The majority of respondents indicated that they usually follow proper practices regarding hand washing, coughing and sneezing, wearing face masks and social distancing. Few gaps were, however, noted. Although 82% indicated that they usually wear face masks in crowded places, only 52% responded that they usually wear face masks outside in general and 17% replied that they never wear face masks (table 4). When the respondents were asked about their overall compliance to their national lockdown/traffic ban, 5856 (8.1%), 19 166 (26.7%) and 46 868 (65.2%) reported low, moderate and high compliance levels, respectively.

Likewise, females, those with higher education, residing in urban areas or knowing an individual who had a COVID-19 diagnosis had better practice scores (p≤0.001). However, those who experienced COVID-19 diagnosis reported significantly lower practice scores than those who did not. The one-way ANOVA test revealed that the overall practices score and compliance to national lockdown/traffic ban varied by country (online supplemental appendix 3; figure 1C).

Correlation between KAP towards COVID-19

We recorded significant positive correlations (p<0.001) between KAP scores in our sample, although the magnitude of these correlations in our sample was weak. For example, knowledge scores were positively correlated to attitudes (r=0.05) and practice (r=0.12) scores, while

attitude scores were positively correlated (r=0.276) to practice scores.

Interestingly, knowledge was inversely associated with fear of getting COVID-19 (r=−0.04) and negative mental health effects of the pandemic (r=−0.02) and was directly associated with compliance to lockdown (r=0.11). Likewise, better attitudes were associated with lockdown compliance (r=0.08) and practice scores were directly correlated to fear of getting COVID-19 (r=0.167) (online supplemental appendix 3).

DISCUSSION

The current cross-sectional study assessed the levels and determinants of KAP towards COVID-19 in 22 countries around the globe. Our results show that the public in those countries had fair knowledge and good attitudes towards COVID-19. We, however, uncovered many gaps in the public understanding and behaviours towards COVID-19. For example, one-third of our participants did not know that infected individuals can be asymptomatic, which increases their risk of exposure to the disease. Further, about half of the participants thought that antibiotics may be an effective treatment and about 74% thought that a curative treatment exists, which may give them a false sense of security. Another alarming finding is that almost half of our participants held negative/uncertain attitudes regarding contacting Chinese people and more than one-third had similar attitudes towards doctors.

Our analysis showed that 82% of respondents usually wear face masks in crowded places, but only 52% wear masks outdoors in general. This finding is relevant for public awareness programmes. Several studies and predictive models showed that wearing face masks can reduce COVID-19 spread.[24 25] In compliance with the building evidence, major public health authorities around the world unanimously recommend wearing face masks outdoors in general, not just in crowded places.[26 27] However, the compliance rates to these recommendations vary between and within countries. Our study highlights the importance of public awareness about the value of masks in preventing infections and slowing the spread of COVID-19.

In the current study, we found a significant positive correlation between knowledge and attitudes, which coincides with several former studies on COVID-19.[7 28 29] However, the magnitude of correlation in our study was weak, similar to a former Indonesian study.[30] This is probably because although knowledge is essential in shaping attitudes, this is not absolute and several other factors may be involved. A stronger correlation was found between attitudes and practices, indicating that promoting knowledge alone is insufficient and effective interventions to improve practices should target promoting both adequate knowledge and positive attitudes. Interestingly, our analysis also showed lower knowledge scores in those who reported having a confirmed diagnosis with COVID-19. This can be explained in the light of our finding that knowledge scores were directly correlated to practice scores and compliance with lockdown/traffic ban orders. This suggests that good knowledge translates into safe practices, which can reduce one's risk of COVID-19 infection.

We found an inverse correlation between knowledge level and fear of getting COVID-19. This implies that improving the knowledge about COVID-19 can alleviate public anxiety and panic. During the severe acute respiratory syndrome (SARS) epidemic (2002–2004), misinformation led to excessive public panic and resistance to comply with public health guidelines.[31 32] We could also infer that people's knowledge would not be improved just by communicating daily increases in COVID-19 cases. In the same vein, about two-thirds of our participants reported moderate to high negative mental health effects for the pandemic. These effects had significant inverse correlations with knowledge and attitude scores; however, the magnitude of the correlations was weak. Several studies showed multiple risk factors for anxiety and mental health problems related to COVID-19, including social media use, worry about economy and personal finances, working in COVID-19 hot spots and being pregnant.[33 34] Therefore, poor knowledge and attitudes may contribute—among a multitude of factors—towards the growing incidence of mental health issues, being reported worldwide.

The association between KAP scores and demographic characteristics in the current study was consistently significant. For example, females had better KAP scores towards COVID-19 than males. This finding echoes previous studies by Al-Hanawi *et al*[35] and Azlan *et al*.[10] In addition, those living in rural areas had lower knowledge and practice scores than their urban counterparts. This may be attributed to relying on digital sources of information with easier access in urban settings or the higher levels of education in urban areas, which were also associated with higher KAP scores in the present study.

Most of the included countries in the current analysis are low-to-middle income countries. These countries had varied KAP levels and also were significantly different when assessed on three rating questions (fear of COVID-19, negative mental health effects and compliance to lockdown). Other studies have assessed KAP levels in countries that have been included in this analysis (eg, USA, UK, Egypt, Saudi Arabia, Pakistan and Indonesia) and countries outside our scope (eg, Malaysia, Turkey and Italy). To put our study in context, we performed a comprehensive review of published public KAP studies in the literature about COVID-19 (online supplemental appendix 4). The majority of these studies showed good public knowledge and practices across different countries, especially those conducted in the later 3 months (probably due to the growing public awareness about COVID-19).

Practical and research recommendations

Although we did not explore sources of knowledge about COVID-19 in this study, previous works highlighted television and social media as the primary sources of knowledge. Using these platforms should be optimised to deliver evidence-based information to the most vulnerable groups, for example, less educated and those living in rural areas. Political leaders and stakeholders should take action to eliminate fear and discrimination against healthcare professionals and Asian community members.[36] Research-wise, future studies should evaluate other populations, not surveyed in the present study; considering the relatively low Cronbach's alpha values (<0.6) in few language translations in our study, these studies should perform validation through pilot testing and revision. In addition, they should test the value of innovative strategies in mitigating mental health effects of public health disasters like COVID-19.

CONCLUSION

The current multinational cross-sectional study showed fair public knowledge on COVID-19; however, it uncovered several gaps in the public understanding and practices about the diseases. Moreover, it highlighted the negative mental health effects of COVID-19 pandemic. Some demographic groups were less advantaged than others including the less educated and those living in rural areas. Future awareness efforts should target those groups and develop innovative strategies to mitigate negative mental health effects, as well as discriminatory behaviours against Asians and healthcare professionals.

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