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ORIGINAL RESEARCH

Knowledge, Attitude, and Practices Among the General Population During the Later Stage of the COVID-19 Pandemic in Malaysia: A Cross-Sectional Study

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Purpose: A different pattern of mental health issues was reported during the later stage of the COVID-19 pandemic; however, few studies have examined Malaysians' knowledge, attitudes, and practices (KAP) prevalent during this time.

Patients and Methods: A nationwide online cross-sectional study was conducted in Malaysia from June 1, 2021 to June 14, 2021, ie, 18-months from the first reported COVID-19 case in the country. Citizens aged 18 years and above were recruited by means of the snowball sampling method. ANOVA, Pearson correlation, and linear regression tests were used.

Results: Of the 2168 respondents, most were young adults (62.7%), females (62.4%), tertiary educated individuals (84%), non-health care workers (85.9%), and individuals who knew someone diagnosed with COVID-19 (75.2%). The mean score for knowledge was 10.0 ± 1.52 (maximum score = 12); correct response rate for each question ranged from 54.2% to 99%. The mean score in terms of attitude was 1.3 ± 0.85 (maximum score = 2); 68.7% respondents agreed that control over COVID-19 would finally be achieved; and 62.3% believed that Malaysia could conquer COVID-19. The mean score for practices was 5.1 ± 1.10 (maximum score = 6); 81.5%, 88.1%, and 74.1% respondents avoided crowded places, confined spaces, and conversations in close physical proximity, respectively. Furthermore, 94.2% wore masks when leaving home; 89.0% practiced hand hygiene; and 83.8% adhering to COVID-19 warnings. Small but significant correlations were found between knowledge and attitude ($r = 0.078$, $p < 0.001$) as well as between knowledge and practices ($r = 0.070$, $p = 0.001$).

Conclusion: Malaysians exhibited sound knowledge but negative attitudes and inadequate practices pertaining to COVID-19 during the pandemic's later stage. At this phase, unlike at the early stage, the public's sound knowledge ensured little improvement in their attitudes and practices. Therefore, health education at the later pandemic stage should focus on promoting positive attitudes and developing better practices.

Keywords: knowledge, attitude, practices, COVID-19 pandemic, pandemic fatigue, late pandemic

Introduction

An outbreak of unusual pneumonia with an unknown etiology was reported in Wuhan, capital of Hubei province, China, in December 2019.[1] In January 2020, a novel beta coronavirus that was 80% similar to the severe acute respiratory syndrome (SARS) coronavirus 1 (SARS-CoV-1)—which had caused the SARS outbreak in 2003—was identified as the etiology agent.[2] The World Health Organization (WHO) named this virus the SARS coronavirus 2 (SARS-CoV-2); the disease spectrum caused by it was called Coronavirus 2019 (COVID-19).[3]

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Human-to-human transmission of SARS-CoV-2 occurred easily via respiratory droplets, direct contact, fomites, and aerosols.[4,5] Because of the global society's extensive air, sea, and land mobility, SARS-CoV-2 spread rapidly from Asia to Europe, North America, Africa, and South America.[6] In March 2020, the WHO declared COVID-19 a global public health emergency and pandemic.[7,8] As of July 27, 2021, 195 million people had been infected with COVID-19 worldwide, of which there had been 4.1 million attributable deaths.[9]

Malaysia reported its first COVID-19 case in January 2020.[10] As a part of the preventive measures under the latest COVID-19 norms, Malaysians were instructed to avoid the "3Cs," ie, *Crowded* places, *Confined* spaces, and *Closed* conversation, and practice the "3Ws," namely, *Wear* a mask, *Wash* hands, and heed COVID-19 *Warnings*.[11] A lockdown called the "Movement Control Order" (MCO) was also implemented to break the COVID-19 chain and avoid overwhelming the nation's healthcare system.[12] The first MCO (1.0) involved a nationwide lockdown from March 18, 2020 to May 3, 2020, which ensured the reduction of daily new COVID-19 cases to single-digit numbers. The second (2.0) and third (3.0) MCOs, which involved lockdowns in some states reporting many COVID-19 cases, were implemented on January 11, 2021 and April 16, 2021, respectively. Following a surge to an average of 7653 new cases and 71 deaths daily for a week, the fourth MCO (4.0), also involving a nationwide lockdown, was implemented on June 1, 2021.[9]

Surveys based on knowledge, attitude, and practices (KAP) seek to determine what is known (knowledge), what is believed (attitude), and what is being done (practiced) by a certain population in terms of a specific topic of interest.[13] People's knowledge is usually assessed to determine the degree to which the community's knowledge is consistent with the biomedical concepts.[14] Attitude examines the predispositions toward thinking, feeling, and acting about a particular object.[15] Therefore, it involves complex interactions between beliefs, feelings, and values. Practices refer to various health measures taken to prevent the disease. Previous studies have found that knowledge, attitude, and risk perceptions toward infectious diseases significantly correlate with protective behaviors.[16,17] In turn, these behaviors play vital roles in the prevention and control of infectious diseases.[18] The lessons learned from the SARS epidemic suggested that knowledge on and attitudes toward infectious diseases can also be associated with feelings of panic and anxiety, which further complicates attempts to prevent the spread of the disease.[19]

Different public mental health patterns, including burnout, grief, and anxiety, have been reported in the later COVID-19 pandemic stage;[20] however, Malaysians do not possess sufficient knowledge on KAP because the existing COVID-19 KAP studies had been conducted in the early pandemic stage. Therefore, this study, which was conducted 18-months from the first reported COVID-19 case in the country, sought to determine Malaysians' KAP during MCO 4.0. It was postulated that the surge in the COVID-19 cases during the later pandemic stage was possibly because of poor public attitudes and practices.

Materials and Methods

Study Design and Patients

An online nationwide cross-sectional study was conducted in Malaysia from June 1, 2021 to June 14, 2021. The study comprised Malaysian citizens aged 18 years and older, all of whom were residing in the country during the study. Furthermore, individuals unable to read in English and Malay were excluded from the study. The calculated sample size comprised 470 participants, taking a precision of 5% and an expected good knowledge prevalence of 77.2%.[21,22]

The primary study objective was to determine the KAP of the general population during the later COVID-19 pandemic stage in Malaysia. The correlations between each component of the respondents' KAP were also investigated, and the socio-demographic determinants of a better KAP were explored as the secondary objective. Ethics approval was obtained from the Medical Research and Ethics Committee of the University Malaya Medical Center (MECID. No: 2021531–10185). Online written informed consent was obtained from all participants before the commencement of the study. This study was conducted in accordance with the Declaration of Helsinki.

Procedure

Due to the COVID-19 pandemic, a web-based survey—as opposed to an offline one—was conducted for the purpose of data collection. Respondents were recruited through advertisements and surveys posted on the mobile WhatsApp platform; they were asked to complete an online consent form after confirming that they had understood the purpose, risks, and benefits of the study. The anonymous self-administered online questionnaire was administered in English and Malay, and was completed in approximately 10–15 minutes. No incentives were offered for completing the questionnaire.

The online questionnaire comprised two parts, namely, the socio-demographic characteristics and respondents' KAP with regard to COVID-19. The socio-demographic characteristics included age group, gender, marital status, region of residence, household income, education level, occupation, whether the respondents were healthcare workers, and whether the respondents knew someone who had been diagnosed with COVID-19. The age groups were divided into 18–40 years (young adults), 41–60 years (middle-aged adults), and over 60 years (elderly).[23] The regions of residence were classified as the Central region (Selangor, Kuala Lumpur, and Putrajaya); the Southern region (Johor, Melaka, and Negeri Sembilan); the Northern region (Perak, Penang, Kedah and Perlis); the East Coast (Pahang, Kelantan, and Terengganu); and Borneo Island (Sabah, Sarawak, and Labuan). Household income was categorized in terms of B40 as the lowest 40% (≤ RM 6200/month); M40 as the middle 40% (> RM 6200–RM 13,000/month); and T20 (> RM 13,000/month) as the top 20% of family income in Malaysia.[24]

The KAP of the respondents with regard to COVID-19 was assessed by means of a questionnaire developed by Zhong et al.[25] The original questionnaire comprised 16 questions on COVID-19; 12 of these questions gauged the respondents' knowledge, two determined their attitudes, and two explored their practices pertaining to COVID-19. Of the 12 knowledge questions, four, three, and five questions were regarding clinical presentations, transmission modes, and COVID-19 prevention and control, respectively. The response options for these questions were "true", "false", and "unsure". Respondents scored one point for correct answers and zero points for incorrect ones. The Cronbach's alpha of the questionnaire ranged from 0.66 to 0.71.[22,25] The two attitude questions pertained to respondents' opinions on the humans' final control over COVID-19 and respondents' confidence levels with regard to eradicating the virus. The country in the questions was changed from China to Malaysia in order to adopt for Malaysian population. The response options for the attitude questions were "yes," "no," and "unsure"; participants scored one point for "yes" and zero points for "unsure." The two questions on practices were modified and adapted to six questions reflecting norms pertaining to the 3*C*s and 3*W*s in Malaysia. Respondents were asked if they had practiced the 3*C*s, ie, *Crowded* places, *Confined* spaces, and conversations in *Close* proximity, and the 3*W*s, which include *Wearing* a mask, *Washing* hands, and adhering to COVID-19 *Warnings*, during the few days before MCO 4.0. The response options were "yes" and "no"; participants scored zero points upon responding with "yes" for questions based on the 3*C*s and one point for responding with "yes" for those pertaining to the 3*W*s, and vice-versa for the "no" answers. The maximum scores for knowledge, attitude, and practices were 12, 2, and 6, respectively, with higher scores indicating a better KAP with regard to COVID-19. A cut-off score of 90% or more on the desired answers indicated a good correct-response rate for each question.[25]

Statistical Analysis

Results for the continuous variables were expressed as mean ± standard deviation (SD) or as the median with an interquartile range. The results for the categorical variables were expressed as percentages. The differences between the groups for the continuous variables were compared by means of an independent *t*-test or a Mann–Whitney *U*-test when comparing two groups. The differences between the groups for the continuous data were compared using a one-way ANOVA test or a Kruskal–Wallis *H*-test when comparing more than two groups. A Tukey's test was used for the posthoc analysis for the one-way ANOVA test, whereas the Dunn's procedure with a Bonferroni adjustment was used for the Kruskal–Wallis *H*-test. The correlations for the continuous variables were calculated using Pearson or Spearman correlation tests. The correlation coefficient (*r*) was defined as weak (0.10–0.29), medium (0.30–0.49), or strong (≥0.50) based on Cohen classification.[26] Multivariate analyses were performed using linear regression wherein a two-sided *p*-value of less than 0.05 was considered significant. Statistical analyses were performed using the Statistical Package for the Social Sciences software package (IBM SPSS Statistic 25.0, SPSS Inc, Chicago, IL, USA).

Results

Socio-Demographic Characteristics of Respondents

Of the 2213 survey responses received, 2186 (98.8%) respondents agreed to participate in the study. Following the exclusion of 18 respondents who were below 18 years of age, the final sample comprised 2168 respondents (Table 1). The majority of respondents were aged 18–40 years (62.7%); females (62.4%); tertiary-educated individuals (84.0%); non-healthcare workers (85.9%); and individuals who knew someone diagnosed with COVID-19 (75.2%). The proportions of single (45.8%) and married (50.7%) respondents were similar. The household-income respondent composition was similar to nationwide reports, ie, 49.1%, 34.8%, and 16.1% respondents belonged to the B40, M40, and T20 categories, respectively. The majority of respondents were still employed; most of these respondents were working in the public (28.1%) or private (28.1%) sectors. The highest number of respondents (40.8%) hailed from the Central region, followed by Borneo Island (33.9%), the East Coast (11.6%), the Northern region (7.9%), and the Southern region (5.8%).

Knowledge Regarding COVID-19

The mean score for the 12 knowledge questions was 10.0 ± 1.52, with the rate of correct responses for each question ranging from 54.2% (K2) to 99.0% (K12) (Table 2). All questions had correct response rates of 90% or more, except for K2 (54.2%), K4 (70.7%), K5 (59.3%), K6 (87.4%), K7 (88.0%), and K8 (69.1%). The percentages of questions with good correct-response rates were 50.0% (2/4) and 80% (4/5) for the clinical-presentation questions and prevention-and-control questions, respectively. None of the transmission-route questions had good correct-response rates.

Mean knowledge differed significantly in terms of age group, region of residence, household income, education level, occupation, whether respondents were healthcare workers, and whether respondents knew someone diagnosed with COVID-19 (with $p < 0.001$ for all) (Table 3). Respondents who were above 60 years of age, tertiary-educated individuals, or healthcare workers, together with those who knew someone diagnosed with COVID-19 (especially friends and colleagues), had significantly higher mean knowledge scores than their comparison group. The T20 and M40 household-income brackets had significantly higher mean knowledge scores compared to the B40 household income bracket ($p < 0.001$ for both). The mean knowledge scores for the respondents from the Central and Northern regions were significantly higher than for the respondents from Borneo Island ($p = 0.001$ and $p = 0.011$, respectively). The retired respondents had significantly higher mean knowledge scores than respondents working in the private sector ($p = 0.009$), students ($p = 0.019$), and the unemployed ($p < 0.001$). Furthermore, respondents working in the public sector had significantly higher mean knowledge scores than the unemployed ($p = 0.009$).

Attitude Toward COVID-19

The mean score for the two attitude questions was 1.3 ± 0.85; 68.7% respondents agreed that COVID-19 would finally be controlled successfully, and 62.3% were confident that Malaysia could win the battle against COVID-19.

The mean attitudes differed significantly by age group, marital status, region of residence, occupation, and whether the respondent knew someone diagnosed with COVID-19 ($p < 0.001$–0.003). Respondents who knew someone diagnosed with COVID-19 (especially family and relatives) had significantly higher mean attitude scores than those who did not. The mean attitude score was significantly higher among married respondents compared to the scores obtained by those who were unmarried ($p = 0.001$). Moreover, the scores were significantly higher among East Coast respondents compared to the scores obtained by those from the rest of the country ($p < 0.001$–0.015). Respondents over 60 years of age and as well as those in the age-range of 41–60 years had significantly higher mean attitude scores than respondents aged 18–40 years ($p = 0.039$ and $p = 0.001$, respectively). Respondents working in the public sector, the self-employed, and the retired had significantly higher mean attitude scores than those working in the private sector ($p < 0.001$–0.014).

Practices Toward COVID-19

The mean score for the six practices questions was 5.1 ± 1.10. The proportion of correct responses for each question ranged from 74.1% (P3) to 94.2% (P4), with only P4 having a good correct response rate. The correct response rate was more than 80% for all questions except for P3 (74.1%).

Table 1 Socio-Demographic Characteristics of the Respondents of the Study

Demographic Characteristics	Total Respondents, n = 2168
Age group, n (%)	
18–40 years	1359 (62.7)
41–60 years	608 (28.0)
Over 60 years	201 (9.3)
Gender, n (%)	
Male	816 (37.6)
Female	1352 (62.4)
Marital status, n (%)	
Single	994 (45.9)
Married	1102 (50.8)
Widowed/separated	72 (3.3)
Region, n (%)	
Central	884 (40.8)
Eastern	252 (11.6)
Northern	171 (7.9)
Southern	126 (5.8)
Borneo	735 (33.9)
Household income, n (%)	
B40	1065 (49.1)
M40	754 (34.8)
T20	349 (16.1)
Education level, n (%)	
Tertiary	1822 (84.0)
Secondary and below	346 (16.0)
Occupation, n (%)	
Public sector	610 (28.1)
Private sector	609 (28.1)
Self-employed	194 (8.9)
Retired	163 (7.5)
Student	397 (18.3)
Unemployed	195 (9.0)
Healthcare workers, n (%)	
No	1863 (85.9)
Yes	305 (14.1)
Knew someone diagnosed with COVID-19, n (%)	
No	538 (24.8)
Yes	1630 (75.2)
Household members	77 (3.6)
Families	225 (10.4)
Relatives	554 (25.6)
Friends	949 (43.8)
Colleagues	528 (34.4)
Neighbors	374 (17.3)

Abbreviations: B40, lowest 40% of family income group in Malaysia; M40, middle 40% of family income group in Malaysia; T20, top 20% of family income group in Malaysia; COVID-19, coronavirus 2019.

Table 2 Respondents Answers to COVID-19 Knowledge, Attitude, and Practices Items

Questions*	Yes, n (%)	No, n (%)	Unsure, n (%)
K1. The main clinical symptoms of COVID-19 are fever, fatigue, dry cough, and myalgia.	1952 (90.0)*	91 (4.2)	125 (5.8)
K2. Unlike the common cold, stuffy nose, runny nose, and sneezing are less common in persons infected with the COVID-19 virus.	1176 (54.2)*	520 (24.0)	472 (21.8)
K3. Currently there is no effective cure for COVID-19, but early symptomatic and supportive treatment can help most patients recover from the infection.	2007 (92.6)*	57 (2.6)	104 (4.8)
K4. Not all persons with COVID-19 will develop to severe cases. Only those who are elderly, have chronic illnesses, and are obese are more likely to be severe cases.	1533 (70.7)*	472 (21.8)	163 (7.5)
K5. Eating or contacting wild animals would result in the infection by the COVID-19 virus.	250 (11.5)	1286 (59.3)*	632 (29.2)
K6. Persons with COVID-19 cannot infect the virus to others when a fever is not present.	71 (3.3)	1895 (87.4)*	202 (9.3)
K7. The COVID-19 virus spreads via respiratory droplets of infected individuals.	1908 (88.0)*	118 (5.4)	142 (6.5)
K8. Ordinary residents can wear general medical masks to prevent the infection by the COVID-19 virus.	1498 (69.1)*	553 (25.5)	117 (5.4)
K9. It is not necessary for children and young adults to take measures to prevent the infection by the COVID-19 virus.	68 (3.1)	2078 (95.8)*	22 (1.0)
K10. To prevent the infection by COVID-19, individuals should avoid going to crowded places such as train stations and avoid taking public transportations.	2116 (97.6)*	33 (1.5)	19 (0.9)
K11. Isolation and treatment of people who are infected with the COVID-19 virus are effective ways to reduce the spread of the virus.	2105 (97.1)*	23 (1.1)	40 (1.8)
K12. People who have contact with someone infected with the COVID-19 virus should be immediately isolated in a proper place. In general, the observation period is 10–14 days.	2146 (99.0)*	11 (0.5)	11 (0.5)
A1. Do you agree that COVID-19 will finally be successfully controlled?	1490 (68.7)[#]	208 (9.6)	470 (21.7)
A2. Do you have confidence that Malaysia can win the battle against the COVID-19 virus?	1351 (62.3)[#]	328 (15.1)	489 (22.6)
P1. In recent days before the MCO 4.0, have you gone to any crowded place?	401 (18.5)	1767 (81.5)[+]	-
P2. In recent days before the MCO 4.0, have you gone to any confined place?	258 (11.9)	1910 (88.1)[+]	-
P3. In recent days before the MCO 4.0, do you have close conversation with non-household member?	561 (25.9)	1607 (74.1)[+]	-
P4. In recent days before the MCO 4.0, have you worn a mask when leaving home?	2043 (94.2)[+]	125 (5.8)	-
P5. In recent days before the MCO 4.0, have you regularly wash your hand using soap and water, or hand sanitiser?	1929 (89.0)[+]	239 (11.0)	-
P6. In recent days before the MCO 4.0, have you practise caution by avoiding handshakes, as well as staying at home and seeking treatment if you are developing symptoms related to COVID-19?	1817 (83.8)[+]	351 (16.2)	-

Notes: *Correct answer for knowledge. [#]Positive attitude towards COVID-19. [+]Correct answer for practices. *Questions adapted from: Zhong BL, Luo W, Li HM, et al. Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: a quick online cross-sectional survey. *Int J Biol Sci*. 2020;16(10):1745–1752. doi:10.7150/ijbs.45221.[25]

Abbreviations: COVID-19, coronavirus 2019; MCO, movement control order.

Table 3 Comparison of Socio-Demographic Characteristics and Mean Knowledge, Attitude, and Practices Scores

Demographic Characteristics	Knowledge Score Mean ± SD	p-value	Attitude Score Mean ± SD	p-value	Practices Score Mean ± SD	p-value
Age group, n (%)						
18–40 years	9.9 ± 1.52	< 0.001	1.3 ± 0.86[f]	< 0.001	5.0 ± 1.15[j]	< 0.001
41–60 years	10.0 ± 1.44		1.4 ± 0.83		5.3 ± 1.00	
Over 60 years	10.4 ± 1.65[a]		1.4 ± 0.80		5.4 ± 0.99	
Gender, n (%)						
Male	9.9 ± 1.62	0.112	1.28 ± 0.85	0.261	5.0 ± 1.21	< 0.001
Female	10.0 ± 1.45		1.3 ± 0.85		5.2 ± 1.02	
Marital status, n (%)						
Single	9.9 ± 1.55	0.329	1.2 ± 0.86	0.001	5.0 ± 1.17	< 0.001
Married	10.0 ± 1.50		1.4 ± 0.83[g]		5.2 ± 1.04[k]	
Widowed/separated	10.0 ± 1.27		1.3 ± 0.83		5.3 ± 0.97	
Region, n (%)						
Central	10.1 ± 1.52	0.001	1.3 ± 0.84	< 0.001	5.2 ± 1.07[l]	0.010
Southern	9.9 ± 1.42		1.3 ± 0.85		5.2 ± 1.11	
Northern	10.2 ± 1.40		1.4 ± 0.84		5.1 ± 1.13	
Eastern	10.0 ± 1.43		1.7 ± 0.64[h]		5.1 ± 1.13	
Borneo	9.8 ± 1.57[b]		1.3 ± 0.88		5.0 ± 1.12	
Household income, n (%)						
B40	9.7 ± 1.63[c]	< 0.001	1.3 ± 0.84	0.492	5.0 ± 1.17[m]	< 0.001
M40	10.2 ± 1.40		1.3 ± 0.86		5.2 ± 1.00	
T20	10.3 ± 1.28		1.3 ± 0.84		5.2 ± 1.08	
Education level, n (%)						
Tertiary	10.1 ± 1.46	< 0.001	1.3 ± 0.85	0.895	5.1 ± 1.10	0.460
Secondary and below	9.5 ± 1.71		1.3 ± 0.86		5.1 ± 1.12	
Occupation, n (%)						
Public sector	10.1 ± 1.45[d]	< 0.001	1. 4 ± 0.83	< 0.001	5.2 ± 1.09	0.007
Private sector	9.9 ± 1.46		1.2 ± 0.88[i]		5.0 ± 1.16	
Self-employed	10.0 ±1.54		1.4 ± 0.81		5.1 ± 1.17	
Retired	10.4 ± 1.69[e]		1.5 ± 0.78		5.4 ± 0.88[n]	
Student	9.9 ± 1.49		1.3 ± 0.84		5.0 ± 1.10	
Unemployed	9.6 ± 1.79		1.3 ± 0.88		5.2 ± 1.00	
Healthcare workers, n (%)						
No	9.9 ± 1.55	< 0.001	1.3 ± 0.86	0.064	5.1 ± 1.10	0.012
Yes	10.4 ± 1.24		1.4 ± 0.81		5.3 ± 1.10	
Know someone diagnosed with COVID-19, n (%)						
No	9.7 ± 1.78	< 0.001	1.2 ± 0.89	0.003	5.2 ± 1.04	0.137
Yes	10.1 ± 1.43		1.3 ± 0.83		5.1 ± 1.12	
Household members						
Yes	10.3 ± 1.26	0.084	1.3 ± 0.80	0.873	4.9 ± 1.27	0.126
No	10.0 ± 1.53		1.3 ± 0.85		5.1 ± 1.10	
Families						
Yes	10.2 ± 1.37	0.059	1.4 ± 0.78	0.024	5.1 ± 1.05	0.373
No	10.0 ± 1.53		1.3 ± 0.86		5.1 ± 1.11	

(*Continued*)

Table 3 (Continued).

Demographic Characteristics	Knowledge Score Mean ± SD	p-value	Attitude Score Mean ± SD	p-value	Practices Score Mean ± SD	p-value
Relatives						
Yes	10.1 ± 1.57	0.212	1.4 ± 0.81	0.018	5.0 ± 1.14	0.040
No	10.0 ± 1.50		1.3 ± 0.86		5.1 ± 1.09	
Friends						
Yes	10.1 ± 1.42	< 0.001	1.3 ± 0.85	0.971	5.1 ± 1.14	0.084
No	9.9 ± 1.58		1.3 ± 0.85		5.2 ± 1.07	
Colleagues						
Yes	10.2 ± 1.26	< 0.001	1.4 ± 0.83	0.204	5.1 ± 1.13	0.621
No	9.9 ± 1.59		1.3 ± 0.86		5.1 ± 1.10	
Neighbors						
Yes	10.1 ± 1.42	0.181	1.3 ± 0.84	0.452	5.2 ± 1.05	0.282
No	10.0 ± 1.54		1.3 ± 0.85		5.1 ± 1.11	

Notes: Significantly different in post-hoc analysis; Knowledge score; [a]Higher than 41–60 years and 18–40 years; [b]Lower than Central and Northern region; [c]Lower than M40 and T20; [d]Higher than unemployed; [e]Higher than private sector, student, and unemployed. Attitude score; [f]Lower than 41–60 years and over 60 years; [g]Higher than single; [h]Higher than Central, Southern, Northern, and Borneo region; [i]Lower than public sector, self-employed, and retired. Practices score; [j]Lower than 41–60 years and over 60 years; [k]Higher than single; [l]Higher than Borneo zone; [m]Lower than M40 and T20; [n]Higher than private sector and student.

Abbreviations: SD, standard deviation; B40, lowest 40% of family income group in Malaysia; M40, middle 40% of family income group in Malaysia; T20, top 20% of family income group in Malaysia; COVID-19, coronavirus 2019.

The means pertaining to practices differed significantly by age group, gender, marital status, region of residence, household income, occupation, and whether the respondents were healthcare workers ($p < 0.001$–0.012). Females and healthcare workers had significantly higher scores pertaining to mean practices, married respondents had significantly higher mean scores for practices compared to the scores obtained by unmarried respondents ($p < 0.001$). Moreover, respondents from the Central region had significantly higher mean scores for practices than the scores obtained by those from Borneo Island ($p = 0.005$). Respondents over 60 years of age and those in the age-range of 41–60 years had significantly higher scores for practices than the scores obtained by respondents aged 18–40 years ($p < 0.001$ for both). The T20 and M40 income groups had significantly higher scores pertaining to practices compared to the scores obtained by individuals from the B40 income group ($p = 0.004$ and $p < 0.001$, respectively). Retired respondents had significantly higher mean scores for practices compared to the scores obtained by those working in the private sector and students' scores ($p = 0.013$ and $p = 0.004$, respectively).

Correlations Between COVID-19 Knowledge, Attitude, and Practices

The correlations between knowledge and attitude ($r = 0.078$, n = 2168, $p < 0.001$) and those between knowledge and practices ($r = 0.070$, n = 2168, $p = 0.001$) were very small; no correlations were found between attitude and practices (r = −0.013, n = 2168, $p = 0.530$).

Multivariate Analyses for COVID-19 Knowledge, Attitude, and Practices

The multivariate analyses revealed that age, household income, education level, occupation, occupation status as healthcare workers, and acquaintance with someone diagnosed with COVID-19 were significant knowledge predictors ($p < 0.05$ for all). Furthermore, age and acquaintance with someone diagnosed with COVID-19 ($p < 0.05$ for both) were significant predictors of attitude. Furthermore, age, gender, residential region, household income, being a healthcare worker, and knowing someone diagnosed with COVID-19 were significant predictors in terms of practices ($p < 0.05$ for all).

Discussion

The respondents for this online nationwide cross-sectional survey conducted in the later COVID-19 pandemic stage in Malaysia primarily comprised young adults, females, tertiary-educated individuals, non-healthcare workers residing in the Central region of Peninsular Malaysia or Borneo Island, and individuals who knew someone (mainly friends,

colleagues, or relatives) having been diagnosed with COVID-19. Although most respondents scored well on half of the COVID-19 knowledge-based questions, their COVID-19 practices were inadequate and their attitudes toward COVID-19 control poor.

After 18-months from the first COVID-19 case in Malaysia, the respondents had sufficient knowledge regarding the prevention and control of COVID-19; however, their knowledge in terms of clinical presentations and COVID-19 transmission modes was inadequate and needed further improvement. The respondents were not very optimistic about the control of COVID-19 in Malaysia; however, they were more optimistic about the virus being controlled at a global level. Even though wearing a mask is mandatory in Malaysia, 5.8% respondents admitted that they did not wear a mask when leaving home. Despite the intensive nationwide 3*C*s and 3*W*s campaigns, a quarter of the respondents continued to have close conversations with non-household members; moreover, one-fifth of the respondents continued frequenting crowded places and were not cautious about COVID-19. Finally, one-tenth of the respondents continued visiting confined areas and did not practice regular hand hygiene.

Generally, it was found that young adults and those working in the private sector had lower KAP toward COVID-19, possibly because young adults have been told they are unlikely to suffer serious illness from or develop complications following a COVID-19 infection.[27] Such an attitude is likely to have reduced their levels of concern with regard to the disease. Some respondents working in the private sector were employed as manual workers; as a result, their knowledge of COVID-19 was low. In addition, their non-compliance with COVID-19 preventive measures was high because of their crowded and confined workplaces.[28] Furthermore, the high COVID-19 incidence among manual workers in factories and construction sites could have made these respondents less optimistic.[29] Respondents from the lower-income groups—especially those from the B40 group—lacked COVID-19 knowledge and did not follow the essential COVID-19 practices. This lack of knowledge stemmed from their lower education levels, whereas the inadequate adherence to COVID-19 practices was owing to the fact that they were manual workers and unable to work from home.[30] In other words, the need to visit their workplaces regularly could have increased the risk of violating the 3*C*s.

Respondents from Borneo Island particularly lacked COVID-19 knowledge and did not adhere to the practices. This lack of knowledge and nonadherence to practices could have stemmed from their limited access to COVID-19 prevention information resources. In particular, those hailing from rural areas with inadequate network coverage could not access such information.[31] The East Coast respondents had more optimistic attitudes because the COVID-19 incidence was lower in this area;[32] however, single respondents were were less optimistic, possibly because they had less family and social support.[33] Moreover, they may have been unable to adhere to COVID-19 practices because they lived alone and, therefore, did not have the responsibility of protecting their close family members from being infected.[34] Owing to their training, healthcare workers had better COVID-19 knowledge and adhered to COVID-19 practices more consistently than the others. Respondents who knew someone diagnosed with COVID-19 displayed more knowledge and better attitude pertaining to this subject compared to the other respondents.[35] This increased awareness and better attitude was possibly because this type of event could have promoted health-seeking behaviors, including obtaining more information from books, mass media, and the Internet. Females were found to have better COVID-19 practices than males because they were less likely to engage in "risk-taking" behaviors.[36]

The COVID-19 KAP of the respondents in this study was different from the KAP reported during the early COVID-19 pandemic stage. Using a similar questionnaire, Azlan et al reported an almost similar knowledge percentage (35.7–99.1%) but better attitude percentages (83.1–95.5%) during the MCO 1.0.[22] Although the majority of the respondents in their study avoided going to crowded places and practiced hand hygiene, only half of them wore a mask when leaving home. During the MCO 4.0, the respondents in this study were not too optimistic about the ability to control COVID-19; this lack of optimism could be for several reasons, some of which are as follows: 1. The daily new COVID-19 cases and deaths were significantly higher during MCO 4.0 than MCO 1.0.[9] 2. The COVID-19 pandemic remained uncontrolled despite three rounds of MCO in the past 18-months. 3. The emergence of the variants was resulting in a rebound in COVID-19 cases in the neighboring countries such as Indonesia and India.[37] A larger number of respondents wore masks when leaving home during the MCO 4.0 compared to MCO 1.0 possibly because by this time, there was an adequate supply of personal protective devices and wearing masks in public places had become mandatory.[22]

Several studies reported public KAPs in other countries from the early COVID-19 pandemic stage. A multinational study involving 22 countries reported fair knowledge and attitude and good COVID-19 practices.[38] In China, Zhong et al and Gao et al reported a good COVID-19 KAP among people in Hubei province and nationwide, respectively,[25,34] The findings of Zhong et al and Gao et al's studies revealed that the KAPs were lower among younger, unmarried, and less educated respondents as well as among non-healthcare workers and respondents from rural areas. These findings were consistent with the results of this study. A good COVID-19 KAP was reported among the public in Saudi Arabia, especially among the elderly and females.[39] In contrast, a moderate COVID-19 KAP level was reported among Indonesian residents during the pandemic,[40] and a poor COVID-19 KAP was found in Thailand and Bangladesh.[41,42] However, the study in Thailand was focused on less-educated villagers from the northern part of the country, and the majority of the respondents in the second study were young and unmarried and were students. A survey of less-educated, lower-income minorities in Hong Kong reported less knowledge but good attitude and practices.[43] However, contrary results were obtained among the public in the United States, the United Kingdom,[44] and low-income households in the Philippines.[45] None of these individuals adequately followed COVID-19 practices despite possessing sound knowledge of the symptoms and transmission routes. Therefore, these studies did not yield similar results as this study.

The studies conducted during the COVID-19 pandemic early stage consistently reported strong positive correlations between the KAP components,[25,34,46–48] except for a study by Masoud et al (knowledge–attitude, $r = 0.05$; knowledge–practices, $r = 0.12$).[38] However, in the present study, respondents displayed sound COVID-19 knowledge but poor attitudes and inadequate practices. Low correlations were found between knowledge and attitude and knowledge and practices; no correlation was found between attitude and practices. Because other studies had been conducted earlier in the COVID-19 pandemic, the respondents in this study had perhaps been provided with considerable information on the subject by mass media over a period of time, resulting in increased COVID-19 knowledge. Attitudes toward COVID-19 were mainly influenced by the disease control at a particular time, with the length of this pandemic and persistent poor control of COVID-19 possibly leading to the less optimistic attitudes of respondents. The COVID-19 practices were influenced by Malaysia's regulations; however, because of the prolonged pandemic period, respondents may have been experiencing "pandemic fatigue" and "burnout" owing to the strict regulations; consequently, they had perhaps begun violating the COVID-19 prevention measures.[49] The re-opening of the economy may have also contributed partially to the poor practices owing to workplace hazards such as poor ventilation and crowding.[30]

This study is among the very few researches having investigated the KAP toward COVID-19 among the general population in the later stages of the COVID-19 pandemic. The strengths of this study were its large sample size and the fact that it was conducted during a surge in COVID-19 cases. The temporal patterns of the COVID-19 KAP among the public were examined, and the respondents' practices were comprehensively evaluated in accordance with the government's 3*C*s and 3*W*s policies.

However, there were several limitations to this study. First, snowball sampling was a non-probability sampling method. Second, the participants' responses were subjective and subject to recall bias due to the cross-sectional design of the study. However, a future study evaluating the KAP of a similar population at different time points could mitigate these limitations. Third, the majority of the respondents in this online study were youngsters, females, and tertiary-educated individuals, implying that the more vulnerable groups, including the elderly, the less-educated, and people from rural areas may have been overlooked due to limited internet access. These groups are likely to have poorer KAP because social media and news websites—which require internet access—have acted as common sources of COVID-19 information.[50] Fourth, the definition of the late or later COVID-19 pandemic stage was not standardized because it has ranged from three to six months after the onset of COVID-19 outbreak in other studies.[51,52] In Malaysia, the COVID-19 pandemic exit plan, called the "National Recovery Program," was unveiled on 15th June 2021.[53] Following the high vaccination rates among the adult populations, coupled with the drastic reduction in the total and severe cases, Malaysia was expected to transition from the COVID-19 pandemic to an endemic phase by the end of October 2021.[54] Fifth, we did not explore if any of the respondents had been diagnosed with COVID-19, which may have been a confounding factor; however, we felt that it was not appropriate to ask these questions due to confidentiality. Sixth, the domains and

concepts covered in the attitude questions were limited. Therefore, questionnaires with better COVID-19 attitude constructs should be developed in future studies. Seventh, due to time limits and study urgency, attitude was tested using only two questions, and practices were tested using only six questions. Furthermore, the validity and reliability of the practices questions were not tested.

Conclusions

This study found that even though Malaysian citizens have acquired sufficient COVID-19 knowledge during the later stages of the pandemic, their attitude toward its control is poor, and their practices regarding preventive measures is inadequate. Unlike in the early stage of the COVID-19 pandemic, sound knowledge has led to little improvement in attitude or practices during this time.

Therefore, health education during the later pandemic stage should focus on promoting a positive attitude and better practices in the public. For example, the public should be encouraged to adopt the correct attitude towards practices that can prevent COVID-19. Their knowledge of the practices should also be enhanced and the rationale for the 3*C*s and 3*W*s more clearly explained. Greater emphasis should be placed on vulnerable groups such as young adults, males, and unmarried individuals as well as less-educated people, lower-income groups, and individuals from rural areas. In short, this study provides timely insights for the government and public health organizations to establish more appropriate policies and interventions for combatting COVID-19.

Abbreviations

SARS, severe acute respiratory syndrome; SARS-CoV-1, SARS coronavirus 1; WHO, World Health Organization; SARS-CoV-2, SARS coronavirus 2; COVID-19, coronavirus 2019; MCO, movement control order; KAP, knowledge, attitude, and practices; B40, lowest 40% of family income group in Malaysia; M40, middle 40% of family income group in Malaysia; T20, top 20% of family income group in Malaysia; SD, standard deviation.

Data Sharing Statement

The datasets used and/or analysed during the current study are available from the corresponding author - Diana Leh-Ching Ng: diananglehching@gmail.com, on reasonable request.

Ethics Approval and Informed Consent

The ethics approval for this study was obtained from the Medical Research and Ethics Committee of UMMC (MECID. No: 2021531 – 10185). Online written informed consent was obtained from every participant. This study was conducted in accordance with the Declaration of Helsinki.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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References

1. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet*. 2020;395 (10223):497–506. doi:10.1016/S0140-6736(20)30183-5
2. Gorbalenya AE, Baker SC, Baric RS, et al. The species Severe acute respiratory syndrome-related coronavirus: classifying 2019-nCoV and naming it SARS-CoV-2. *Nat Microbiol*. 2020;5(4):536–544.
3. World Health Organisation. Naming the coronavirus disease (COVID-19) and the virus that causes it; 2020. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it. Accessed July 10, 2021.
4. Li Q, Guan X, Wu P, et al. Early transmission dynamics in Wuhan, China, of novel coronavirus–infected pneumonia. *N Engl J Med*. 2020;382 (13):1199–1207. doi:10.1056/NEJMoa2001316
5. Centers for Disease Control and Prevention. Scientific brief: SARS-CoV-2 transmission; 2021. Available from: https://www.cdc.gov/coronavirus/2019-ncov/science/science-briefs/sars-cov-2-transmission.html. Accessed July 10, 2021.
6. Wilder-Smith A. COVID-19 in comparison with other emerging viral diseases: risk of geographic spread via travel. *Trop Dis Travel Med Vaccines*. 2021;7(1):3. doi:10.1186/s40794-020-00129-9
7. World Health Organisation. Statement on the second meeting of the International Health Regulations (2005) Emergency committee regarding the outbreak of novel coronavirus (2019-nCoV); 2020. Available from: https://www.who.int/news-room/detail/30–01–2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov.). Accessed July 10, 2021.
8. World Health Organisation. WHO director-general's opening remarks at the media briefing on COVID-19–11 2020; 2020. Available from: https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19–11-march-2020. Accessed July 10, 2021.
9. Worldometer. COVID-19 coronavirus pandemic; 2020. Available from: https://www.worldometers.info/coronavirus/. Accessed July 27, 2021.
10. Umair S, Waqas U, Faheem M. COVID-19 pandemic: stringent measures of Malaysia and implications for other countries. *Postgrad Med J*. 2021;97(1144):130–132. doi:10.1136/postgradmedj-2020-138079
11. Shah AUM, Safri SNA, Thevadas R, et al. COVID-19 outbreak in Malaysia: actions taken by the Malaysian government. *Int J Infect Dis*. 2020;97:108–116. doi:10.1016/j.ijid.2020.05.093
12. Tang KHD. Movement control as an effective measure against Covid-19 spread in Malaysia: an overview. *Z Gesundh Wiss*. 2020;1–4. doi:10.1007/s10389-020-01316-w
13. Andrade C, Menon V, Ameen S, Kumar Praharaj S. Designing and conducting knowledge, attitude, and practice surveys in psychiatry: practical guidance. *Indian J Psychol Med*. 2020;42(5):478–481. doi:10.1177/0253717620946111
14. Good BJ. *Medicine, Rationality, and Experience: An Anthropological Perspective*. Cambridge: Cambridge University Press; 1994.
15. Yoder PS. Negotiating relevance: belief, knowledge, and practice in international health projects. *Med Anthropol Q*. 1997;11(2):131–146. doi:10.1525/maq.1997.11.2.131
16. Goodwin R, Haque S, Neto F, Myers LB. Initial psychological responses to Influenza A, H1N1 ("Swine flu"). *BMC Infect Dis*. 2009;9(1):166. doi:10.1186/1471-2334-9-166
17. Xiang N, Shi Y, Wu J, et al. Knowledge, attitudes and practices (KAP) relating to avian influenza in urban and rural areas of China. *BMC Infect Dis*. 2010;10(1):34. doi:10.1186/1471-2334-10-34
18. de Zwart O, Veldhuijzen IK, Elam G, et al. Perceived threat, risk perception, and efficacy beliefs related to SARS and other (emerging) infectious diseases: results of an international survey. *Int J Behav Med*. 2009;16(1):30–40. doi:10.1007/s12529-008-9008-2
19. Person B, Sy F, Holton K, Govert B, Liang A. National center for infectious diseases scot. Fear and stigma: the epidemic within the SARS outbreak. *Emerg Infect Dis*. 2004;10(2):358–363. doi:10.3201/eid1002.030750
20. Cushing E. Late-stage pandemic is messing with your brain; 2021. Available from: https://www.theatlantic.com/health/archive/2021/03/what-pandemic-doing-our-brains/618221/. Accessed July 10, 2021.
21. Charan J, Biswas T. How to calculate sample size for different study designs in medical research? *Indian J Psychol Med*. 2013;35(2):121–126. doi:10.4103/0253-7176.116232
22. Azlan AA, Hamzah MR, Sern TJ, Ayub SH, Mohamad E. Public knowledge, attitudes and practices towards COVID-19: a cross-sectional study in Malaysia. *PLoS One*. 2020;15(5):e0233668. doi:10.1371/journal.pone.0233668
23. Lachman ME, Teshale S, Agrigoroaei S. Midlife as a pivotal period in the life course: balancing growth and decline at the crossroads of youth and old age. *Int J Behav Dev*. 2015;39(1):20–31. doi:10.1177/0165025414533223
24. Che Sulaiman NF, Sanusi NA, Muhamad S. Survey dataset of Malaysian perception on rising cost of living. *Data Brief*. 2020;28:104910. doi:10.1016/j.dib.2019.104910
25. Zhong B-L, Luo W, Li H-M, et al. Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: a quick online cross-sectional survey. *Int J Biol Sci*. 2020;16(10):1745–1752. doi:10.7150/ijbs.45221
26. Cohen J. *Statistical Power Analysis for the Behavioral Sciences*. 2nd ed. Routledge; 1988.
27. Sim BLH, Chidambaram SK, Wong XC, et al. Clinical characteristics and risk factors for severe COVID-19 infections in Malaysia: a nationwide observational study. *Lancet Regional Health Western Pacific*. 2020;4. doi:10.1016/j.lanwpc.2020.100055
28. International Labours Organisation. The socioeconomic impacts of COVID-19 in Malaysia: policy review and guidance for protecting the most vulnerable and supporting enterprises; 2020. Available from: https://www.ilo.org/wcmsp5/groups/public/—asia/—ro-bangkok/documents/publication/wcms_751600.pdf. Accessed July 10, 2021.
29. Blue C. Factories open during MCO despite contributing more Covid-19 clusters; 2021.

30. Rahman AA, Jasmin AF, Schmillen A. The vulnerability of jobs to COVID-19: the case of Malaysia; 2020. Available from: https://think-asia.org/handle/11540/12748. Accessed July 10, 2021.
31. Jalli N. Lack of internet access in Southeast Asia poses challenges for students to study online amid COVID-19 pandemic; 2020. Available from: https://theconversation.com/lack-of-internet-access-in-southeast-asia-poses-challenges-for-students-to-study-online-amid-covid-19-pandemic-133787. Accessed July 10, 2021.
32. Ministry of Health Malaysia. Current situation of COVID-19 pandemic in Malaysia; 2021. Available from: http://covid-19.moh.gov.my/.http://covid-19.moh.gov.my/. Accessed July 10, 2021.
33. Thomas PA, Liu H, Umberson D. Family relationships and well-being. *Innovation Aging*. 2017;1(3). doi:10.1093/geroni/igx025
34. Gao H, Hu R, Yin L, et al. Knowledge, attitudes and practices of the Chinese public with respect to coronavirus disease (COVID-19): an online cross-sectional survey. *BMC Public Health*. 2020;20(1):1816. doi:10.1186/s12889-020-09961-2
35. Skinner CS, Tiro J, Champion VL. The Health Belief Model. In: *Health Behavior: Theory, Research, and Practice*. 5th ed. Hoboken, NJ, US: Jossey-Bass/Wiley; 2015:75–94.
36. Pawlowski B, Atwal R, Dunbar RIM. Sex differences in everyday risk-taking behavior in humans. *Evol Psychol*. 2008;6(1):147470490800600104. doi:10.1177/147470490800600104
37. Singh J, Rahman SA, Ehtesham NZ, Hira S, Hasnain SE, Hasnain SE. SARS-CoV-2 variants of concern are emerging in India. *Nat Med*. 2021;27(7):1131–1133. doi:10.1038/s41591-021-01397-4
38. Masoud AT, Zaazouee MS, Elsayed SM, et al. KAP-COVID$_{GLOBAL}$: a multinational survey of the levels and determinants of public knowledge, attitudes and practices towards COVID-19. *BMJ Open*. 2021;11(2):e043971. doi:10.1136/bmjopen-2020-043971
39. Al-Hanawi MK, Angawi K, Alshareef N, et al. Knowledge, attitude and practice toward COVID-19 among the public in the kingdom of Saudi Arabia: a Cross-sectional study. *Front Public Health*. 2020;8:217. doi:10.3389/fpubh.2020.00217
40. Christine Tan AK, Halim DA, Wijovi F, et al. Knowledge, attitude, and practices towards Covid-19 in the midst of pandemics among Jakarta residents. *J Epidemiol Public Health*. 2020;5(4):477–488. doi:10.26911/jepublichealth.2020.05.04.10
41. P Srichan, T Apidechkul, R Tamornpark, et al. Knowledge, attitudes and preparedness to respond to COVID-19 among the border population of northern Thailand in the early period of the pandemic: a cross-sectional study. *WHO South East Asia J Public Health*. 2020;9(2):118–125. doi:10.4103/2224-3151.294305
42. Ferdous MZ, Islam MS, Sikder MT, Mosaddek ASM, Zegarra-Valdivia JA, Gozal D. Knowledge, attitude, and practice regarding COVID-19 outbreak in Bangladesh: an online-based cross-sectional study. *PLoS One*. 2020;15(10):e0239254. doi:10.1371/journal.pone.0239254
43. Wong CL, Chen J, Chow KM, et al. Knowledge, attitudes and practices towards COVID-19 amongst ethnic minorities in Hong Kong. *Int J Environ Res Public Health*. 2020;17(21):7878. doi:10.3390/ijerph17217878
44. Geldsetzer P. Knowledge and perceptions of COVID-19 among the general public in the United States and the United Kingdom: a cross-sectional online survey. *Ann Intern Med*. 2020;173(2):157–160. doi:10.7326/M20-0912
45. Lau LL, Hung N, Go DJ, et al. Knowledge, attitudes and practices of COVID-19 among income-poor households in the Philippines: a cross-sectional study. *J Glob Health*. 2020;10(1):011007. doi:10.7189/jogh.10.011007
46. Lee M, Kang BA, You M. Knowledge, attitudes, and practices (KAP) toward COVID-19: a cross-sectional study in South Korea. *BMC Public Health*. 2021;21(1):295. doi:10.1186/s12889-021-10285-y
47. Alahdab S. A cross-sectional survey of knowledge, attitude and practice (KAP) towards COVID-19 pandemic among the Syrian residents. *BMC Public Health*. 2021;21(1):296. doi:10.1186/s12889-021-10353-3
48. Hager E, Odetokun IA, Bolarinwa O, Zainab A, Okechukwu O, Al-Mustapha AI. Knowledge, attitude, and perceptions towards the 2019 Coronavirus Pandemic: a bi-national survey in Africa. *PLoS One*. 2020;15(7):e0236918. doi:10.1371/journal.pone.0236918
49. World Health Organisation. Pandemic fatigue - reinvigorating the public to prevent COVID-19; 2020. Available from: https://apps.who.int/iris/bitstream/handle/10665/335820/WHO-EURO-2020-1160-40906-55390-eng.pdf. Accessed July 10, 2021.
50. Adella Halim D, Kurniawan A, Agung FH, et al. Understanding of young people about COVID-19 during early outbreak in Indonesia. *Asia Pac J Public Health*. 2020;32(6–7):363–365. doi:10.1177/1010539520940933
51. Bonny-Noach H, Cohen-Louck K, Levy I. Substances use between early and later stages of the COVID-19 pandemic in Israel. *Isr J Health Policy Res*. 2021;10(1):46. doi:10.1186/s13584-021-00484-8
52. Xu H, Gan Y, Zheng D, et al. Relationship between COVID-19 infection and risk perception, knowledge, attitude, and four nonpharmaceutical interventions during the late period of the COVID-19 epidemic in China: online cross-sectional survey of 8158 adults. *J Med Internet Res*. 2020;22(11):e21372. doi:10.2196/21372
53. National Recovery Plan. Guiding Malaysia through the covid-19 pandemic crisis safely - NRP report; 2021. Available from: https://pelanpemulihannegara.gov.my/index-en.html. Aceessed December 28, 2021.
54. New Straits Times. Covid-19 endemic stage for Malaysia expected late October; 2021. Available from: https://www.nst.com.my/news/nation/2021/09/723446/covid-19-endemic-stage-malaysia-expected-late-october. Accessed December 28, 2021.