KNOWLEDGE, ATTITUDE, AND PRACTICES TOWARDS COVID-19 AMONG ADULTS IN INDONESIA DURING THE EARLY PANDEMIC: A RAPID ONLINE SURVEY

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Abstract. The novel coronavirus disease 2019 (COVID-19) is an infectious disease emerging worldwide including in Indonesia. An assessment on knowledge, attitudes, and practices (KAP) towards COVID-19 is necessary to help design public health interventions in Indonesia. The online survey was performed to assess knowledge, attitudes, and practices (KAP) regarding COVID-19 among Indonesian adults aged ≥15 years old. Generalized linear models (GLMs) were built to assess the effects of socio-demographic factors on KAP scores. A total of 3,582 participants enrolled in the online survey. The knowledge score was determined by gender and education (p-value <0.05). Gender, education, monthly income, region, and score of knowledge (p-value <0.05) determined the attitudes score. Whereas, the practices score was associated with all variables except region and income (p-value <0.05). This study demonstrates that socio-demographic factors could determine KAP scores regarding COVID-19. Therefore, enhanced information, education, and communication (IEC) programs and inter-sectorial collaborations targeting populations with low education backgrounds are essential. This paper can also be used as basic data for encouraging younger populations and women, so they can be actively involved in promoting public awareness towards COVID-19.

Keywords: COVID-19, Indonesia, knowledge, attitude, behavior

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INTRODUCTION

There have been three significant outbreaks in the past three decades, severe acute respiratory syndrome-coronavirus (SARS-CoV) in 2002), Middle East Respiratory Syndrome (MERS) in 2012, and SARS-CoV-2 or Coronavirus disease 2019 (COVID-19) (de Wit *et al*, 2016; Rabaan *et al*, 2020). Although COVID-19 was first reported in 2019 in Wuhan (Tang *et al*, 2020), it began to increase and spread in various countries in early 2020. The most potential risk for the spread of COVID-19 related to travels around the world causes regional and global spread. The coronavirus originated from animals, but when humans begin to be infected with this virus, transmission occurs rapidly, causing an outbreak. SARS and COVID-19 have something in common, namely, attacking the respiratory tract with varying levels of pathogenicity (Rabaan *et al*, 2020).

Currently, the increasing wave of COVID-19 infections is expected to be controlled through vaccination. The WHO recommends that the coverage be more than 70% and reach 100% in vulnerable and high-risk groups (WHO, 2022). However, this disease should be taken cautiously. Mutations of the virus and vaccine immunity remain a problem and challenge today (To *et al*, 2021). An area must have preparedness management and outbreak management. Improvement of public understanding of disease is necessary to reduce the risk of transmitting an outbreak or infection, which in turn might determine people's attitudes and behaviors (Khadka *et al*, 2020).

In Indonesia, during the pandemic period before the vaccination target is reached (2020-2021), several policies and campaigns have been advocated intensively. These policies and campaigns are concerned with

improving people's awareness of the risk of COVID-19 and the importance of implementing preventive measures (*eg*, applying social/physical distancing, good personal hygiene behaviors, self-quarantine) through various communication channels. However, responses to recommended actions implementation may vary in the population. Understanding how people become aware of an outbreak is crucial to identify misconceptions about the disease and to develop appropriate and effective communication strategies to improve their awareness and behavior (Azlan *et al*, 2020). Successful prevention measures greatly depend on people's adherence to recommended preventive measures policies during this pandemic (Zhong *et al*, 2020).

Online surveys on knowledge, attitudes, and practices (KAP) towards COVID-19 have been carried out in many countries (Zhong *et al*, 2020; Erfani *et al*, 2020; Sari *et al*, 2021). However, to the best of our knowledge, assessments of KAP about COVID-19 among adults in Indonesia remain scarce. In Indonesia, two KAP studies have been documented, targeting undergraduate students (Saefi *et al*, 2020) and general populations, with relatively limited samples (Sari *et al*, 2021). In the present study, we conducted a rapid online survey on Indonesian adults (age ≥15 years old). This study aimed to examine socio-demographic factors associated with KAP scores towards COVID-19 to help inform policymakers in designing effective health promotion and communication strategies to promote awareness of COVID-19 and other outbreaks in Indonesia.

MATERIALS AND METHODS

Study design

A cross-sectional online survey study was conducted in the beginning of the COVID-19 pandemic on Indonesian adult populations (≥15 years old) living in 34 provinces from 13-16 April 2020. A non-probability or convenience sampling approach was employed (Saunders *et al*, 2009). This approach was chosen as it was not feasible to do a community-based field survey during the pandemic.

Instrument and measurement

An online questionnaire was developed on the Google Forms™ platform. To test the reliability of the instrument, a preliminary survey was conducted on 30 participants. The Cronbach's alpha was calculated. Data from the preliminary survey were not included in the final results. The result of a final reliability test showed adequate reliability (Cronbach's alpha = 0.76).

The questionnaire was designed in the Indonesian language, consisting of closed-ended, multiple-choice, Likert-scale-type questions. The KAP questionnaire was developed following the guidelines for the prevention and control of COVID-19 issued by the Indonesian Ministry of Health (MOH RI, 2020). The questions were categorized into five sections:

a) Socio-demographic characteristics (13 items), including gender, age, residence, occupation, education, and monthly income information.

b) Knowledge of COVID-19 (11 items), including questions on sources of information, modes of transmission, symptoms, and preventive measures. An individual knowledge score is defined as the proportion of correct answers (e.g., items given score 1) relative to total questions (6 items) (for example, if there were a total of 5 correct answers, then the total individual score would be 5/6 x 100%).

c) Attitudes towards COVID-19 (11 items, C01-C11), including questions on attitudes towards preventive measures. A Likert scale covering "strongly disagree" (score: +2), "somewhat disagree" (score: +1), "somewhat agree" (score: -1), "strongly agree" (score: -2), and "don't know/uncertain" (score: 0) responses was used.

d) Practices of preventive measures against COVID-19 (7 items, D03-D09), including questions on personal hygiene practices and the frequency of seeking information about COVID-19. Five levels of practices (1 = never, 2 = rarely, 3 = sometimes, 4 = often, and 5 = always) were used. Score '0' was given if a respondent answered 'never'/'rarely'/'sometimes', and score "1" was given when the respondent answered 'often' or 'always'.

e) Risk perception on COVID-19 (11 items, E01-E11). This

section included questions regarding perceived severity, perceived susceptibility, perceived efficacy, perceived self-efficacy, and barriers. This section was developed based on the Health Belief Model (Champion and Skinner, 2008).

Data collection

The invitation to participate and the link to the online questionnaire were distributed through social media platforms, including WhatsApp, Facebook, and Instagram. An electronic form of consent to participate was provided on the first page of the questionnaire. Respondents were asked to read and express their consent before the survey.

Statistical analysis

Descriptive statistics on socio-demographic characteristics, knowledge, attitudes, and practices towards COVID-19 were calculated. Generalized linear models (GLMs) were constructed to test the associations between outcome variables (KAPs scores) and explanatory variables (*eg*, age, sex, education, occupation, income, and region) in both univariate and multivariate analyses. A p-value < 0.05 was considered statistically significant for the associations between KAP scores and independent variables. Associations were reported as regression coefficients beta (β) and their 95% confidence intervals (95% CI). All data analyses were performed using Statistical Package for the Social Sciences (SPSS) version 15 (IBM Inc, Chicago, IL).

Ethical approval

Ethical approval was provided by the Ethical Committee for Health Research, National Institute of Health Research and Development, the Ministry of Health of Indonesia (Number: LB.02.01/2/KE.248/2020).

RESULTS

Knowledge on COVID-19

The average score for knowledge was 84.76 (good knowledge), with a standard deviation (SD) of 16.92. Overall, 78.2% of the participants had good knowledge. The participants knew of the agent of COVID-19 (95.4%), but only half knew how COVID-19 is transmitted (52.5%). Eighty-two percent of the participants (n = 2,926) were able to correctly answer on three main symptoms of COVID-19 (fever, cough, and short-breath). Most participants thought that COVID-19 can be fatal (95.6%) but preventable (98.9%) (Table 1).

Attitude towards COVID-19

Almost all respondents (99.2%) had favorable attitudes towards COVID-19. The respondents would use a facial mask (97.45%), practice physical distancing (98.3%), and wash their hands with soap and water (99.05%). Moreover, almost all participants would immediately seek doctors when feeling unwell (98.85%). No more than five percent of the respondents would go on an unnecessary travel or on a 'mudik' trip (*ie*, a trip to their hometown) during the pandemic. However, there were few participants (n = 619, 17.3%) who believed that COVID-19 can only infect certain people and that it will not be transmitted by handshaking (n = 614, 17.2%). Fifty-six percent of the participants would refrain from engaging in a physical contact with people acquiring COVID-19 (Table 1).

Preventive practices towards COVID-19

The mean (SD) score for practices was 80.18 (18.36). Overall, two out of three participants had good practice towards COVID-19. To prevent transmission, the participants always used a facial mask (86.6%), washed their hands (88.3%), practiced physical distancing when interacting with others (85.4%), and made sure to take a bath and wear clean clothes when they were back home (85%). Most participants always covered their nose and mouth

Table 1

Knowledge, attitude, preventive practices towards COVID-19 among adults (≥15 years old) (N = 3582)

Question	Frequency, *n* (%)	
Knowledge	Yes	No
COVID-19 is caused by coronavirus	3418 (95.4)	164 (4.6)
COVID-19 is transmitted through droplets and contact with sick people	1882 (52.5)	1700 (47.4)
The main symptoms of COVID-19 are fever, cough, short-breath	2926 (81.7)	656 (18.3)
COVID-19 could lead to death	3424 (95.6)	158 (4.4)
COVID-19 is a preventable disease	3542 (98.9)	40 (1.2)
Proper handwashing with soap and water, covering nose and mouth while coughing and avoiding contacts with sick people can prevent COVID-19 transmission	3029 (84.6)	553 (15.4)
Attitude	Favorable	Unfavorable
I would seek any information related to COVID-19 to help prevent COVID-19 transmission	3471 (96.9)	111 (3.1)
I would wear a face mask even if I feel healthy	3491 (97.4)	91 (2.5)
I would keep distant from people to prevent COVID-19 transmission	3524 (98.3)	58 (1.7)
Routinely wash my hand with soap and water could help in preventing COVID-19 transmission	3548 (99.0)	34 (0.9)
I will immediately seek a doctor if I feel unwell	3541 (98.8)	41 (1.1)
Everyone can be infected by COVID-19	2963 (82.7)	619 (17.3)
I would not travel to the high-risk zone or '*mudik*'[a] to help prevent COVID-19 transmission	3416 (95.4)	166 (4.6)

Table 1 (cont)

Question	Frequency, *n* (%)	
Preventive practices	Favorable	Unfavorable
I wear a face mask	3101 (86.6)*	481 (13.4)*
I wash my hands with soap and water	3162 (88.3)*	420 (11.7)*
I keep distant while speaking with others	3060 (85.4)	522 (14.6)
I change my clothes and take a shower before I meet my family	3050 (85.1)	532 (14.9)
I cover my nose and mouth while coughing	3441 (96.1)	141 (3.9)
I go outside only for the urgent and essential matters	1329 (37.1)*	2253 (62.9)*

[a]an annual mass migration after Ramadhan to celebrating the Ied al-Fitr Festival

*Percentage of good preventive behavior of respondents who answered "always"

while coughing (96%). Nevertheless, few participants (n = 1,329, 37%) kept staying at home and only went out when there were urgent needs (Table 1).

Socio-demographic factors predicting knowledge, attitudes, and practices towards COVID-19

The results of the linear regression analysis, quantifying the effect of socio-demographic factors on KAP scores, are presented in Tables 2-4. Based on the univariate analysis, all variables except region (age group, gender, employment, education, and monthly income) were significantly associated with knowledge (p<0.05) (Table 2). Based on the multivariate analysis, the predictors of level of knowledge were gender and education (p<0.05) (Table 3). Men tended to have a lower knowledge score compared to women (β = -3.58, 95% CI: -4.73 to -2.43). Respondents who only had a primary level of education (β = -20.04, 95% CI: -27.54 to -12.55) and a high school level of education (β = -5.28, 95% CI: -6.90 to -3.66) also had a lower knowledge score compared to those who had a university degree.

In the univariate analysis, all variables except age groups (gender, employment, education, and monthly income) and the knowledge score were significantly associated with attitudes (p<0.05) (Table 3). In the multivariate analysis, the predictors of attitudes were gender, education, monthly income, region, and score of knowledge (p<0.05) (Table 3). Men tended to have a lower attitudes score compared to women (β = -0.07, 95% CI: -0.09 to -0.04). Respondents who only had a primary level of education (β = -0.24, 95% CI: -0.42 to -0.06) had a lower attitudes score compared to those who had a university degree.

Respondents who had monthly income less than Indonesian Rupiah (IDR) 2 million tended to have lower attitudes compared to people who had more than IDR 10 million (β = -0.09, 95% CI: -0.15 to -0.03). Respondents who had monthly income of IDR 2-5 million also tended to have a lower attitudes score compared to people who had more than IDR 10 million (β = -0.08, 95% CI: -0.14 to -0.02). Respondents who lived in western Indonesia tended to have a lower attitudes score compared to people who lived in eastern Indonesia (β = -0.06, 95% CI: -0.09 to -0.03). An increase in knowledge score would

Table 2
Estimates of the generalized linear model on the association between knowledge score and sociodemographic factors

Factor	Univariate analysis			Multivariate analysis		
	β	95% CI	p-value	β	95% CI	p-value
Age groups (year)						
15-24	-3.89	-5.758, -2.023	0.0001	-1.843	-3.964, 0.278	0.089
25-44	0.345	-1.240, 1.930	0.67	-0.545	-2.139, 1.048	0.503
>44	1			1		
Gender						
Male	-3.673	-4.808, -2.537	0.0001	-3.582	-4.730, -2.433	0.0001
Female	1			1		
Employment						
Not employed	-2.484	-3.871, -1.097	0.0001	0.202	-1.533, 1.937	0.82
Healthcare workers	2.635	1.343, 3.928	0.0001	1.131	-0.181, 2.444	0.091
Non-healthcare workers	1			1		
Education						
Primary school	-21.397	-28.891, -13.902	0.0001	-20.043	-27.538, -12.548	0.0001
High school	-7.189	-8.553, -5.825	0.0001	-5.278	-6.895, -3.660	0.0001
University degree	1			1		

Table 2 (cont)

Factor	Univariate analysis			Multivariate analysis		
	β	95% CI	p-value	β	95% CI	p-value
Monthly income (in IDR)						
<2,000,000	-4.12	-6.5333, -1.707	<0.01	-2.212	-4.761, 0.336	0.089
2,000,001-5,000,000	-0.604	-3.045, 1.836	0.627	-0.974	-3.402, 1.454	0.432
5,000,001-10,000,000	0.046	-2.582, 2.674	0.927	-0.405	-2.992, 2.181	0.759
>10,000,000	1			1		
Region						
Western Indonesia	0.336	-0.981, 1.653	0.617	NA	NA	NA
Eastern Indonesia	1			NA	NA	NA

β: intercept; CI: confidence interval; IDR: Indonesian Rupiahs; NA: Not applicable (were not included into the multivariate analysis)

Statistically significant when $p<0.05$

Table 3
Estimates of the generalized linear model on the association between attitudes score and sociodemographic factors

Factor	Univariate analysis			Multivariate analysis		
	β	95% CI	p-value	β	95% CI	p-value
Age groups (year)						
15-24	-0.036	-0.081, 0.10	0.128	NA	NA	NA
25-44	0.023	-0.016, 0.062	0.248	NA	NA	NA
>44	1					
Gender						
Male	-0.086	-0.114, -0.058	0.0001	-0.068	-0.096, -0.041	0.0001
Female	1			1		
Employment						
Not employed	-0.034	-0.068, 0.0001	>0.01	-0.06	-0.045, 0.033	0.764
Healthcare workers	0.062	0.031, 0.094	0.0001	0.026	-0.005, 0.058	0.104
Non-healthcare workers	1			1		
Education						
Primary school	-0.392	-0.577, -0.207	0.0001	-0.241	-0.421, -0.061	<0.01
High school	-0.107	-0.141, -0.074	0.0001	-0.33	-0.070, 0.005	>0.01
University degree	1			1		

Table 3 (cont)

Factor	Univariate analysis			Multivariate analysis		
	β	95% CI	p-value	β	95% CI	p-value
Monthly income (in IDR)						
<2,000,000	-0.11	-0.0169, -0.051	0.0001	-0.089	-0.150, -0.029	<0.01
2,000,001-5,000,000	-0.061	-0.121, -0.001	>0.01	-0.08	-0.138, -0.022	<0.01
5,000,001-10,000,000	-0.039	-0.104, 0.025	0.234	-0.052	-0.114, 0.10	0.099
>10,000,000	1			1		
Region						
Western Indonesia	-0.053	-0.086, -0.021	<0.01	-0.059	-0.091, -0.028	0.0001
Eastern Indonesia	1			1		
Knowledge score	0.006	0.006, 0.007	0.0001	0.006	0.005, 0.007	0.0001

β: intercept; CI: confidence interval; IDR: Indonesian Rupiahs; NA: Not applicable (were not included into the multivariate analysis)

Statistically significant when $p<0.05$

increase attitude score by 0.06 (β = -0.06, 95% CI: -0.09 to -0.03).

In the univariate analysis, all variables besides region were associated with practices (Table 4). The multivariate analysis showed that all variables besides region and income remained significant. Younger respondents (aged <25 years old) had a lower score of consistently practicing recommended preventive behavior (β = -2.30, 95% CI: -4.574 to -0.030) than those aged ≥45 years old. The score of preventive measures practice in male was lower than in female (β = -2.25, 95% CI: -3.49 to -1.01). The practices score in unemployed respondents was lower than non-healthcare worker respondents (non-HCWs) (β = -2.11, 95% CI: -3.97 to -0.25).

It is different when we compared the practice score between those who worked as HCWs and non-HCWs. The practice score of HCWs was higher than that of non-HCWs (β = 6.63, 95% CI: 5.22 to 8.03). Respondents who only had a primary level of education had a lower score of practicing preventive behavior compared to respondents who had a university degree (β = -11.82, 95% CI: -19.87 to -3.76). An increase in knowledge score would increase the practices score by 0.07 (β = 0.07, 95% CI: 0.03 to 0.10).

DISCUSSION

To the best of our knowledge, evidence regarding knowledge, attitudes, and practices (KAP) in relation to COVID-19 in Indonesia is limited. To date, there are two studies investigating the KAP towards COVID-19 in Indonesia, targeting different populations (Sari *et al*, 2021; Saefi *et al*, 2020). Unlike previous studies, this study captured a much larger number of respondents and, most importantly, attempted to assess the effect of socio-demographic factors on KAP scores towards COVID-19 among Indonesian adult respondents during the early phase of the pandemic. Our study demonstrates a moderate level of KAP of Indonesian adults regarding COVID-19. We found that KAP scores were influenced by the respondents' socio-demographic backgrounds. Our study could help inform policymakers in designing or evaluating existing health promotion programs in relation to COVID-19 transmission control in Indonesia.

Table 4

Estimates of the generalized linear model on the association between practices score and sociodemographic factors

Factor	Univariate analysis			Multivariate analysis		
	β	95% CI	p-value	β	95% CI	p-value
Age groups (year)						
15-24	-5.982	-8.002, -3.963	0.0001	-2.302	-4.574, -0.030	>0.01
25-44	-0.118	-1.833, 1.597	0.893	-0.405	-2.112, 1.302	0.642
>44	1			1		
Gender						
Male	-2.588	-3.824, -1.351	0.0001	-2.249	-3.485, -1.013	0.0001
Female	1			1		
Employment						
Not employed	-4.206	-5.676, -2.735	0.0001	-2.108	-3.967, -0.250	>0.01
Healthcare workers	7.483	6.113, 8.854	0.0001	6.628	5.222, 8.034	0.0001
Non-healthcare workers	1			1		
Education						
Primary school	-17.004	-25.177, -8.831	0.0001	-11.817	-19.874, -3.760	<0.01
High school	-7.007	-8.494, -5.519	0.0001	-1.6	-3.342, 0.142	0.072
University degree	1			1		

Table 4 (cont)

Factor	Univariate analysis			Multivariate analysis		
	β	95% CI	p-value	β	95% CI	p-value
Monthly income (in IDR)						
<2,000,000	-5.438	-8.047, -2.829	0.0001	-2.598	-5.328, 0.133	0.062
2,000,001-5,000,000	0.043	-2.596, 2.681	0.975	-1.278	-3.878, 1.322	0.335
5,000,001-10,000,000	-0.698	-3.540, 2.143	0.630	-1.661	-4.431, 1.109	0.240
>10,000,000	1			1		
Region						
Western Indonesia	-0.781	-2.211, 0.648	0.284	NA	NA	NA
Eastern Indonesia	1					
Knowledge score	0.118	0.082, 0.153	0.0001	0.007	0.034, 0.105	0.0001

β: intercept; CI: confidence interval; IDR: Indonesian Rupiahs; NA: Not applicable (were not included into the multivariate analysis)

Statistically significant when $p<0.05$

Our study shows that gender and education were significant predictors of the knowledge score. Women had a better knowledge score than men. Our findings are consistent with previous studies in Hubei, China, and in Fukui (Zhong *et al*, 2020; Takahashi *et al*, 2017). As expected, our results confirmed the hypothesis that those who had a higher education background had a better knowledge score than others. This could explain that people with a higher education background might have a better access to information and might be able to selectively capture the information. This result is supported by research in Iran where the majority of the respondents with an academic degree actively responded to conditions in the pandemic, and they were able to selectively capture information from reliable sources (Erfani *et al*, 2020). Similar findings have been reported in China, Bahrain, and Ethiopia (Zhong *et al*, 2020; Abebe and Demissie, 2012). The impact of socio-economic conditions on health included choices for access to healthcare and variations in health-related behaviors (Deaton, 2002). Good education and knowledge might have affected people's attitudes significantly as evidenced in our study. Furthermore, level of income might have partly explained this effect. Better access to information from higher income was also stated by other research (Castro *et al*, 2013; Harapan *et al*, 2018)

Our findings showed that the majority of respondents tended to have good attitudes towards COVID-19 preventive measures, such as the use of masks, washing hands with soap, self-isolation, and not traveling from or to a red zone or not going on a "mudik" trip to celebrate Eid-al-Fitr in their hometown. These findings are in line with studies elsewhere (Azlan *et al*, 2020; Abdelhafiz *et al*, 2020; Roy *et al*, 2020). Our analysis demonstrated that gender, education, income, and knowledge were good predictors of the respondents' attitudes towards COVID-19. Interestingly, our results showed that the participants in western Indonesia had a significantly lower score of attitudes than those in eastern Indonesia. This might be related to high variety in norms, culture, and socio-economic factors that could not be captured in our study. It should be noted that this study was conducted in Indonesia, a country where traditions and religion are considered to be an essential aspect in the community. Individuals' attitudes and perceptions could be influenced by their experience, their acceptance/understanding of

information, and existing traditions and religion (Zambianchi *et al*, 2019).

Our study demonstrates that age, gender, employment, education, and knowledge scores were significant predictors of practices scores among respondents. Older respondents were much better at demonstrating preventive practices compared to younger individuals. This phenomenon might be due to the strong subjective norms in Indonesian culture, which might affect someone's behavior (Yanti *et al*, 2020). A lower practice score in younger respondents might also be due to less adherence to disease prevention measures in the younger respondents, as found by studies in Japan (Uchida *et al*, 2017). A better practice score among women might be affected by their role and sense of responsibility in taking care of their family and household needs (Pujiyanti and Triratnawati, 2011). The present study shows that women were more likely to have better knowledge and practices on COVID-19 than men. It is consistent with a study in Ecuador, which reported that Ecuadorian women had better knowledge and were better at implementing measures in disease prevention than men (Cabezas *et al*, 2013). Most importantly, our study highlights that improved knowledge score was associated with improved practices score. The findings indicated that providing adequate, accurate, and frequent information regarding COVID-19 could potentially help improve the community's awareness and behavior in reducing the risk of COVID-19. Health promotion programs such as school-based interventions may help to improve understanding on disease risks at early ages.

In this study, the majority of the participants demonstrated positive practices in preventing the transmission of COVID-19. This was reflected by most of the respondents doing six out of the seven practices recommended by the World Health Organization. However, there were almost three-quarters of the participants who still went to crowded places for unessential reasons, which might increase the risk of transmission. Further qualitative studies may be needed to explore the underlying factors determining the individual's practice to prevent COVID-19 transmission.

There are many Indonesian traditions and rituals in the community that involve large numbers of people. 'Pengajian' (reading Qur'an (Islam's holy book)), 'arisan' (routine family gathering), and 'mudik' (annual migration

during Eid-al-Fitr festivity) are some of the common mass gathering events among Indonesian society (Bowen, 1989; Muller, 2016). Tradition is the main predisposing aspect of the decision to participate in these mass gathering activities (Azlan *et al*, 2020). Such activities are potential for the transmission of COVID-19 and can challenge the implementation of restriction measures. A similar cultural challenge was also experienced by Malaysia (Azlan *et al*, 2020). These findings indicated that culture-based interventions are needed to improve the effectiveness of social restriction programs.

In our study, based on our multivariate analysis, we found that income was not a significant predictor of KAP scores. It is important to note that although it is not statistically significant, the socioeconomic status is known as an important condition influencing the population's health (ie, determining access to health services, access to information, etc). Our findings provide helpful information that can be used as a basis for improving health promotion programs regarding COVID-19 control in Indonesia. The findings suggest that enhanced promotion strategies need to be more streamlined and directed towards various groups of people (ie, populations with low education and low income) to improve their knowledge. Public health efforts such as intensifying information, education, and communication (IEC) programs and community-based awareness programs by involving sectors beyond health are crucial.

The results of this study need to be carefully interpreted as there are potential limitations that may influence the study. First, in this survey, we used non-probability sampling with the 'convenience sampling' technique in which the questionnaire was sent to the contact numbers available on the research members' contact list. Participation in this research was voluntary. This method has the potential to cause 'selection bias' and 'effect of voluntary participation', which may restrict the generalization of findings (Friedman and Wyatt, 2005).

Second, the findings of this study could not be generalized and reflect the level of KAP of Indonesian people as the sample size of our study (n = 3,582) was inadequate. We had attempted to collect data from as many participants as possible to overcome this issue to maximize the response rate by prolonging the period of survey (14 days) and asking participants

to redistribute invitations/links to their networks.

Third, the online survey also has the potential for social desirability bias. It does not reflect the actual conditions because it was possible for the participants to find out information to answer what was asked in the questionnaire. It was also possible that the participants gave responses to satisfy what was expected to be correct by society rather than to genuinely reflect their values or views. Therefore, a qualitative study is important and can be helpful to further investigate and understand people's perspectives towards COVID-19.

Fourth, this online survey could only capture respondents who were willing to respond, and we could reach those populations on low social level and in rural areas in Indonesia. Thus, the findings presented in this paper may not reflect the actual KAP on low strata. To address this issue and to follow up the findings presented in this paper, we also attempted to conduct telephone-based interviews targeting those individuals on different strata based on the results of the online survey. The results of qualitative study will be reported in a separate paper.

Lastly, this is a cross-sectional survey, which could only measure the views of participants at a particular time. This study provides information on KAP among people during the early pandemic. The level of KAP may change over time across regions due to interventions. Future studies may be needed to re-evaluate the KAP following the implementation of interventions (*eg,* social restrictions and public health awareness programs).

In summary, our study demonstrates satisfactory levels of knowledge, attitudes, and practices of Indonesian adults towards COVID-19 during the early phase of the pandemic. Further, the study demonstrates that socio-demographic factors could determine KAP scores regarding COVID-19. Enhanced information, education, and communication (IEC) programs and inter-sectorial collaborations targeting populations with low education backgrounds are essential. Younger populations and women can be actively involved in promoting public awareness towards COVID-19.

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CONFLICT OF INTEREST DISCLOSURE

The authors declared no conflict of interest.

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