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Factors associated with high compliance behaviour against COVID-19 in the early phase of pandemic: a cross-sectional study in 12 Asian countries

Chun En Chua ,[1] Guan Sen Kew,[2] Alla Demutska,[3] Sabrina Quek,[4] Evelyn Xiu Ling Loo,[5] Hao Gui,[6] Scott Wong,[7] Hui Xing Lau,[8] En Xian Sarah Low,[7] Tze Liang Loh,[9] Shien Lung Ooi,[10] Emily C W Hung,[11] M Masudur Rahman,[12] Uday C Ghoshal ,[13] Hei Wong,[14] Cynthia K Y Cheung,[15] Ari F Syam,[16] Niandi Tan,[17] Yinglian Xiao,[18] Jin-Song Liu,[19] Fang Lu,[20] Chien-Lin Chen,[20] Yeong Yeh Lee ,[21] Ruter M Maralit,[22] Yong-Sung Kim,[23] Tadayuki Oshima,[24] Hiroto Miwa,[24] Junxiong Pang ,[6] Kewin Tien Ho Siah[2]

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CEC and GSK are joint first authors.
JP and KTHS are joint senior authors.

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For numbered affiliations see end of article.

Correspondence to
Dr Junxiong Pang;
ephpjv@nus.edu.sg

ABSTRACT

Introduction Regardless of having effective vaccines against COVID-19, containment measures such as enhanced physical distancing and good practice of personal hygiene remain the mainstay of controlling the COVID-19 pandemic. Countries across Asia have imposed these containment measures to varying extents. However, residents in different countries would have a differing degree of compliance to these containment measures potentially due to differences in the level of awareness and motivation in the early phase of pandemic.

Objectives In our study, we aimed to describe and correlate the level of knowledge and attitude with the level of compliance with personal hygiene and physical distancing practices among Asian countries in the early phase of pandemic.

Methods A multinational cross-sectional study was carried out using electronic surveys between May and June 2020 across 14 geographical areas. Subjects aged 21 years and above were invited to participate through social media, word of mouth and electronic mail.

Results Among the 2574 responses obtained, 762 (29.6%) participants were from East Asia and 1812 (70.4%) were from Southeast Asia (SEA). A greater proportion of participants from SEA will practise physical distancing as long as it takes (72.8% vs 60.6%). Having safe distancing practices such as standing more than 1 or 2 m apart (AdjOR 5.09 95% CI (1.08 to 24.01)) or more than 3 or 4 m apart (AdjOR 7.05 95% CI (1.32 to 37.67)), wearing a mask when they had influenza-like symptoms before the COVID-19 pandemic, preferring online news channels such as online news websites/applications (AdjOR 1.73 95% CI (1.21 to 2.49)) and social media (AdjOR 1.68 95% CI (1.13 to 2.50) as sources of obtaining information about COVID-19 and high psychological well-being (AdjOR 1.39 95% CI (1.04 to 1.87)) were independent factors associated with high compliance.

Conclusions We found factors associated with high compliance behaviour against COVID-19 in the early phase of pandemic and it will be useful to consider them in risk assessment, communication and pandemic preparedness.

Strengths and limitations of this study

- ► This study addresses the gap in literature by using a multinational cross-sectional survey to provide in-depth exploration of general public's knowledge, attitude and practice (KAP) of personal hygiene and physical distancing in East Asia and Southeast Asia.
- ► Quantitative analysis reveals key factors associated with high compliance to provide policy makers useful information on the KAP of COVID-19 containment measures to guide public health policies.
- ► KAP instrument used in this study could have a more thorough assessment of its instrument validity and reliability to be more robust.
- ► Although this cross-sectional study design can only demonstrate associations between patterns and social-demographic variables, it can guide future cohort study to demonstrate causations.

INTRODUCTION

The novel COVID-19 was first reported in December 2019 and has currently more than 166 million reported cases globally with over 3.4 million deaths as of 24 May 2021.[1] While mRNA-1273 vaccine showed 94.1% efficacy at preventing COVID-19 illness[2] and vaccination reduced the overall attack rate to 4.6% from 9.0% without vaccination over 300 days,[3] the virus that causes COVID-19, SARS-CoV-2, may well mutate; the eventual vaccine may provide only partial protection; and, notably, vaccine hesitancy may preclude large-scale uptake and the development of herd immunity.[4] Moreover, this impact can only be

achieved in the context of continued preventative strategies for all individuals in the community recommended by the WHO. These strategies include high compliance with good personal hand hygiene, wearing of face masks, physical distancing of at least 1 m between individuals and staying at home.[5]

Several countries in Asia like China, Indonesia, Singapore and Malaysia took strict measures by imposing lockdown measures.[6] Malaysia implemented a movement control order (MCO) from March to June 2020,[7] and Singapore had a circuit breaker from April to June 2020[8] to shut workplaces, schools and other social interaction. However, lifting of lockdown measures has differing effectiveness among Asian countries—Malaysia saw a spike in cases and reimplemented MCO in 13 January 2021 which extended to 18 February 2021,[9] while Singapore's cases remained low.[10]

Pandemics have ravaged the world since time immemorial, and many studies have looked at the correlation of how knowledge, attitude and practice (KAP) of the public to preventative measure are correlated to compliance with precautionary measures in infectious disease.[10–12] Several existing literatures have also demonstrated that KAP of COVID-19 are significantly associated with protective behaviour which can play a major role in the prevention and control of infectious diseases in countries such as Malaysia,[13] Hong Kong[14] and China.[12] However, this is the first multinational quantitative cross-sectional survey to assess the KAP of personal hygiene and physical distancing among Asian countries. We aim to evaluate the factors that are associated with high compliance to personal hygiene and physical distancing. In our study, compliance was divided into high and low categories where an arbitrary cut-off scores of above 75th percentile based on the practice questions were classified as high. A cut-off score of above 75th percentile was chosen instead of 50th percentile so as to have a more conservative estimate of compliance.

We also aim to compare the differences in KAP between Southeast Asia (SEA) and East Asia (EA) which are economically and culturally different at baseline. For example, in Hong Kong, Japan and South Korea, the habit of mask wearing by people with respiratory conditions was already widespread before the pandemic. After months of counselling the public against wearing face coverings unless they were unwell, Singapore's Government made it mandatory for everyone to wear one outside from April 2020, and provided reusable cloth masks to the entire population.[15]

Non-pharmaceutical measures are useful in curbing the epidemic peak of COVID-19,[12–14] and we hypothesise that its sustainability even after the development of vaccines requires good KAP on these measures. For improvement of strategy effectiveness, it is important to survey public knowledge, perceptions and behaviours to identify the barriers and gaps to guide existing studies[4] on public health initiatives to encourage compliance with non-pharmaceutical measures as the response to COVID-19 has underscored the need for governments to improve their outbreak preparedness and response.

METHODOLOGY

Study design and recruitment

This was a cross-sectional multinational study conducted in Asia from May to June 2020 and subjects aged 21 years and above were invited to participate in an anonymised survey through social media platforms such as Facebook ads, Instagram and WhatsApp, as well as through word of mouth and electronic mail.

The selection of study sample was done through convenience sampling with demographics compared with the World Bank data to assess if the cohort was representative. The larger the target sample size, the higher the external validity and the greater the generalisability of the study. This study aimed to maximise reach and gather data from as many respondents as possible through the platforms.

Patient and public involvement statement

Patients or the public were involved in the design, or conduct, or reporting or dissemination plans of our research.

Study instrument

The secured survey was conducted via mySurvey, an online survey platform hosted by the National University of Singapore (Verint Systems, New York, USA). The survey link is https://mysurvey.nus.edu.sg/EFM/se/543BE5C2182BB4F7 (online supplemental file 1). The initial questionnaire was developed in the English language. Translation to other languages was performed by Google Translate with review by native speakers of the language (including Simplified and Traditional Chinese, Indonesian Bahasa, Malay, Bengali and Korean). It was subsequently translated back to English for review by the local questionnaire development team to resolve any discrepancies in language. Our questionnaire was grouped into four main sections: (1) demographics, (2) KAP on personal hygiene; (3) KAP on physical distancing and (4) the biopsychosocial impact on participants.

Questions on a five-point Likert scale (never, seldom, 50% of the time, most of the time, always) were designed to assess how often participants were compliant to good personal hygiene and physical distancing practice. To assess the psychological impact of COVID-19, the Mental Health Continuum—Short Form (MHC-SF)[16] was used. The MHC-SF is a 14-item questionnaire that assesses three components (ie, emotional, social and psychological) of well-being and can also be used to classify participants as flourishing and not-flourishing.[17] For each question, participants were asked to rate their feelings in the past month on a six-point Likert scale (never, once or twice a month, about once a week, two or three times a week, almost every day, every day). This assessment tool has been validated in many different countries such as Italy, South Korea and South Africa.[18–20]

The study is aligned with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines. The checklist can be found in online supplemental file 2.

Statistical analysis

Statistical analysis was performed using SPSS V.26 (IBM SPSS Statistics). Differences in responses to the questionnaire between the two regions were assessed using χ^2 test for questions with categorical outcomes and univariate analysis for questions with continuous outcomes. Bonferroni correction was applied. Subjects' compliance was divided into high and low categories, where scores above 75th percentile were classified as high. Subjects' compliance with physical distancing measures were derived from the questions 'How often do you wash your hands with soap or alcohol-based disinfectant a day?', 'Do you wash your hands before and after handling food?', 'Do you cover your mouth when you sneeze or cough?', 'Do you wear a mask in public?', 'Do you AVOID touching your eyes nose and mouth during COVID-19 pandemic?', 'Do you avoid shaking hands?', 'Do you wipe surfaces and objects with disinfectant regularly?' and 'Do you avoid standing or sitting close to people?', where subjects who responded to all of the questions with hand washing for five to six times per day or seven or more times per day and most of the time or always for the other questions were classified as having high compliance, while the rest of the participants were classified as having low compliance. Univariate and multivariate logistic regression (including factors that were significant in univariate analysis) was carried out. The statistical significance level was set at p<0.05.

Reliability analysis (online supplemental file 1; figure 1 and 2) was conducted by assessing Cronbach's alpha coefficient with recommended cut-off α>=0.7 to assess internal consistency. A three-factor confirmatory factor analysis (CFA) was conducted for the questions under MHC-SF using the software: R, lavaan package with Raykov's rho using recommended cut-off ω>=0.7. Fit measurement indices and recommended cut-off values: χ^2—cut-off: p>0.05; standard root mean square—cut-off: <=0.08; root mean square error of approximation—cut-off: <=0.08 (90% CI); Comparative Fit Index (CFI)—cut-off: >=0.95. Exploratory factor analysis which involves the following was conducted with software: R, psych package: Bartlett test and Kaiser-Meyer-Olkin (KMO) test to check if the factor analysis is appropriate; Scree plot and parallel analysis to identify the number of factors; factor analysis with minimum residual method as well as oblique rotation allowing for covariance between factors; filter items whose loading larger than 0.4 and no cross-loading.

Ethics

As no individual identifiable information was obtained during the questionnaire, confidentiality and anonymity were maintained. The National Healthcare Group Domain Specific Review Board reference number for this study is 2020/00470.

RESULTS

Comparison of demographic variables between participants from EA and SEA

Among the 2574 responses obtained, 762 (29.6%) participants were from EA (China, Hong Kong, Taiwan, South Korea, Macau and Japan) and 1812 (70.4%) were from SEA (Singapore, Indonesia, Brunei, Cambodia, Myanmar, Philippines, Thailand, Vietnam and Malaysia). The proportion of older participants above 50 years old, as well as male participants were significantly higher for EA as compared with SEA (23.4% vs 19.2%;47.5% vs 32.7%, respectively, p<0.01). EA population was dominated by the Chinese (75.6%) and Korean (21.5%), while the SEA population was dominated by the Chinese (51.5%) and Malay (25.4%, p<0.01) (table 1).

In table 1, most participants from EA were currently based in Hong Kong (37.4%), Taiwan (23.1%) and South Korea (21.7%), while participants from SEA were based in Indonesia (25.4%), Malaysia (18.0%) and Singapore (54.8%, p<0.01). There was a higher proportion of countries with upper-middle income in EA compared with SEA (39.1% vs 18.2%, p<0.01). Similarly, a greater proportion of participants from EA had household incomes of more than US$10 000 (42.4% vs 23.0%, p<0.01) and stayed in private apartment or condominium (43.4% vs 20.6%, p<0.01) compared with SEA. Family sizes were significantly smaller (1–4 members) in EA as compared with SEA (79.7% vs 62.5%, p<0.01).

A higher proportion of participants from the SEA had tertiary education compared with those from EA (80.2% vs 70.6%, p<0.01). A greater proportion of employees from SEA were healthcare workers (52.0% vs 43.0%, p<0.01) and had to interact physically with people (68.6 vs 59.1%, p<0.01) than those from EA. There was a higher proportion of participants diagnosed with COVID-19 (1.9% vs 0.7%, p=0.034) and had friends or family members with COVID-19 in SEA than in EA (10.0% vs 4.7%, p<0.01, respectively).

There were no significant differences between participants from EA and SEA in employment status (74.5% vs 74.2%), working from home arrangements (36.9% vs 37.1%), having older people or children at home (47.0% vs 44.9%) and having a serious medical condition (12.1% vs 12.6%).

Overall reliability, exploratory and confirmatory factor analysis

The overall reliability for the questions under MHC-SF was Cronbach's alpha (α)=0.94, which illustrates great overall internal consistency. From the three-factor CFA for MHC-SF, all the α,ω>=0.7, which shows high internal consistency in every single construct (online supplemental figures 1, 2 and table 1). The overall reliability for the questions under personal hygiene and physical distancing showed α=0.74, which illustrated acceptable

Table 1 Demographic variables and responses to the survey questions on knowledge, attitude and practice of personal hygiene and physical distancing during COVID-19

Question	East Asia (n=762)	Southeast Asia (n=1812)	P value
Demographics			
Age group			<0.01
21–30	123 (16.1)	638 (35.2)	
31–40	236 (31.0)	506 (27.9)	
41–50	225 (29.5)	321 (17.7)	
>50	178 (23.4)	347 (19.2)	
Gender			<0.01
Male	362 (47.5)	593 (32.7)	
Female	400 (52.5)	1219 (67.3)	
Race			<0.01
Bengali	0 (0)	10 (0.6)	
Caucasian	3 (0.4)	24 (1.3)	
Chinese	576 (75.6)	934 (51.5)	
Filipino	0 (0)	46 (2.5)	
Indian	0 (0)	130 (7.2)	
Japanese	5 (0.7)	1 (0.1)	
Korean	164 (21.5)	9 (0.5)	
Malay	1 (0.1)	460 (25.4)	
Others	13 (1.7)	198 (10.9)	
Country you are currently based in			<0.01
Brunei Darussalam	0 (0.0)	1 (0.1)	
Cambodia	0 (0.0)	9 (0.5)	
China	122 (16.0)	0 (0.0)	
Hong Kong	285 (37.4)	0 (0.0)	
Indonesia	0 (0.0)	460 (25.4)	
Japan	10 (1.3)	0 (0.0)	
Macau	4 (0.5)	0 (0.0)	
Malaysia	0 (0.0)	326 (18.0)	
Myanmar	0 (0.0)	18 (1.0)	
Philippines	0 (0.0)	1 (0.1)	
Singapore	0 (0.0)	993 (54.8)	
South Korea	165 (21.7)	0 (0.0)	
Taiwan	176 (23.1)	0 (0.0)	
Thailand	0 (0.0)	3 (0.2)	
Vietnam	0 (0.0)	1 (0.1)	
Economic region			<0.01
High	454 (59.6)	994 (54.9)	
Upper-middle	298 (39.1)	329 (18.2)	
Middle/Low	10 (1.3)	489 (27.0)	
What is your highest education level?			<0.01
No formal education/Primary school	2 (0.3)	7 (0.4)	
Secondary school	63 (8.3)	174 (9.6)	
Pre-university	159 (20.9)	177 (9.8)	
Tertiary—undergraduate/postgraduate degree	538 (70.6)	1454 (80.2)	
Employment			1.0
Full-time	568 (74.5)	1345 (74.2)	
Part-time	39 (5.1)	108 (6.0)	
Not working	155 (20.3)	359 (19.8)	

Continued

Table 1 Continued

Question	East Asia (n=762)	Southeast Asia (n=1812)	P value
Sector employed under			<0.01
Accommodation	5 (0.8)	5 (0.3)	
Administrative and support service activities	46 (7.4)	157 (10.7)	
Art, entertainment and recreation	9 (1.4)	19 (1.3)	
Engineering	51 (8.2)	56 (3.8)	
Financial and insurance services	40 (6.4)	77 (5.3)	
Food services	13 (2.1)	19 (1.3)	
Health services	267 (43.0)	760 (52.0)	
Information and communication	27 (4.3)	53 (3.6)	
Other community, social and personal services	23 (3.7)	64 (4.4)	
Professional services	78 (12.6)	164 (11.2)	
Real estate activities	6 (1.0)	8 (0.5)	
Retail trade	12 (1.9)	17 (1.2)	
Transportation and storage	7 (1.1)	19 (1.3)	
Utilities and other good-producing industries	21 (3.4)	30 (2.1)	
Wholesale trade	16 (2.6)	14 (1.0)	
Work from home			1.0
Yes	229 (36.9)	542 (37.1)	
No	392 (63.1)	920 (62.9)	
Healthcare worker			<0.01
Yes	267 (43.0)	760 (52.0)	
No	354 (57.0)	702 (48.0)	
Housing			<0.01
Government housing with 2 or 3 rooms	77 (10.1)	301 (16.6)	
Government housing with more than 3 rooms	55 (7.2)	414 (22.8)	
Dormitory/Nursing home	39 (5.1)	55 (3.0)	
Private apartment or condominium	331 (43.4)	374 (20.6)	
Private landed property	260 (34.1)	668 (36.9)	
Does your job require you to have physical interactions with many people?			<0.01
Yes	450 (59.1)	1243 (68.6)	
No	312 (40.9)	569 (31.4)	
Annual household income per capita in US$ (total household income/number of people in the household)			<0.01
Less than $1000	45 (5.9)	331 (18.3)	
$1000–$2000	89 (11.7)	257 (14.2)	
$2000–$4000	107 (14.0)	355 (19.6)	
$4000–$6000	84 (11.0)	181 (10.0)	
$6000–$8000	44 (5.8)	131 (7.2)	
$8000–$10 000	70 (9.2)	141 (7.8)	
More than $10 000	323 (42.4)	416 (23.0)	
Family			<0.01
Small family (1–4)	607 (79.7)	1132 (62.5)	
Big family (5 or more)	155 (20.3)	680 (37.5)	
Do you have any elderly people >65 years old or young children <12 years old at home?			0.7
Yes	358 (47.0)	814 (44.9)	
No	404 (53.0)	998 (55.1)	
Do you suffer from any serious medical condition?			1.0
Yes	92 (12.1)	228 (12.6)	
No	670 (87.9)	1584 (87.4)	
Have you been diagnosed with COVID-19?			0.034

Continued

Table 1 Continued

Question	East Asia (n=762)	Southeast Asia (n=1812)	P value
Yes	5 (0.7)	35 (1.9)	
No	757 (99.3)	1777 (98.1)	
Do you have any friend or family member who is infected by COVID-19?			<0.01
Yes	36 (4.7)	182 (10.0)	
No	726 (95.3)	1630 (90.0)	
Knowledge of personal hygiene			
COVID-19 CANNOT be transmitted by			<0.01
Door hands and handphone surfaces	12 (1.6)	23 (1.3)	
Mosquito bites	617 (81.0)	1605 (88.6)	
Sneezing and rubbing of eyes	19 (2.5)	94 (5.2)	
Not sure	114 (15.0)	90 (5.0)	
Which medium can kill COVID-19?			0.018
Hand dryers	13 (1.7)	9 (0.5)	
Hot water	6 (0.8)	12 (0.7)	
Soap and alcohol disinfectant	727 (95.4)	1767 (97.5)	
Not sure	16 (2.1)	24 (1.3)	
Attitude of personal hygiene			
I am interested in increasing my knowledge about hygiene measures			0.026
Yes	672 (88.2)	1530 (84.4)	
No	90 (11.8)	282 (15.6)	
Wearing a face mask is important during the COVID-19 pandemic			<0.01
I DO NOT think that wearing a face mask is important	7 (0.9)	20 (1.1)	
Because government ordered me to wear a face mask	2 (0.3)	48 (2.6)	
Because we can protect our self and others from COVID-19	746 (97.9)	1737 (95.9)	
Because my family members asked me to wear a face mask	7 (0.9)	7 (0.4)	
What is your preferred source of obtaining information with regard to COVID-19?			<0.01
Messaging platforms (eg, WhatsApp/SMS/Telegram) from friends	41 (5.4)	246 (13.6)	
Newspaper (hardcopy)	13 (1.7)	46 (2.5)	
Online news websites/apps	381 (50.0)	890 (49.1)	
Social media, for example, Facebook/ Instagram/Twitter	118 (15.5)	394 (21.7)	
TV news	209 (27.4)	236 (13.0)	
Practice of personal hygiene			
How often do you wash your hands with soap or alcohol-based disinfectant a day?			0.3
I do not wash my hand with soap or disinfectant	6 (0.8)	9 (0.5)	
1–2 times/day	61 (8.0)	129 (7.1)	
3–4 times/day	146 (19.2)	346 (19.1)	
5–6 times/day	189 (24.8)	383 (21.1)	
7 or more times/day	360 (47.2)	945 (52.2)	
Do you wash your hands before and after handing food?			<0.01
Never	3 (0.4)	2 (0.1)	
Seldom	15 (2.0)	42 (2.3)	
50% of the time	33 (4.3)	119 (6.6)	
Most of the time	248 (32.5)	467 (25.8)	
Always	463 (60.8)	1182 (65.2)	
Do you cover your mouth when you sneeze or cough?			<0.01
Never	1 (0.1)	6 (0.3)	
Seldom	7 (0.9)	24 (1.3)	
50% of the time	12 (1.6)	90 (5.0)	
Most of the time	207 (27.2)	562 (31.0)	

Continued

Table 1 Continued

Question	East Asia (n=762)	Southeast Asia (n=1812)	P value
Always	535 (70.2)	1130 (62.4)	
Do you wear a mask in public?			<0.01
Never	6 (0.8)	93 (5.1)	
Seldom	23 (3.0)	41 (2.3)	
50% of the time	23 (3.0)	27 (1.5)	
Most of the time	161 (21.1)	193 (10.7)	
Always	549 (72.0)	1458 (80.5)	
Do you usually wear a mask when you have influenza-like symptoms before the COVID-19 pandemic?			<0.01
Never	79 (10.4)	600 (33.1)	
Seldom	198 (26.0)	392 (21.6)	
50% of the time	94 (12.3)	168 (9.3)	
Most of the time	165 (21.7)	247 (13.6)	
Always	226 (29.7)	405 (22.4)	
Do you AVOID touching your eyes nose and mouth during the COVID-19 pandemic?			0.020
Never	15 (2.0)	31 (1.7)	
Seldom	67 (8.8)	173 (9.5)	
50% of the time	99 (13.0)	328 (18.1)	
Most of the time	320 (42.0)	750 (41.4)	
Always	261 (34.3)	530 (29.2)	
Do you avoid shaking hands?			<0.01
Never	13 (1.7)	52 (2.9)	
Seldom	47 (6.2)	91 (5.0)	
50% of the time	49 (6.4)	93 (5.1)	
Most of the time	224 (29.4)	428 (23.6)	
Always	429 (56.3)	1148 (63.4)	
Do you wipe surfaces and objects with disinfectant regularly?			0.012
Never	25 (3.3)	89 (4.9)	
Seldom	144 (18.9)	417 (23.0)	
50% of the time	172 (22.6)	382 (21.1)	
Most of the time	274 (36.0)	546 (30.1)	
Always	147 (19.3)	378 (20.9)	
Knowledge of physical distancing			
How far apart should people stand or sit?			<0.01
>0.5 m	16 (2.1)	12 (0.7)	
>1 or 2 m	722 (94.8)	1755 (96.9)	
>3 or 4 m	24 (3.1)	45 (2.5)	
Attitude of physical distancing			
Do you think that physical distancing measures is important and will help to reduce the spread of COVID-19?			1.0
Yes	747 (98.0)	1781 (98.3)	
No	15 (2.0)	31 (1.7)	
I should stay at home when I am not feeling well			<0.01
Yes	739 (97.0)	1795 (99.1)	
No	23 (3.0)	17 (0.9)	
Which of the following would you consider as main reason for compliance with physical distancing measures?			<0.01
Fear of getting COVID-19	435 (57.1)	912 (50.3)	
Fear of family members getting COVID-19	318 (41.7)	790 (43.6)	
Fear of fines/punitive measures	9 (1.2)	110 (6.1)	
Would you willingly participate in the contact tracing app?			<0.01
Yes	504 (66.1)	1455 (80.3)	

Continued

Table 1 Continued

Question	East Asia (n=762)	Southeast Asia (n=1812)	P value
No	258 (33.9)	357 (19.7)	
For how long are you willing to practice physical distancing behaviour to keep yourself and others safe?			<0.01
As long as it takes	462 (60.6)	1319 (72.8)	
For another 2–3 weeks	59 (7.7)	68 (3.8)	
For another 1 month	81 (10.6)	115 (6.3)	
For another 3 months	85 (11.2)	136 (7.5)	
For another 6 months	51 (6.7)	154 (8.5)	
I want physical distancing to stop now	24 (3.1)	20 (1.1)	
Practice of physical distancing			
Do you avoid standing or sitting close to people?			<0.01
Never	12 (1.6)	20 (1.1)	
Seldom	105 (13.8)	55 (3.0)	
50% of the time	167 (21.9)	166 (9.2)	
Most of the time	350 (45.9)	637 (35.2)	
Always	128 (16.8)	934 (51.5)	
How often do you go out of the house in a week (excluding going out for work)?			<0.01
Never	27 (3.5)	220 (12.1)	
1–2 times	354 (46.5)	968 (53.4)	
3–4 times	190 (24.9)	311 (17.2)	
5–6 times	84 (11.0)	179 (9.9)	
More than 7 times	107 (14.0)	134 (7.4)	
How many people do you meet face-to-face (<1 m) apart everyday (excluding own household)?			<0.01
0–5	401 (52.6)	1273 (70.3)	
6–10	151 (19.8)	199 (11.0)	
>10	210 (27.6)	340 (18.8)	
On average, how many places do you go in a day (excluding home)?			<0.01
0	37 (4.9)	477 (26.3)	
1–2	540 (70.9)	1200 (66.2)	
3–4	150 (19.7)	104 (5.7)	
>5	35 (4.6)	31 (1.7)	
Overall well-being due to COVID-19			
What do you think your probability of getting COVID-19 is in the next 1 month?			<0.01
0%, I will not get infected by COVID-19	277 (36.4)	502 (27.7)	
<25%	396 (52.0)	917 (50.6)	
<50%	77 (10.1)	310 (17.1)	
<75%	9 (1.2)	74 (4.1)	
100%	3 (0.4)	9 (0.5)	
Effects of physical distancing on mental health			<0.01
Not flourishing	505 (66.3)	871 (48.1)	
Flourishing	257 (33.7)	941 (51.9)	
Well-being total scores			<0.01
High	89 (11.7)	478 (26.4)	
Low	673 (88.3)	1334 (73.6)	
Emotional well-being			<0.01
High	73 (9.6)	383 (21.1)	
Low	689 (90.4)	1429 (78.9)	
Social well-being			<0.01
High	70 (9.2)	382 (21.1)	
Low	692 (90.8)	1430 (78.9)	

Continued

Table 1 Continued

Question	East Asia (n=762)	Southeast Asia (n=1812)	P value
Psychological well-being			<0.01
High	122 (16.0)	507 (28.0)	
Low	640 (84.0)	1305 (72.0)	

overall internal consistency. Bartlett (p value <0.001) and KMO (>0.80) tests suggested that the data are suitable for factor analysis. Scree suggested two principal components. From the two-factor CFA for personal hygiene and physical distancing questions, the construct of personal hygiene shows great internal consistency, while the construct of physical distancing has limited internal consistency which may be attributed to the small number of items in the construct (online supplemental figures 1, 2 and table 2).

Knowledge, attitude and practice of personal hygiene

Knowledge

A higher proportion of participants from SEA were aware that COVID-19 could not be transmitted by mosquito bites (88.6% vs 81.0%, p<0.01) and soap and disinfectant can kill COVID-19 (97.5% vs 95.4%, p=0.018) compared with those from EA.

Attitude

A higher proportion of participants from EA was interested in increasing their knowledge about good hygiene measures (88.2% vs 84.4%, p=0.026) and understood that wearing a face mask is important during the COVID-19 pandemic as it can protect themselves and their family (97.9% vs 95.9%, p<0.01) as compared with SEA. A greater proportion of participants from EA preferred obtaining information on COVID-19 from official news channels (newspaper, online news website/apps and TV news) (79.1% vs 64.6%, p<0.01).

Practice

A greater proportion of participants from SEA always washed their hands before and after handling food (65.2% vs 60.8%), wore a mask in public (80.5% vs 72.0%), avoided shaking hands (63.4% vs 56.3%) and wiped surfaces and objects with disinfectant regularly (20.9% vs 19.3%, p<0.05) as compared with subjects from EA. Interestingly, there was a higher proportion of participants from EA who always cover their mouths when sneezing or coughing, wear a mask when they had influenza-like symptoms before the COVID-19 pandemic and avoided touching their eyes, noses and mouths during the COVID-19 pandemic (70.2%, 29.7%, 34.3%, respectively) compared with SEA (62.4%, 22.4%, 29.2%, respectively, p<0.05). There were no significant differences between proportion of participants from EA and SEA who washed their hands with soap or alcohol-based disinfectant frequently (at least seven times per day: 47.2% vs 52.2%).

Knowledge, attitude and practice of physical distancing

Knowledge

A higher proportion of participants from SEA felt that people should stand or sit more than 1 or 2 m apart as compared with those from EA (96.9% vs 94.8%, p<0.01).

Attitudes

A greater proportion of participants from SEA felt that they should stay home when not feeling well, were willing to participate in the contact tracing application and were willing to practise physical distancing as long as it takes (99.1%, 80.3%, 72.8%) as compared with those from EA (97.0%, 66.1%, 60.6%, p<0.01).

There were differences in reasons for compliance between SEA and EA; a higher proportion of participants from EA stated that fear of getting COVID-19 was the main reason for compliance with physical distancing measures (57.1% vs 50.3%), while a higher proportion from SEA stated fear of family members getting COVID-19 as the main reason (43.6% vs 41.7%, p<0.01).

There were no significant differences between the proportion of participants from EA and SEA who believed in the importance of physical distancing measures in reducing the spread of COVID-19 (98.0% vs 98.3%).

Practices

A higher proportion of participants from SEA always avoided standing or sitting close to people compared with EA (51.5% vs 16.8%, p<0.01). Similarly, more subjects from EA went out of the house more than seven times a week (14.0% vs 7.4%), met more than 10 people not from their household face-to-face every day (27.6% vs 18.8%) and went to more than five places except home (4.6% vs 1.7%, p<0.01).

Overall well-being due to COVID-19

In figure 1, a higher proportion of participants from EA felt that they have the lower chance (<25%) of getting infected by COVID-19 (88.4%) than those from SEA (78.3%, p<0.01). A greater proportion of participants from SEA were flourishing (51.9% vs 33.7%, p<0.01) and had better overall well-being (mean±SD: 46.3±14.9 vs 41.1±14.2, p<0.01), emotional (based on happiness, interest in life and satisfaction with life) (10.6±3.6 vs 9.30±3.4, p<0.01), social (based on feelings on social contribution, integration, actualisation and coherence) (15.3±6.2 vs 13.2±5.9, p<0.01) and psychological (based on feelings on self-acceptance, environmental mastery, positive relations with others, personal growth, autonomy

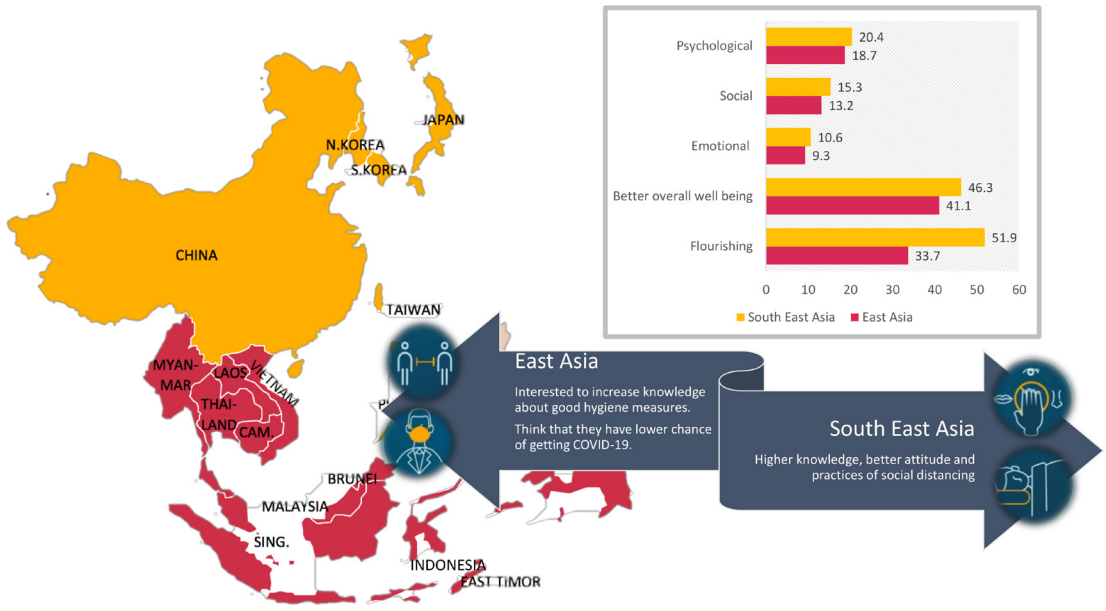

Figure 1 Differences between Southeast Asia and East Asia.

and purpose in life) (20.4±6.8 vs 18.7±6.6, p<0.01) well-being.

Factors associated with compliance

In table 2, participants from EA and SEA were further divided into high compliant and low compliant subgroups. In univariate analysis, being of older age (31–40 years old: OR 1.26 95% CI (1.01 to 1.57); 41–50 years old: OR 1.49 95% CI (1.18 to 1.89); more than 50 years old: OR 1.41 95% CI (1.11 to 1.79)), being a healthcare worker (OR 1.83 95% CI (1.53 to 2.20)) and having a job requiring physical interaction with many people (OR 1.63 95% CI (1.36 to 1.96)) were significantly associated with high compliance (online supplemental table 3). Participants who responded they should stand at least more than 1 or 2 m apart (OR 6.28 95% CI (1.49 to 26.53)) and more than 3 or 4 m apart (OR 8.36 95% CI (1.83 to 38.11)) were significantly associated with high compliance compared with those who responded that will stand <0.5 m apart. Participants who were willing to participate in the contact tracing application (OR 1.45 95% CI (1.19 to 1.78)) and wore masks when they had influenza-like symptoms before the COVID-19 epidemic (seldom: OR 1.37 95% CI (1.04 to 1.81); 50% of the time: OR 2.07 95% CI (1.49 to 2.87); most of the time: OR 3.27 95% CI (2.48 to 4.32); always: OR 5.33 95% CI (4.14 to 6.85)) were significantly associated with high compliance. Participants who preferred official news channels such as online news websites/applications (OR 1.37 95% CI (1.03 to 1.82)) or TV news (OR 1.40 95% CI (1.01 to 1.94)) were significantly associated with high compliance. Participants who had high emotional (OR 2.36 95% CI (1.95 to 2.86)), social (OR 2.20 95% CI (1.79 to 2.70)) and psychological well-being (OR 2.12 95% CI (1.72 to 2.61)) were significantly associated with high compliance. Better attitudes towards personal hygiene and physical distancing were positively correlated with high compliance (R=0.06 and 0.13, respectively, p<0.01). There were no associations between geographical location and high compliance.

Barriers associated with low compliance

Male gender (OR 0.58 95% CI (0.48 to 0.69)), being of Korean ancestry (OR 0.26 95% CI (0.07 to 0.96)) and staying in government housing with more than three rooms (OR 0.74 95% CI (0.55 to 0.98)) were significantly associated with poor compliance. Lack of knowledge on the potential severity of COVID-19 such as fear of fines or punitive measures as the main reason for compliance with physical distancing measures (OR 0.43 95% CI (0.27 to 0.69)) as compared with the fear of getting COVID-19 were significantly associated with poor compliance. As compared with those who will practise physical distancing for as long as necessary, subjects who were willing to practise physical distancing behaviour for another 2–3 weeks (OR 0.52 95% CI (0.34 to 0.81)) or another month (OR 0.67 95% CI (0.48 to 0.93)) or wanted physical distancing to stop (OR 0.14 95% CI (0.04 to 0.44)) were significantly associated with poor compliance. With reference to those who never went out of the house in a week except for work, subjects who went out three to four times (OR 0.60 95% CI (0.43 to 0.83)), five to six times (OR 0.61 95% CI (0.42 to 0.89)) and seven or more times (OR 0.68 95% CI (0.46 to 0.99)) were significantly associated with poor compliance. Subjects who went to three to four places in a day (OR 0.66 95% CI (0.47 to 0.92)) as compared with staying at home were significantly associated with poor compliance. Subjects who believed their probability of getting COVID-19 in the next 1 month was less than 25% (OR 0.70 95% CI (0.58 to 0.84)) and less than 50% (OR 0.76 95% CI (0.59 to 0.98)) as compared with 0% were significantly associated with poor compliance.

Table 2 Multivariate analysis of factors associated with high level of compliance

Question	OR (95% CI)	P value
Age group		
21–30 (ref)		
31–40	1.27 (0.97 to 1.68)	0.1
41–50	1.79 (1.31 to 2.43)	<0.001
>50	1.68 (1.19 to 2.37)	<0.01
Male gender (ref: female)	0.61 (0.49 to 0.77)	<0.001
Race		
Bengali (ref)		
Caucasian	0.65 (0.08 to 5.08)	0.7
Chinese	0.84 (0.15 to 4.69)	0.8
Filipino	2.24 (0.35 to 14.35)	0.4
Indian	1.01 (0.18 to 5.81)	1.0
Japanese	0.29 (0.02 to 5.11)	0.4
Korean	0.50 (0.08 to 3.03)	0.5
Malay	1.02 (0.18 to 5.69)	1.0
Others	0.76 (0.14 to 4.31)	0.8
Southeast Asia (ref: East Asia)	0.84 (0.61 to 1.14)	0.3
Healthcare worker (ref: no)	1.59 (1.27 to 1.99)	<0.001
Housing		
Government housing with 2 or 3 rooms (ref)		
Government housing with more than 3 rooms	0.98 (0.69 to 1.41)	0.9
Dormitory/Nursing home	0.76 (0.38 to 1.50)	0.4
Private apartment or condominium	1.02 (0.73 to 1.43)	0.9
Private landed property	1.08 (0.78 to 1.51)	0.6
Does your job require you to have physical interactions with many people? (ref: no)	1.22 (0.94 to 1.57)	0.1
What is your preferred source of obtaining information with regard to COVID-19?		
Messaging platforms (eg, WhatsApp/SMS/Telegram) from friends (ref)		
Newspaper (hardcopy)	1.25 (0.55 to 2.87)	0.6
Online news websites/apps	1.73 (1.21 to 2.49)	<0.01
Social media, for example, Facebook/Instagram/Twitter	1.68 (1.13 to 2.50)	0.01
TV news	1.33 (0.88 to 2.02)	0.2
Do you usually wear a mask when you have influenza-like symptoms before the COVID-19 pandemic?		
Never (ref)		
Seldom	1.50 (1.09 to 2.07)	0.014
50% of the time	1.99 (1.35 to 2.94)	<0.001
Most of the time	3.32 (2.35 to 4.68)	<0.001
Always	5.09 (3.71 to 6.98)	<0.001
How far apart should people stand or sit?		
>0.5 m (ref)		
>1 or 2 m	5.09 (1.08 to 24.01)	0.040
>3 or 4 m	7.05 (1.32 to 37.67)	0.022
Which of the following would you consider as main reason for compliance with physical distancing measures?		
Fear of getting COVID-19 (ref)		
Fear of family members getting COVID-19	0.95 (0.77 to 1.18)	0.6
Fear of fines/punitive measures	0.85 (0.48 to 1.53)	0.6
Would you willingly participate in the contact tracing app? (ref: no)	1.12 (0.87 to 1.44)	0.4

Continued

Table 2 Continued

Question	OR (95% CI)	P value
For how long are you willing to practice physical distancing behaviour to keep yourself and others safe?		
As long as it takes (ref)		
For another 2–3 weeks	0.62 (0.37 to 1.03)	0.1
For another 1 month	0.75 (0.50 to 1.12)	0.2
For another 3 months	0.84 (0.58 to 1.21)	0.3
For another 6 months	0.79 (0.54 to 1.16)	0.2
I want physical distancing to stop now	0.15 (0.04 to 0.53)	<0.01
How often do you go out of the house in a week (excluding going out for work)?		
Never (ref)		
1–2 times	0.73 (0.50 to 1.07)	0.1
3–4 times	0.61 (0.39 to 0.94)	0.025
5–6 times	0.48 (0.29 to 0.78)	<0.01
More than 7 times	0.59 (0.35 to 0.99)	0.048
On average, how many places do you go in a day (excluding home)?		
0 (ref)		
1–2	0.93 (0.69 to 1.26)	0.7
3–4	0.65 (0.41 to 1.03)	0.1
>5	1.28 (0.64 to 2.60)	0.5
What do you think your probability of getting COVID-19 is in the next 1 month?		
0%, I will not get infected by COVID-19 (ref)		
<25%	0.88 (0.69 to 1.13)	0.3
<50%	0.80 (0.58 to 1.10)	0.2
<75%	0.86 (0.50 to 1.50)	0.6
100%	0.81 (0.16 to 4.13)	0.8
Emotional well-being (ref: low)	1.54 (1.12 to 2.12)	<0.01
Social well-being (ref: low)	1.22 (0.88 to 1.69)	0.2
Psychological well-being (ref: low)	1.39 (1.04 to 1.87)	0.026

Independent risk factors associated with compliance

Being older than 40 years old (41–50 years old: AdjOR 1.79 95% CI (1.31 to 2.43); more than 50 years old: AdjOR 1.68 95% CI (1.19 to 2.37)), being in a healthcare occupation (AdjOR 1.59 95% CI (1.27 to 1.99)), having safe distancing practices such as standing more than 1 or 2 m apart (AdjOR 5.09 95% CI (1.08 to 24.01)) or more than 3 or 4 m apart (AdjOR 7.05 95% CI (1.32 to 37.67)), wearing a mask when they had influenza-like symptoms before the COVID-19 pandemic, preferring online news channels such as online news websites/applications (AdjOR 1.73 95% CI (1.21 to 2.49)) and social media (AdjOR 1.68 95% CI (1.13 to 2.50)) as sources of obtaining information about COVID-19 and high emotional (AdjOR 1.54 95% CI (1.12 to 2.12)) and psychological well-being (AdjOR 1.39 95% CI (1.04 to 1.87)) were independent factors associated with high compliance (table 2).

On the other hand, being of male gender (AdjOR 0.61 95% CI (0.49 to 0.77)), unwillingness to continue with physical distancing (AdjOR 0.15 95% CI (0.04 to 0.53)), going out of the houses frequently (three to four times: AdjOR 0.61 95% CI (0.39 to 0.94); five to six times: AdjOR 0.48 95% CI (0.29 to 0.78); more than seven times: AdjOR 0.59 95% CI (0.35 to 0.99)) were significantly associated with poor compliance. There were no associations between geographical location and compliance.

DISCUSSION

Four countries in Asia took strict measures by imposing lockdown restrictions.[21] During our survey period in May–June 2020, lockdowns were imposed such as Singapore had a circuit breaker and Malaysia had an MCO. On the other hand, South Korea and China started to ease their restrictions in this period. In order to effectively manage the spread and social effects of this pandemic, it is imperative to understand the factors associated with high and low compliance behaviours to ease progressive exit from lockdown.[22]

Differences in KAP between EA and SEA

Findings (online supplemental table 4) from this study indicate that subjects from both SEA and EA are highly knowledgeable in personal hygiene and physical

distancing measures. However, a greater proportion of subjects from SEA felt that they should stay at home when they are not feeling well, are more willing to participate in the contact tracing application and to practise physical distancing as long as it takes. We postulate that this could be because subjects from EA felt they had a lower chance of getting infected by COVID-19 during the survey period. The positive impact of transparency, a better healthcare system, as well as the respective government's handling of the pandemic in its initial months may have built EA's community confidence in having a lower chance of getting infected by COVID-19. South Korea, Japan, Taiwan and Hong Kong were ranked in the top 10 world's most efficient healthcare systems.[23] During the study period from May to June 2020, new COVID-19 cases in EA were on a declining rate and were already past the peak which occurred between February and March 2020. This was in stark contrast with countries in SEA such as Singapore, which registered record-high COVID-19 cases between late April and May as a result of the spread of COVID-19 among its migrant worker population. Similarly, in other SEA countries such as Indonesia, there was also a rising COVID-19 infection rate during the survey study period, with more than a thousand COVID-19 cases a day on most days in June. The worsening pandemic situation in SEA resulted in subjects being more fearful of COVID-19 and hence more willing to participate in measures to reduce the risk of COVID-19.

Association of well-beings with compliance behaviour in Asia

Psychological well-being was associated with high compliance in the current study. Unlike emotional well-being, referring to feelings of happiness and life satisfaction, psychological well-being refers to self-realisation.[24] Interestingly, social well-being, referring to the functioning of the individual within the society, was not a significant factor of compliance. This could possibly suggest that being compliant is more related to feelings of fulfilment and purpose than to community functioning. Previous studies have shown that good health behaviours have been related to positive affect and well-being, similar to the current study. For example, in a Korean study, negative affect from academic stress contributed to poor health behaviours such as drinking alcohol and smoking.[25] Recent reviews confirm that well-being and positive affect can increase health promotive and illness preventative behaviours.[26 27] A study across 24 countries in Asia, Africa and America among university students showed that happiness was positively linked to health behaviours such as physical activity.[24] Higher happiness was associated with lower stress, a healthy diet and exercise in middle-aged Korean adults.[28] A 2008 longitudinal study showed that psychological well-being predicted health behaviours, such as eating fruits and vegetables, independent of depressive symptoms.[29] The mechanisms of this should be understood and explored more, but possible suggestions include a boost in self-efficacy, energy, will power and self-control.[27 29] The above results highlight the importance of investigating well-being and adaptive functioning independently of measuring psychopathology in health promotion and compliance.

Factors and barriers to compliance behaviour

Findings from our study revealed that older age, being in a healthcare occupation and preferring online news and social media as sources of COVID-19 information were significantly associated with high compliance behaviour. Several studies conducted in other Asian countries have indicated high levels of COVID-19 knowledge among the general population and healthcare workers.[13 30] In one study, Malaysians above the age of 50 had higher knowledge scores compared with other age groups in Malaysia, possibly due to a higher risk perception of infection and complications from the disease.[13] High COVID-19 knowledge scores were significantly associated with a lower likelihood of negative attitudes and potentially dangerous practices towards COVID-19.[30]

It is also postulated that people who use online news have more initiatives to find out more about COVID-19 and hence higher compliance. A case study revealed that Taiwan's novel collaboration between the public and government in the development of online tools for mask rationing with more than 2 million users helped flatten its COVID-19 curve. The rationing system and the searching tools fully met their expectations until late April when the government was able to produce ample numbers of masks domestically.[31]

Movement tracking applications keep track of the people whom an individual comes into contact with on a daily basis and could prove useful in contact tracing when one gets infected with COVID-19. Although our findings showed that the majority (66.1% in EA and 80.3% in SEA) were willing to download a contact tracing application, the reality might be different. In Singapore, a movement tracking mobile phone application called 'TraceTogether' was initially only used by one-fifth of the Singaporean population, rendering its implementation ineffective.[32] However, the adoption of the TraceTogether app and tokens stand at more than 60% by December 2020 after widespread distribution of the tokens to its residents and reassurance that their data are stored in the device and will not be shared unless there is an infection. Adoption could also have increased because the app or token is now required to enter more places, such as cinemas. There is a need for future research to identify other successful interventions to encourage more people to use tracing application, and data privacy being one potential barrier.[33]

In our study, men were found to be less compliant with physical distancing measures. This was also consistent with the Chinese H1N1 KAP study,[11] which found that men were more likely to go to crowded places and not wear masks outside their homes. Based on previous studies,[34–36] men were also found to be more likely to engage in risk-taking behaviours.

Public health recommendations

As psychological well-being is associated with high compliance in our study, to possibly increase the impact of public health policy and intervention, psychological well-being should be addressed in risk communication and assessment of the pandemic. Pandemic preparedness planning should also include components to increase psychological well-being towards public health measures such as vaccine uptake. In a Chinese study, good COVID-19 knowledge was associated with optimistic attitudes and appropriate practices towards COVID-19.[30] This is important in people who come from the lower-income group or have lower educational level as they tend to be less motivated to know about the disease and prevention measures, and they may not have access to accurate information, high quality of medical care and housing. For example, Singapore's migrant worker outbreak, due to lack of physical distancing in poorly ventilated dormitories, highlights the vulnerability and burden of this highly susceptible subpopulation during this crisis.[37] Additionally, it was reported that there was a spate of suicides and attempted suicides involving migrant workers living at the dormitories due to uncertainties over their health, jobs and prolonged confinement.[38] Hence, risk communication plays an important role in compliance with precautionary measures as well as reducing anxiety about the pandemic. Mental health outreach also needs to be expanded to meet the increasing demands.

In our study, we inferred that a high level of discipline would possibly be needed for the sustainability of physical distancing measures. Questions in our questionnaire such as unwillingness to continue with physical distancing and going out houses frequently were significantly associated with poor compliance. Interestingly, in a Chinese study, high level of self-control buffers the association between perceived severity of COVID-19 as a risk factor for mental health problems.[39] The COVID-19 pandemic illustrates uncertainty, shifting circumstances and rapidly changing recommendations. Restrictions on activities often have major economic implications and impingement on civil liberties.[40] Singapore has one of the most restrictive physical distancing policies in the world. The quick adoption of such restrictive policies has been possible due to public trust and confidence in the government's capacity for crisis management such as Multi-Ministry Taskforce in coordinating pandemic efforts and active communication through local news media in a timely manner.[41] Given these collective efforts, the mortality rate in Singapore remains low compared with that of many other nations (as of 3 May 2020, according to the statistics by WHO (2020), the global mortality rate is 6.99%, compared with 0.0989% in Singapore). Hence, building public confidence is paramount so that the public is motivated to have self-discipline to follow government's recommendations, which also reduces anxiety in overall mental health.

To encourage a high level of discipline, public health messaging could focus on males and younger age group. Our study also showed that older age was significantly associated with high compliance behaviour and male gender was found to be less compliant with physical distancing measures. Male is identified as a risk factor for death and intensive care unit admission,[42] which could be associated with gender-based sociocultural and behavioural differences. By tackling gender as an element of social systems and structures through addressing the association of males with risk-taking behaviours in COVID-19 pandemic, health promotion will enhance health and social outcomes.[43] Adolescents and young adults were identified internationally as a group with potentially low compliance rates with public health measures.[44] Growing evidence shows that young people are more likely to get infected with the new variant in Brazil[45] and new outbreaks in Singapore were found in tuition centres and schools.[46] Hence, public campaigns can be targeted at young people to increase their compliance as they are not spared from COVID-19, compared with the older age.

Public health intervention that focuses on social responsibility for behavioural change is also crucial. Questions such as standing more than 1 m apart and wearing a mask when they had influenza-like symptoms before the COVID-19 pandemic were significantly associated with high compliance. Solidarity and social responsibility of the public have been a key to Vietnam's success in combating COVID-19 to date, with only just over 300 cases by 20 May 2020 and not a single death. Given Vietnam's weak healthcare system and low budget, the government's call for precautionary measures using messages such as 'to stay home is to love your country' must have necessitated a rapid collective response.[47] The recent new outbreak of COVID-19 cases in EA such as Japan and South Korea in April 2021[48] could be associated with complacency with preventive measures. In our study, subjects from EA were less likely to stay at home when they were unwell and to participate in contact tracing applications during our survey period in May 2020 after their peak of COVID-19. Vigilance on resurgence of COVID-19 cases through continued and collective efforts on compliance with physical distancing and personal hygiene after recovery and vaccinations have to be emphasised to the public by our governments. Thus, policies to relish public's togetherness to encourage social responsibility is critical to prevent and delay occurrence of new waves of COVID-19 transmission. Community empowerment should be a key component in building pandemic preparedness.

Limitations of the study

Our study cohort may not be truly representative of the demographics of the various countries as participants were recruited via networks of healthcare workers and disseminated through different social media platforms. The relatively high rate of respondents working in healthcare sector and having tertiary education indicate a potential selection bias inadvertently introduced into the study, which may overestimate the level of KAP in our study group. The second limitation is the KAP instrument used in this study.

A more thorough assessment of instrument validity and reliability would have produced a more robust instrument. Possible factors contributing to KAP, such as health literacy, were not measured in this study, which may overestimate the risk effect observed. Moreover, there can be a potential recall and social desirability bias, as participants may have answered the attitude and practice questions positively based on what they perceive to be expected of them.

This cross-sectional study design can only demonstrate associations between patterns and social-demographic variables and causation cannot be attributed to the findings. A further cohort-based study design should be considered to monitor and assess changes in KAP patterns to evaluate the effectiveness of the different policies and intervention implemented to guide subsequent policies as part of the overall risk management framework.

CONCLUSION

Older individuals, female, healthcare workers, individuals with preference of online news and social media, social responsibility, discipline and high psychological well-being are factors associated with high compliance behaviour towards personal hygiene and physical distancing measures in the early phase of pandemic. In the next step of public policy formulation, public health communication and community empowerment could be improved by focusing at these factors to target the entire population in all its diversity, regardless of languages, cultures, education and socioeconomic level.

Author affiliations
[1]Department of Medicine, Yong Loo Lin School of Medicine, National University Hospital, Singapore
[2]Division of Gastroenterology & Hepatology, Department of Medicine, National University Hospital, Singapore
[3]Department of Clinical Psychology, James Cook University, Singapore
[4]Department of Medicine, Yong Loo Lin School of Medicine, National University of Singapore, Singapore
[5]Department of Paediatrics, Yong Loo Lin School of Medicine, National University of Singapore, Singapore
[6]Saw Swee Hock School of Public Health, National University of Singapore and National University Health System, Singapore
[7]Department of Medicine, Ng Teng Fong General Hospital, Singapore
[8]Singapore Institute for Clinical Sciences (SICS), Agency for Science Technology and Research, Singapore
[9]Department of Otorhinolarygology, Head and Neck Surgery, Universiti Putra Malaysia, Serdang, Selangor, Malaysia
[10]Department of Anaesthesiology, Columbia Asia Hospitals Pvt Ltd, Sarawak, Malaysia
[11]Cambridge Paediatrics, Hong Kong
[12]Department of Gastroenterology, Sheikh Russel National Gastroliver Institute and Hospital, Dhaka, Bangladesh
[13]Department of Gastroenterology, Sanjay Gandhi Postgraduate Institute Medical Science, Lucknow, India
[14]Medicine and Therapeutics, The Chinese University of Hong Kong Faculty of Medicine, Hong Kong
[15]State Key Laboratory of Pharmaceutical Biotechnology, University of Hong Kong, Hong Kong
[16]Division of Gastroenterology, Department of Internal Medicine, University of Indonesia, Depok, Jawa Barat, Indonesia
[17]Departments of Gastroenterology and Hepatology, the First Affiliated Hospital, Sun Yat-sen University First Affiliated Hospital, Guangzhou, Guangdong, China
[18]Department of Gastroenterology, Wuhan Union Hospital of Huazhong University of Science and Technology, Wuhan, China
[19]China Academy of Chinese Medical Sciences, Xiyuan Hospital, Beijing, China
[20]Department of Medicine, Buddhist Tzu Chi Hospital and University School of Medicine, Hualien, Taiwan
[21]Gut Research Group, Faculty of Medicine, Universiti Kebangsaan Malaysia, Bangi, Selangor, Malaysia
[22]Department of Medicine, The Medical City, Pasig City, Manila, Philippines
[23]Wonkwang Digestive Disease Research Institute, Gut and Food Healthcare, Wonkwang University School of Medicine Hospital, Iksan, Jeollabuk-do, Korea (the Republic of)
[24]Division of Gastroenterology and Hepatology, Hyogo College of Medicine, Nishinomiya, Hyogo, Japan

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Twitter Yeong Yeh Lee @justntweet

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ORCID iDs
Chun En Chua http://orcid.org/0000-0002-0338-5589
Uday C Ghoshal http://orcid.org/0000-0003-0221-8495
Yeong Yeh Lee http://orcid.org/0000-0002-6486-7717
Junxiong Pang http://orcid.org/0000-0002-9788-701X

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