COVID-19 News Exposure as a Modifiable Risk Factor of Psychological Symptoms: Can an Official WhatsApp Channel Help?

Jean C J Liu, Eddie M W Tong

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Jean C J Liu[1] PhD; Eddie M W Tong[2] PhD

[1]Yale-NUS College Singapore SG
[2]Department of Psychology National University of Singapore Singapore SG

Corresponding Author:
Jean C J Liu PhD
Yale-NUS College
02-221
16 College Avenue West
Singapore
SG

Abstract

Background: In a global pandemic, digital technology offers innovative methods to disseminate public health messages. As an example, the messenger application WhatsApp was adopted by both the World Health Organization and government agencies to provide updates on coronavirus disease 2019 (COVID-19). During a time when rumours and excessive news threaten psychological well-being, these services allow for rapid transmission of information and may boost resilience.

Objective: In this study, we sought to: (1) assess well-being during the pandemic; (2) replicate prior findings linking exposure to COVID-19 news with psychological distress; and (3) examine whether subscription to an official WhatsApp channel can mitigate this risk.

Methods: Across 8 weeks of the COVID-19 outbreak (7 March - 21 April 2020), we conducted a survey of 1145 adults in Singapore. As the primary outcome measure, participants completed the Depression, Anxiety and Stress Scale (DASS-21). As predictor variables, participants also answered questions pertaining to: (1) their exposure to COVID-19 news; (2) their use of the Singapore government's WhatsApp channel; and (3) their demographics.

Results: Within the sample, 7.9% of participants had severe or extremely severe symptoms on at least one DASS-21 subscale. Depression scores were associated with increased duration spent receiving COVID-19 updates, whereas use of the official WhatsApp channel emerged as a protective factor ($b = -.07$, $t(863) = -2.04$, $P = 0.04$). Similarly, increased anxiety scores were associated with increased exposure to both updates and rumours, but this risk was mitigated by trust in the government's WhatsApp messages ($b = -.05$, $t(863) = -2.13$, $P = 0.03$). Finally, although stress symptoms increased with the duration spent receiving updates, these symptoms were not significantly related to WhatsApp use.

Conclusions: Our findings suggest that messenger apps may be an effective medium to disseminate pandemic-related information, allowing official agencies to reach a broad sector of the population rapidly. In turn, this use may promote public well-being amidst an 'infodemic'. Clinical Trial: ClinicalTrials.gov NCT04305574

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ORIGINAL PAPER

COVID-19 News Exposure as a Modifiable Risk Factor of Psychological Symptoms: Can an Official WhatsApp Channel Help?

Jean CJ Liu,[1,2*] Eddie MW Tong[3]

[1]Division of Social Sciences, Yale-NUS College, Singapore

[2]Neuroscience and Behavioral Disorders Programme, Duke-NUS Medical School, Singapore

[3]Department of Psychology, National University of Singapore, Singapore

*Address correspondence to:

Jean Liu

16 College Avenue West #02-221

Singapore 138527

Email: jeanliu@yale-nus.edu.sg

Phone: (+65) 6601 3694

Key words: Mental health, social media, pandemic, depression, anxiety, stress

Study registration: NCT04305574: Social media use during COVID-19 (https://clinicaltrials.gov/ct2/show/study/NCT04305574)

Abstract

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Conclusions: Our findings suggest that messenger apps may be an effective medium to disseminate pandemic-related information, allowing official agencies to reach a broad sector of the population rapidly. In turn, this use may promote public well-being amidst an 'infodemic'.

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1. Introduction

On 11 March 2020, the World Health Organization declared that the outbreak of coronavirus disease 2019 (COVID-19) had become a global pandemic [1, 2]. Within six months of the first reported cases (in December 2019), more than 9 million people have been infected in over 200 countries and territories [3]. In response, an estimated 1 in 3 individuals worldwide have been placed under mandatory quarantines or movement restrictions as part of wide-ranging measures to control transmission [4].

Given the magnitude of the crisis, several studies have begun to document its impact on mental health [5]. For example, one study in China found that nearly all COVID-19 patients (96%) had symptoms of post-traumatic stress disorder [6]. Within the general population, several studies have also recorded elevated levels of depression, anxiety, stress, and other psychological symptoms [2, 7-9]. These findings underscore the need to address mental health as part of the broader public health response [10].

Preliminary research suggests that psychological symptoms during the outbreak are most common amongst those with pre-existing health conditions [2], contacts of confirmed cases [2], and migrant and health workers [8, 11]. Age, gender, and educational level have also been implicated as risk factors [7, 8, 11]. Although these demographic and situational characteristics allow vulnerable individuals to be identified, a separate set of risk factors may prove modifiable – those pertaining to the receipt of COVID-19 news.

To date, resilience during the pandemic has been observed: (i) when individuals receive regular updates on COVID-19 [2], and (ii) when they perceive the information to be adequate [2]. However, spending excessive time reading updates is associated with poorer outcomes [11-13]. Related to information availability, individuals also fare more poorly when they lack confidence in the healthcare infrastructure, and when they worry about potential infections amongst family members [2]. To the extent that these constitute modifiable risk factors, mitigation may be achieved when official government and trans-government bodies disseminate accurate and timely information, engendering trust in the management of COVID-19. This is particularly crucial in an age of social

media, where false information has spread so rapidly that the World Health Organization termed this an ‘infodemic’ (a portmanteau of information and pandemic) [14].

Given this landscape, several governments have capitalised on social media itself to engage the public [15, 16]. Notably, a growing number of countries – including Australia, Singapore, and the United Kingdom – have used the platform WhatsApp to provide COVID-19 updates (e.g., [17]), as has the World Health Organization [18]. Since WhatsApp is the most widely-used messaging platform worldwide, these channels allow governments to access large segments of the population [19]. Further, messages can be sent near-instantly, co-opting the very channel used to disseminate false information. Accordingly, platforms like WhatsApp may prove ideal for boosting psychological resilience within a global pandemic.

Despite the potential of messenger-based channels, it remains unclear how effective these are since few health crises have arisen since WhatsApp was introduced in 2009 [20]. To address this gap, we conducted a large-scale survey to: (1) assess population mental health during the outbreak; (2) replicate findings on how news exposure may predispose an individual to distress; and (3) assess whether receiving updates through official WhatsApp channels can mitigate risk.

Our study was conducted across two months in Singapore, a city state that reported its first case early in the outbreak (23 January 2020). During the survey period, Singapore experienced a rapid increase in COVID-19 cases – from 138 cases on 7 March (or 24 per million population), to 9125 cases on 21 April (1600 per million population). Consequently, a nation-wide lockdown was imposed during the survey period (on 7 April). Central to our question, the Singapore government also deployed – from the outset of the crisis – a WhatsApp subscription service that provided twice-daily updates on the local situation (e.g., number of new cases, new infection control measures). At the time of the survey, this had been adopted by ~1 in 10 residents [21], providing a natural experiment to evaluate its impact.

2. Materials and Methods

2.1 Study design and population

Across an 8-week span (7 March - 21 April 2020), we recruited 1145 adults who were: (1) aged ≥ 21 years old, and (2) had lived in Singapore for ≥ 2 years. Participants responded to advertisements placed in Facebook and WhatsApp community groups (e.g., groups for residential estates, universities, and workplaces), or to paid Facebook advertisements targeting Singapore-based users who were at least 21 years old. The study was approved by the Yale-NUS College Ethics Review Committee (#2020-CERC-001), and was pre-registered on ClinicalTrials.gov (NCT04305574). In accordance with the Declaration of Helsinki, all participants gave their consent online prior to completing the survey. Participants received no inconvenience fee for their involvement, and were referred to the Ministry of Health's COVID-19 website at the end of the study.

2.2 Predictor variables

Following informed consent, participants completed a 10-min survey hosted on the online platform Qualtrics (https://osf.io/pv3bj). The survey was written at a 7th grade reading level, and was pilot-tested for clarity.

As predictors, participants were asked questions pertaining to: (1) their exposure to COVID-19 news; (2) their use of the government's WhatsApp channel; and (3) demographics.

2.2.1 Exposure to COVID-19 news. To monitor duration spent receiving and discussing COVID-19 news [11], participants were asked to estimate how much time they spent each day: (1) getting updates about COVID-19 (e.g. searching and reading news), and (2) using social media to discuss or share information. (To provide a context for these values, they were also asked whether – compared to pre-outbreak – they spent more, the same, or less time each day: (1) being updated with the news, and (2) using social media. However, these questions were highly correlated with time estimates and were not included in the statistical analyses.)

As the quality of information received has also been found to predict well-being [13], participants were additionally asked about their exposure to COVID-19 rumours. Specifically, participants were shown five common myths that have been propagated about COVID-19 ("drinking

water frequently will help to prevent infection", "eating garlic can help to prevent infection", "the outbreak came about because of people eating bat soup", "the virus was created in a US lab to affect China's economy", and "the virus was created in a Chinese lab as a bioweapon") [22]. For each claim, participants indicated: (1) whether they had heard the claim before; (2) whether they had shared it on social media; and/or (3) whether they thought it was true [23]. An affirmative response was counted as '1', and scores were summed across claims to create three subscale scores (corresponding to the hearing, sharing, and belief of claims).

2.2.2 Use of an official WhatsApp channel. As the primary predictors of interest, participants were asked three questions pertaining to their use of the government's WhatsApp channel. Shortly after the first local cases in Singapore (at the end of January 2020), the government began using a subscription-based WhatsApp channel to send out COVID-19 updates in the country's four primary languages (English, Mandarin, Malay, and Tamil). On average, these messages were sent twice a day: (1) providing an update on confirmed cases ("There are 4 new confirmed cases."); (2) debunking rumours (e.g., "The Prime Minister is not addressing the nation tonight, nor is Singapore locking down."); (3) disseminating new knowledge (e.g., "How does it spread?"); (4) describing infection control measures (e.g., "All sports and recreation facilities will be closed."); (5) describing economic and social support (e.g., "Tourism, transport, retail and F&B sectors get additional support."); or (6) responding to ad-hoc events on the ground (e.g., "Stay calm; don't panic buy."). Messages were written in brief sentences or in point form, with key phrases emphasised in bold (e.g., "Observe good personal hygiene, be socially responsible") and with the use of emoticons (e.g., 😷). When the study began, this service had 635,000 unique subscribers (out of Singapore's resident population of nearly 6 million individuals; ~10%) [21].

To capture WhatsApp usage, participants indicated: (1) whether they had used the government's WhatsApp channel to receive COVID-19 news (yes / no); (2) how likely they were to share or forward messages from the channel (using 4-point scales anchored with "will definitely not forward on" to "will definitely forward on"); and (3) how likely they were to trust a message from this

source (using 4-point scales anchored with “do not trust at all” to “trust completely”).

As a basis of comparison, participants also indicated their use of, willingness to share or forward messages from, and trust of 12 possible news sources. These ranged from traditional sources (e.g., printed newspapers, radio) to social media (e.g., Facebook, YouTube).

2.2.3 Demographics. As the final category of predictors, participants reported their: gender, ethnicity, religion, country of birth, country of citizenship, marital status, education, house type (as a proxy of socioeconomic status), and household size. Based on the survey time-stamp, we also recorded the total number of local cases reported to date, and whether the country was locked down at the time of survey completion.

2.3 Outcome measures

2.3.1 Depression, Anxiety and Stress Scale. As the key outcome measure, participants completed the 21-item Depression, Anxiety and Stress Scale (DASS-21) – a widely-used assay of depression (e.g., “I felt that I had nothing to look forward to”; Cronbach’s α = .90), anxiety (e.g., “I felt I was close to panic”; Cronbach’s α = .80), and stress symptoms (e.g., “I found it hard to wind down”; Cronbach’s α = .89) previously validated within this population [24]. During the COVID-19 outbreak, the DASS-21 has also been used to measure psychological symptoms in both community and patient populations [2, 25].

2.3.2 Expectations and behavioural responses towards the outbreak. As secondary outcome measures, participants reported their reactions to the COVID-19 outbreak. First, participants were asked about their perceptions [26]: (i) how confident they were that the government could control the nationwide spread of COVID-19 (answered using 4-point scales anchored with “not confident at all” to “very confident); (ii) how likely they judged that they or someone in their immediate household would be infected with COVID-19 (using 4-point scales anchored with “not at all likely” to “very likely”); and (iii) how fearful they were about the COVID-19 situation in Singapore (using 4-point scales anchored with “not scared at all” and “very scared”).

Finally, participants also indicated which of 19 possible measures they had undertaken because of the outbreak (e.g., “washed my hands more frequently”, “relied more on online

shopping", "kept a distance from people suspected of recent contact with a COVID-19 case") [27, 28].

2.4 Statistical analysis

First, to describe participants' baseline characteristics, survey responses were summarized with counts (%) and medians (with interquartile ranges [IQR]). For the primary analyses, we then ran a series of linear regression models with DASS-21 subscale scores as outcome measures.

In the first model, we sought to replicate findings identifying the receipt of COVID-19 news as a risk factor for psychological symptoms. Correspondingly, this model included the following predictors: (i) two questions pertaining to the time spent processing COVID-19 news (the number of hours spent getting updates each day, and the number of hours spent using social media to discuss or share COVID-19 information), and (ii) three questions on COVID-19 rumours (the number of rumours heard, shared, and believed).

For the second model, we explored whether the use of an official WhatsApp channel could be protective, having factored in individual differences in the receipt of COVID-19 news. Here, we repeated the first model with three additional predictors: use of the government's WhatsApp channel, trust in its messages, and likelihood of sharing its messages (see Appendix 1 for Spearman's correlations for these predictors).

Finally, we ran two further models to assess the robustness of our findings, controlling for the outbreak situation (Model 3: implementation of a lockdown, and the number of local cases at the point of survey completion), and demographic variables (Model 4: age, gender, ethnicity, religion, marital status, education, house type, household size, and country of birth).

To achieve linearity, the following variables were log-transformed for regression analyses: DASS-21 subscale scores, time spent getting COVID-19 updates, time spent using social media, and the number of local COVID-19 cases. For each model, the type 1 decision-wise error rate was controlled at $\alpha = 0.05$, and power calculations showed statistical power at the 0.90 level to detect small effect sizes ($f^2 = 0.01$). Statistical analyses were conducted using SPSS 25 (IBM Corp, Armonk, NY) and R 3.4.0 (R Core Team, Vienna, Austria).

3. Results

3.1 Response rate

Of 1390 individuals who clicked the survey link, 1145 (82.4%) provided informed consent and participated in the study. As shown in Table 1, the final sample was comparable to the resident population in: the proportion of Singapore citizens, marital status, and household size (≤10% difference). However, the pool of respondents had a greater representation of females (62.4% vs. 51.1%), university graduates (67.2% vs. 32.4%), and persons of no religion (26.6% vs. 18.5%) or Christian belief (34.1% vs. 18.8%). Conversely, there was a reduced representation of participants aged 65 and older (5.6% vs. 39.8%), and of participants who lived in 1-3 room public housing flats (7.3% vs. 23.7%). Survey respondents were also more likely to be of Chinese ethnicity than persons in the general population (83.4% vs. 74.3%).

Table 1. Baseline characteristics of survey respondents.

Characteristic	N	(%)
Age group		
· 21-34	467	(40.8)
· 35-49	394	(34.4)
· 50-64	220	(19.2)
· 65+	64	(5.6)
· Did not answer	0	(0)
Gender		
· Female	715	(62.4)
· Male	382	(33.4)
· Did not answer	48	(4.2)
Ethnicity		
· Chinese	955	(83.4)

· Indian	53	(4.6)
· Malay	30	(2.6)
· Filipino	18	(1.6)
· Caucasian	14	(1.2)
· Others	27	(2.4)
· Did not answer	48	(4.2)
Religion		
· Christianity (Protestant)	390	(34.1)
· No religion	305	(26.6)
· Buddhism	168	(14.7)
· Roman Catholicism	110	(9.6)
· Taoism / Chinese traditional beliefs	45	(3.9)
· Islam	37	(3.2)
· Hinduism	32	(2.8)
· Others	9	(0.8)
· Did not answer	49	(4.3)
Marital status		
· Married	613	(53.5)
· Single	319	(27.9)
· Dating	114	(10.0)
· Widowed / separated / divorced	31	(2.7)
· Did not answer	68	(5.9)
Educational level		
· 1: Primary school	3	(0.3)
· 2: Secondary school	62	(5.4)
· 3: Junior college	93	(8.1)
· 4: Vocational training	16	(1.4)
· 5: Polytechnic / diploma	129	(11.3)
· 6: University (undergraduate)	541	(47.2)
· 7: University (postgraduate)	229	(20.0)
· Others	4	(0.3)
· Did not answer	68	(5.9)
House type		
· 1: HDB flat: 1-2 rooms	9	(0.8)
· 2: HDB flat: 3 rooms	74	(6.5)
· 3: HDB flat: 4 rooms	263	(23.0)
· 4: HDB flat: 5 rooms and/or executive flats	300	(26.2)
· 5: Condominium and/or private apartments	291	(25.4)
· 6: Landed property	127	(11.1)
· Others	13	(1.1)
· Did not answer	68	(5.9)

Household size		
· 1	52	(4.5)
· 2	143	(12.5)
· 3	242	(21.1)
· 4	327	(28.6)
· 5+	313	(27.3)
· Did not answer	68	(5.9)
Citizenship		
· Singapore	964	(84.2)
· Other	133	(11.6)
· Did not answer	48	(4.2)
Country of birth		
· Singapore	876	(76.5)
· Other	221	(19.3)
· Did not answer	48	(4.2)
Years in Singapore		
· ≤20 years	186	(16.2)
· 21-34 years	420	(36.7)
· 35-49 years	304	(26.6)
· 50-64 years	190	(16.6)
· 65+ years	45	(3.9)
· Did not answer	0	(0)

3.2 Characterising the sample: DASS-21 symptoms and COVID-19 responses

We first sought to characterize our sample in terms of their responses to the outbreak. As shown in Figure 1, the average participant: (i) was ‘not very scared’ about the COVID-19 situation (median rating of 2, IQR: 2 to 3), (ii) deemed it ‘not too likely’ that they or a household member would be infected (median rating of 2, IQR: 2 to 3), and (iii) was ‘somewhat confident’ that the government could control the nationwide spread (median rating of 2, IQR: 1 to 2). Most participants (96.9%, 95% CI: 95.7-98.0%) had also voluntarily changed their behaviour as a function of the outbreak, adopting measures such as hand-washing or avoiding crowds (Figure 1).

Correspondingly, the majority of participants reported normal levels of depression, anxiety, and stress symptoms on the DASS-21 scale (median score for depression subscale: 5.57; anxiety subscale: 2.0; stress subscale; 4.0). Nonetheless, ~1 in 10 participants (7.9%) had severe or extremely severe symptoms on at least one subscale (Figure 2).

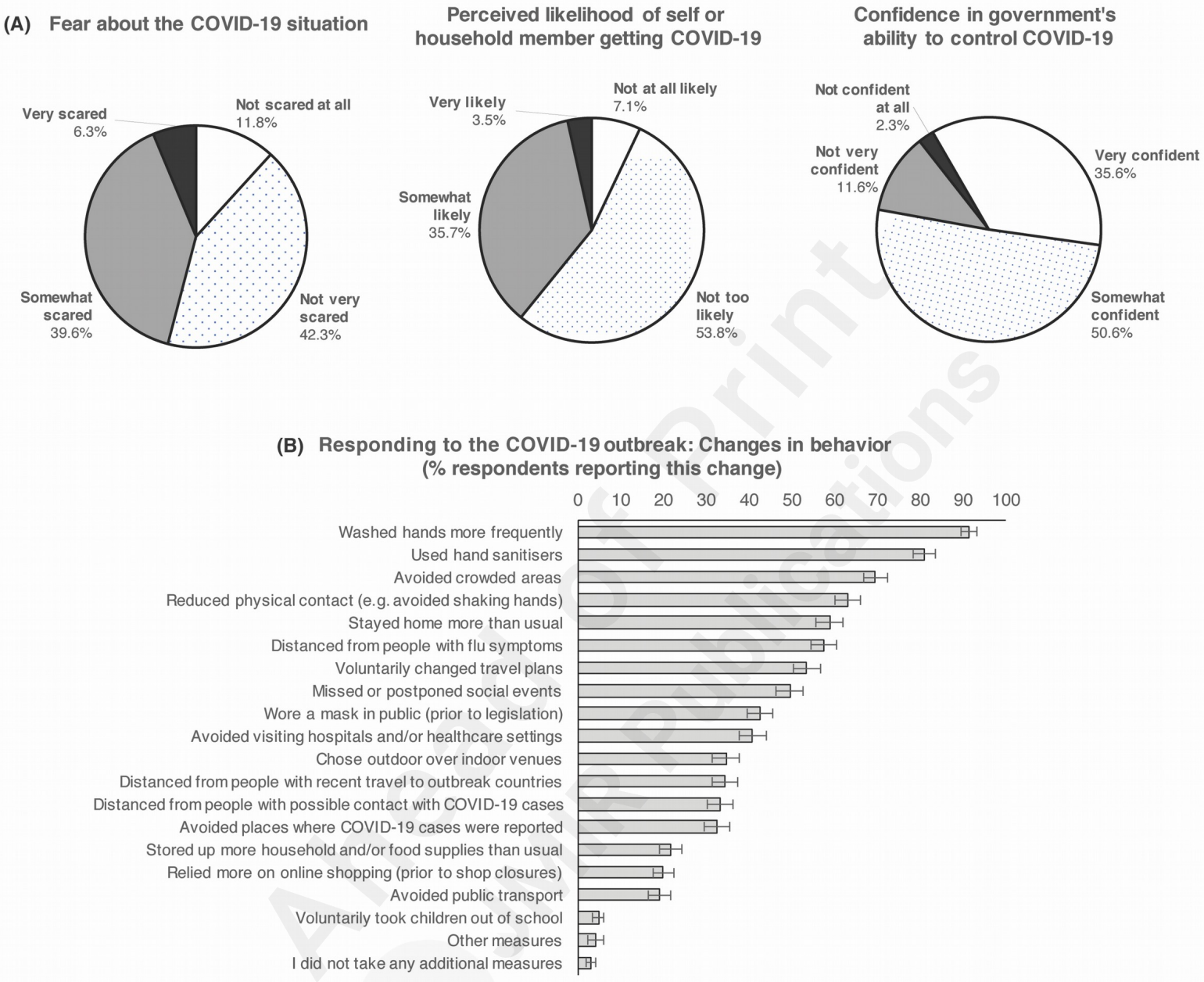

Figure 1. Responses to the COVID-19 outbreak. (A) Participants reported how fearful they were about the COVID-19 situation (top: left-most panel), the likelihood that they or a household member would test positive for COVID-19 (middle panel), and their confidence in the government's ability to control the outbreak (right-most panel). (B) Additionally, participants also reported the behavioural measures they adopted in response to the outbreak. Vertical lines represent the 95% confidence intervals.

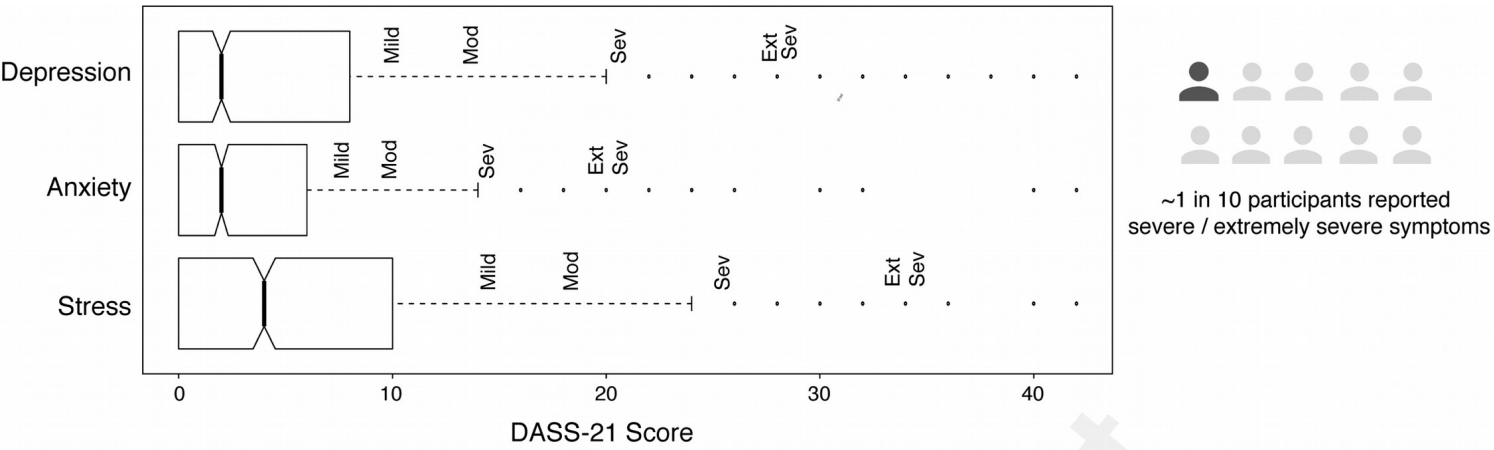

Figure 2. Boxplots of participants' scores on the Depression, Anxiety, and Stress Scale (DASS-21). The width of the box indicates the inter-quartile range, while the mid-line depicts the median. Participants' symptoms were classified as normal, mild, moderate (mod.), severe (sev.), or extremely severe (ext. sev.). Across the three subscales, nearly 1 in 10 participants (7.9%) reported severe or extremely severe symptoms on at least one subscale.

3.3 Characterising the sample: Use of the official WhatsApp channel for COVID-19 news

As shown in Figure 3, nearly 1 in 2 participants (43.9%, 95% CI: 40.8-47%) received updates from the government's WhatsApp channel. Participants reported trusting the messages received (mean rating of 3.52 out of 4, 95% CI: 3.48-3.56), and being likely to forward messages from this source (mean rating of 2.84 out of 4, 95% CI: 2.78-2.90).

For exploratory analyses, we conducted Student's t-tests to examine whether users of the government's WhatsApp channel differed from non-users. On the whole, both users and non-users cut across diverse demographic groups and were largely matched in characteristics (Table 2). However, usage increased as the outbreak progressed ($t(974) = -3.38$, $P = 0.01$; 95% CI of the difference: 0.17-0.65 weeks). As a group, users also had a higher educational level ($t(967) = -2.27$, $P = 0.02$; 95% CI of the difference: 0.03-0.37), and were more likely to be female than non-users ($\chi^2(1, N = 973) = 5.03$, $P = 0.03$; 95% CI for difference in percentage of females: 0.92-12.9%).

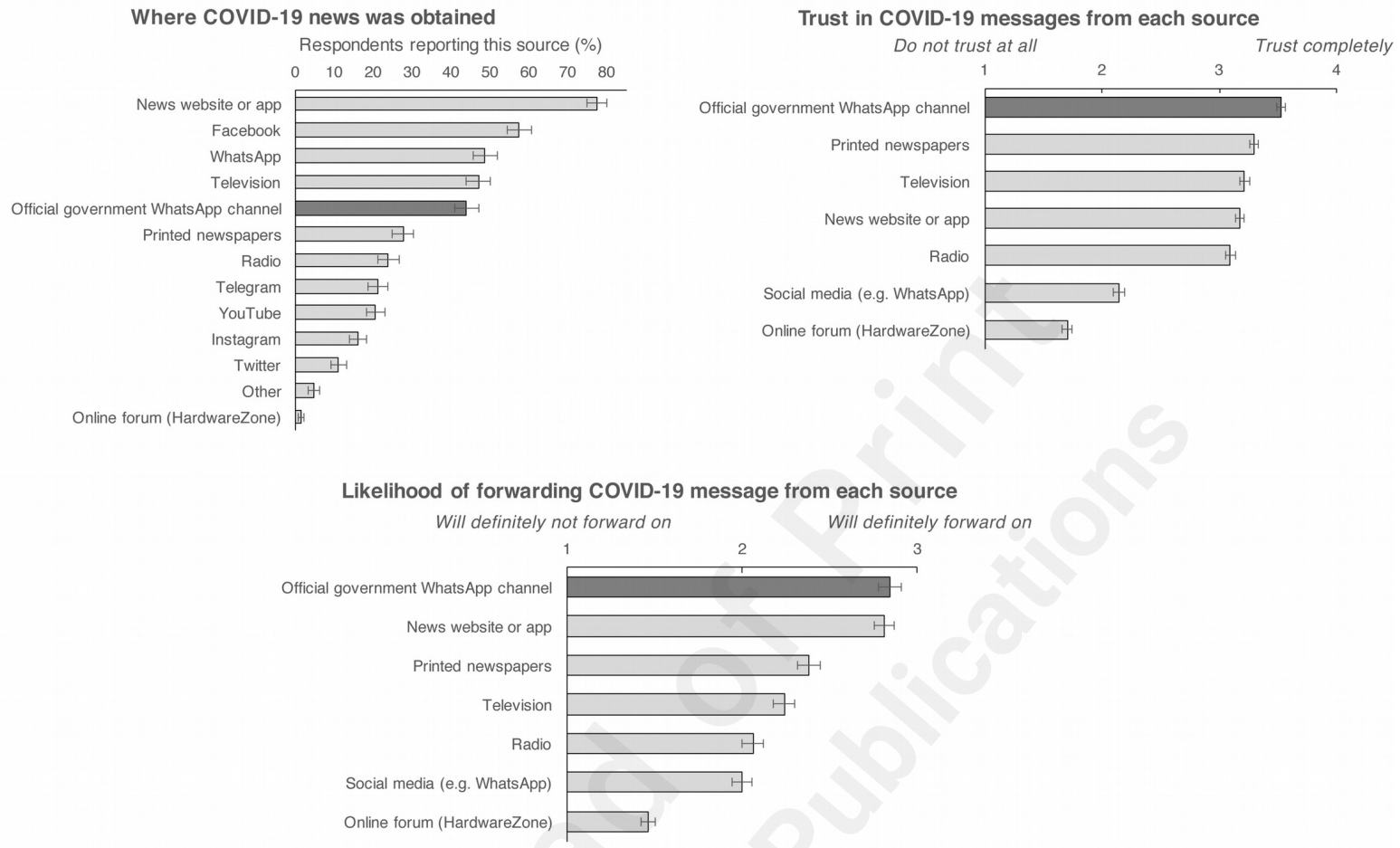

Figure 3. Sources of COVID-19 news. Participants reported where they received COVID-19 news from (top: left panel), the extent to which they trusted each source (top: right panel), and the likelihood of them forwarding messages from each source (bottom panel). Vertical lines represent the 95% confidence intervals.

Characteristic	Government's WhatsApp Channel		
	User (n = 428)	Non-User (n = 548)	Statistic[#] (p-value)
Survey completion week	3.4 (2.0)	3.0 (1.8)	-3.38 (0.001)*
Age in years	39.4 (12.1)	39.7 (13.4)	0.36 (0.72)
Gender[+]	295 Females 133 Males	338 Females 207 Males	5.03 (0.03)*
Ethnicity[+]	377 Chinese 23 Indian 11 Malay 7 Caucasian 4 Filipino	471 Chinese 24 Indian 14 Malay 6 Caucasian 11 Filipino 1 Others	3.57 (0.61)
Religion[+]	162 Christianity 113 No religion 61 Buddhism 39 Roman Catholicism 20 Taoism / Chinese traditional beliefs 16 Hinduism 13 Islam 4 Others	188 Christianity 159 No religion 83 Buddhism 62 Roman Catholicism 18 Taoism / Chinese traditional beliefs 12 Hinduism 20 Islam 2 Others	7.40 (0.39)
Marital status[+]	258 Married 120 Single 40 Dating 10 Widowed / separated / divorced	291 Married 169 Single 65 Dating 18 Widowed / separated / divorced 1 Others	9.31 (0.16)
Educational level	5.7 (1.3)	5.5 (1.4)	-2.28 (0.02)*
House type	4.1 (1.1)	4.1 (1.2)	-0.07 (0.95)
Household size	3.7 (1.2)	3.7 (1.2)	0.02 (0.98)
Citizenship[+]	374 Singapore 54 Others	480 Singapore 65 Others	0.11 (0.74)
Country of birth[+]	335 Singapore 93 Others	439 Singapore 106 Others	0.77 (0.38)

Table 2. Participant characteristics as a function of whether they used the official WhatsApp channel

Years in Singapore	34.1 (15.1)	34.6 (16.1)	0.45

[#]Data reported as means (standard deviations) or counts. Unless otherwise stated, the test statistic refers to the t-statistic.
[+]Pearson's chi-square statistic reported.
*$P < 0.05$

3.3 Predicting depression, anxiety, and stress symptoms during the COVID-19 outbreak

3.3.1 Depression symptoms. Tables 3-5 address the primary research question, highlighting characteristics that predict depression, anxiety, and stress symptoms on the DASS-21 scale. In terms of depression, the duration participants spent receiving COVID-19 updates robustly predicted well-being, with increased duration linked to increased depression scores (Models 1-4; Table 3). Having controlled for exposure to COVID-19 news, however, use of the government's WhatsApp channel emerged as a protective factor (Model 2). Namely, channel users reported lower depression scores than non-users (Figure 4); b = -.07, $t(863)$ = -2.04, P = 0.04. This association persisted after situational and demographic factors were controlled for (Models 3-4, respectively). Finally, the following situational and demographic variables also predicted depression scores ($P < 0.05$): the number of local COVID-19 cases to date (Models 3 and 4), age (Model 4), and marital status (Model 4).

3.3.2 Anxiety symptoms. As shown in Table 4, anxiety symptoms were likewise predicted by exposure to COVID-19 news in a robust manner. Across all 4 models, increased anxiety scores were associated with: increased duration spent obtaining COVID-19 updates; and increased exposure to, sharing, and belief of COVID-19 rumours. After controlling for these variables (Model 2), trust in the government's WhatsApp channel emerged as a protective factor, with increased trust predicting lower anxiety scores (Figure 4; b = -.05, $t(863)$ = -2.13, P = 0.03.) Again, this relation held when the model was adjusted for situational and demographic variables (Model 3 and 4), with the following variables emerging as additional predictors of anxiety scores ($P < 0.05$): being in a lockdown (Models 3 and 4), the number of local cases to date (Models 3 and 4), and age (Model 4).

3.3.3 Stress symptoms. Finally, Table 5 again highlights how the duration spent getting updates predicted stress symptoms (Models 1-4). However, there was no significant predictor related to use of the official WhatsApp channel (Models 2-4). Nonetheless, the following variables

emerged as significant predictors of stress: being in a lockdown (Models 3-4), the number of local cases to date (Models 3-4), age (Model 4), and gender (Model 4).

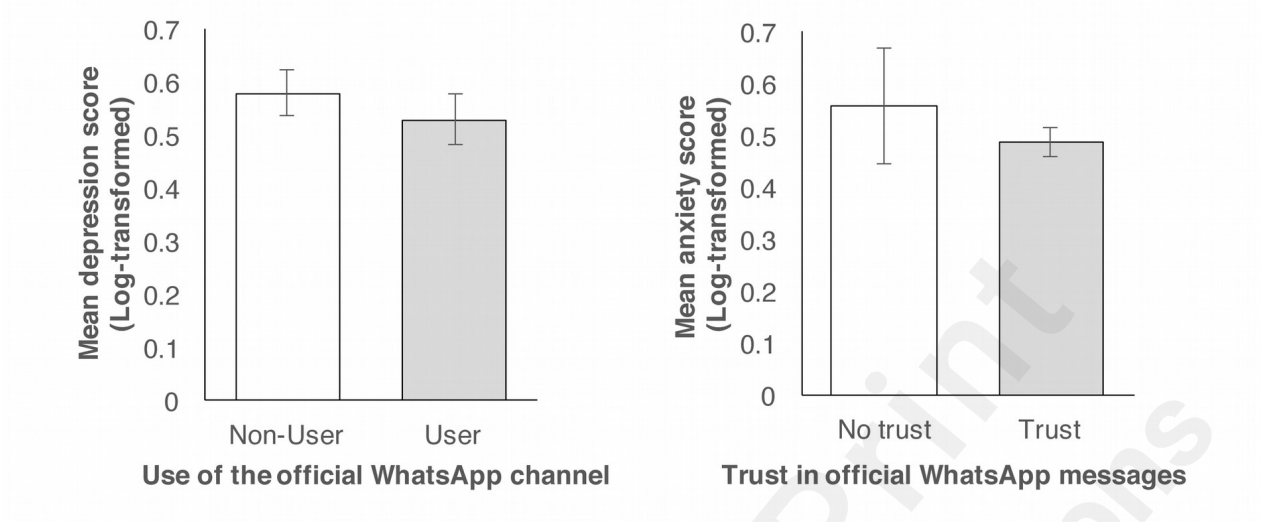

Figure 4. In the left panel, participants' depression scores on the Depression, Anxiety, and Stress Scale (DASS-21) have been plotted as a function of their use of the government's WhatsApp channel for COVID-19 information. In the right panel, corresponding anxiety scores have been plotted as a function of trust in the channel's messages. Vertical lines represent 95% confidence intervals.

Table 3. Predicting depression symptoms during the COVID-19 outbreak

	Dependent Variable: Depression Symptoms (DASS-21)[a,b]			
	(1)	(2)	(3)	(4)
Time spent getting COVID-19 updates (hours per day)[b]	.448*** (.239,.656)	.454*** (.246,.662)	.377*** (.169,.585)	.389*** (.183,.595)
Time spent using social media to discuss or share COVID-19 information (hours per day)[b]	.072 (-.134,.279)	.073 (-.134,.280)	.033 (-.171,.238)	.055 (-.147,.257)
Number of COVID-19 rumours heard	.009 (-.015,.034)	.012 (-.012,.037)	.006 (-.019,.030)	.010 (-.014,.034)
Number of COVID-19 rumours shared	.042 (-.010, .094)	.040 (-.012,.092)	.038 (-.013,.089)	.043 (-.007,.094)
Number of COVID-19 rumours believed	.037 (-.016,.090)	.035 (-.018,.088)	.039 (-.013,.091)	.033 (-.020,.085)
Use of government's WhatsApp channel *(base = non-user)*		-.070** (-.137,-.003)	-.086** (-.153,-.019)	-.083** (-.149,-.017)
Trust in government's WhatsApp messages		-.032 (-.087,.024)	-.026 (-.061,.023)	-.017 (-.072,.038)
Likelihood of sharing government's WhatsApp messages		.015 (-.020,.050)	.014 (-.021,.049)	.014 (-.020,.049)
Lockdown *(base = no lockdown)*			-.077 (-.266,.111)	-.065 (-.254,.125)
Local COVID-19 cases to date[b]			.224*** (.064,.384)	.195** (.036,.355)
Age in years				-.004*** (-.007,-.001)
Gender *(base = female)*				-.006 (-.072,.059)
Ethnicity *(base = Chinese)*				
Indian				-.028 (-.277,.221)
Malay				-.316 (-.694,.062)
Filipino				.194 (-.126,.514)
Caucasian				.009 (-.255,.274)
Others				-.003 (-.909,.902)

Religion *(base = no religion)*				
Christianity				-.018 (-.097,.061)
Buddhism				.059 (-.041,.159)
Roman Catholicism				<0.001 (-.118,.118)
Taoism / Chinese traditional beliefs				.070 (-.090,.230)
Islam				.306 (-.068,.680)
Hinduism				-.124 (-.433,.185)
Marital status *(base = single)*				
Married				-.124*** (-.204,-.045)
Dating				.051 (-.060,.162)
Widowed / separated / divorced				-.114 (-.310,.082)
Educational level				-.007 (-.031,.018)
House type				.018 (-.011,.047)
Household size				-.027 (-.056,.002)
Country of birth *(base = not Singapore)*				-.011 (-.097,.076)
R^2	*.06*	*.06*	*.09*	*.16*

[a]Dependent variable: Depression subscale scores from the 21-item Depression Anxiety Stress Scale (DASS-21). Data reported as beta estimates (95% CI).
[b]Log-transformed
***$P < 0.01$, **$P < 0.05$

Table 4. Predicting anxiety symptoms during the COVID-19 outbreak

	Dependent Variable: Anxiety Symptoms (DASS-21)[a,b]			
	(1)	(2)	(3)	(4)
Time spent getting COVID-19 updates (hours per day)[b]	.278*** (.100,.456)	.282*** (.104,.459)	.262*** (.083,.442)	.283*** (.104,.463)
Time spent using social media to discuss or share COVID-19 information (hours per day)[b]	.010 (-.166,.187)	.003 (-.174,.180)	-.006 (-.183,.171)	.002 (-.175,.178)
Number of COVID-19 rumours heard	.032*** (.011,.053)	.032*** (.011, .053)	.030*** (.009,.051)	.033*** (.012,.054)
Number of COVID-19 rumours shared	.083*** (.039, .127)	.080*** (.036,.125)	.080*** (.036,.125)	.082*** (.038,.126)
Number of COVID-19 rumours believed	.068*** (.023,.113)	.069*** (.023,.114)	.067*** (.022,.113)	.062*** (.016,.107)
Use of government's WhatsApp channel *(base = non-user)*		.023 (-.034,.081)	.021 (-.037,.078)	.025 (-.032,.082)
Trust in government's WhatsApp messages		-.051** (-.099,.-.004)	-.050** (-.097,.003)	-.054** (-.101,-.006)
Likelihood of sharing government's WhatsApp messages		.017 (-.013,.047)	.017 (-.013,.047)	.015 (-.015,.046)
Lockdown *(base = no lockdown)*			-.190** (-.353,-.027)	-.186** (-.352,-.021)
Local COVID-19 cases to date[b]			.165** (.027,.303)	.151** (.012,.290)
Age in years				-.004*** (-.006,-.001)
Gender *(base = female)*				-.036 (-.093,.022)
Ethnicity *(base = Chinese)*				
Indian				.135 (-.083,.352)
Malay				-.038 (-.367,.292)
Filipino				.057 (-.210,.324)
Caucasian				-.101 (-.332,.131)
Others				.171 (-.619,.961)

Religion *(base = no religion)*				
Christianity				-.031 (-.100,.038)
Buddhism				.050 (-.037,.138)
Roman Catholicism				.033 (-.070,.135)
Taoism / Chinese traditional beliefs				.035 (-.105,.175)
Islam				.122 (-.205,.448)
Hinduism				-.260 (-.530,.009)
Marital status *(base = single)*				
Married				-.063 (-.132,.006)
Dating				-.009 (-.106,.088)
Widowed / separated / divorced				-.116 (-.287,.056)
Educational level				-.012 (-.034,.009)
House type				.017 (-.008,.042)
Household size				-.009 (-.034,.017)
Country of birth *(base = not Singapore)*				-.041 (-.117,.034)
R^2	*.06*	*.07*	*.08*	*.12*

[a]Dependent variable: Anxiety subscale scores from the 21-item Depression Anxiety Stress Scale (DASS-21). Data reported as beta estimates (95% CI).
[b]Log-transformed
***$P < 0.01$, **$P < 0.05$

Table 5. Predicting stress symptoms during the COVID-19 outbreak

	Dependent Variable: Stress Symptoms (DASS-21)[a,b]			
	(1)	(2)	(3)	(4)
Time spent getting COVID-19 updates (hours per day)[b]	.405*** (.200,.611)	.411*** (.206,.617)	.353*** (.147,.559)	.385*** (.180,.590)
Time spent using social media to discuss or share COVID-19 information (hours per day)[b]	-.058 (-.262,.145)	-.061 (-.266,.143)	-.091 (-.294,.113)	-.057 (-.258,.144)
Number of COVID-19 rumours heard	.020 (-.004,.044)	.020 (-.004,.044)	.015 (-.009,.039)	.019 (-.005,.043)
Number of COVID-19 rumours shared	.043 (-.008, .094)	.041 (-.010,.092)	.040 (-.010,.091)	.051** (.001,.101)
Number of COVID-19 rumours believed	.031 (-.021,.084)	.032 (-.020,.085)	.033 (-.019,.085)	.026 (-.026,.078)
Use of government's WhatsApp channel *(base = non-user)*		.017 (-.049,.083)	.006 (-.060,.072)	.004 (-.062,.069)
Trust in government's WhatsApp messages		-.048 (-.103,.007)	-.044 (-.098,.011)	-.048 (-.102,.007)
Likelihood of sharing government's WhatsApp messages		.007 (-.028,.041)	.006 (-.029,.041)	.004 (-.031,.038)
Lockdown *(base = no lockdown)*			-.190** (-.378,-.003)	-.204** (-.393,-.016)
Local COVID-19 cases to date[b]			.254*** (.095,.413**)**	.249*** (.090,.407)
Age in years				-.005*** (-.008,-.002)
Gender *(base = female)*				-.084** (-.150,-.019)
Ethnicity *(base = Chinese)*				
Indian				-.056 (-.303,.192)
Malay				-.290 (-.666,.086)
Filipino				-.017 (-.335,.301)
Caucasian				-.036 (-.299,.227)
Others				.144 (-.756,.1.045)

Religion *(base = no religion)*				
Christianity				-.038 (-.117,.040)
Buddhism				.042 (-.057,.142)
Roman Catholicism				.050 (-.067,.167)
Taoism / Chinese traditional beliefs				.069 (-.090,.229)
Islam				.311 (-.061,.683)
Hinduism				-.155 (-.462,.152)
Marital status *(base = single)*				
Married				-.044 (-.123,.035)
Dating				.084 (-.027,.195)
Widowed / separated / divorced				-.179 (-.374,.016)
Educational level				.009 (-.015,.033)
House type				.019 (-.010,.047)
Household size				-.010 (-.039,.019)
Country of birth *(base = not Singapore)*				-.019 (-.105,.067)
R^2	*.04*	*.04*	*.06*	*.12*

[a]Dependent variable: Stress subscale scores from the 21-item Depression Anxiety Stress Scale (DASS-21). Data reported as beta estimates (95% CI).
[b]Log-transformed
***$P < 0.01$, **$P < 0.05$

4. Discussion

In the COVID-19 pandemic, digital technology offers novel solutions to disseminate public health messages [15]. Prior to this study, however, there had been limited evidence evaluating these solutions. Accordingly, we systematically examined governmental use of WhatsApp to provide COVID-19 updates.

As the first thrust of our study, we replicated previous findings that had linked psychological

distress to COVID-19 news exposure [11]. This pattern also emerged in our dataset, such that participants who spent more time getting updates were more likely to display depression, anxiety, and stress symptoms. Similar findings have also been reported in other crises: for example, when Hong Kong experienced social unrest, the duration an individual spent dwelling on socio-political news predicted symptoms of depression and post-traumatic stress disorder [29]. These findings raise a paradox: although transparency promotes resilience [2] and information-seeking is encouraged (e.g., [30]), the duration spent doing so is a marker for poor psychological health.

Construing exposure to COVID-19 news as a modifiable risk factor, one possible way to mitigate risk may be through spreading official advisories via social media. In particular, messenger-based platforms allow a government's advisories to reach a large number of people near-instantly, minimising the need for individuals to search for updates themselves or to sift through misinformation. In support of this case, we observed – as the second thrust of our study – that having controlled for news exposure, subscription to a government's WhatsApp channel was associated with fewer depression symptoms. Similarly, increased trust in official WhatsApp messages was associated with decreased anxiety. Both these associations were robust, and were observed even after situational and demographic characteristics had been adjusted for.

Although preliminary, it is promising that using an official WhatsApp channel may boost psychological resilience. Further research Is needed to identify what mechanisms may underlie these findings. One possibility is that WhatsApp allows speed in message transmission, curbing the spread of rumours that may provoke anxiety. Alternatively, use of an official WhatsApp channel may boost trust in the institution – a factor that has been linked with reduced anxiety in times of crises (e.g., the nuclear disaster in Fukushima) [31, 32]. While these accounts are consistent with anxiety being characterised by worry and the threat of danger (such that increased trust in official messages can allay fears) [33], it is less clear why use of the WhatsApp channel was linked to attenuated depression symptoms.

Mechanisms notwithstanding, another important observation was that the official WhatsApp service was adopted by persons of diverse demographic backgrounds. This stands in contrast to

traditional findings of certain groups being more ‘technologically savvy’ (e.g., young adults) [34], and likely reflects the broad appeal of WhatsApp (which reports over 2 billion users across 180 countries [35]). Aside from its take-up, participants also reported being willing to forward COVID-19 messages from this source. Consequently, the features of an official WhatsApp service may render it suitable for addressing false information during the current ‘infodemic’.

In presenting these findings, we note several limitations of our study. First, we used the approach of large-scale epidemiological surveys, examining the place of an official WhatsApp channel based on real-life usage. Although this design is appropriate for new areas of research, the cross-sectional design precludes strong conclusions about causality. Accordingly, future studies should consider randomized controlled trials – for example, by offering subscription to a random sample of a population when a new WhatsApp service is rolled out. Second, we chose to study WhatsApp because it is the most widely-used messenger platform in both official deployment (e.g., by the World Health Organization and individual governments), and in its worldwide subscription base. In making this choice, however, we were unable to draw conclusions about other messenger-based platforms (e.g., Telegram). Finally, we caution the reader about several features of our study that can limit generalisability. Although we sampled from a wide array of demographic groups, our final set of respondents was not representative of the general population. Correspondingly, further research is needed to examine whether our findings can generalize to populations we have under-sampled (e.g., participants over 65 years of age who may be less likely to respond to online recruitment methods). We note also that the context for COVID-19 research is changing rapidly across countries and across time (e.g., number of COVID-19 cases, progress of vaccine research, government-level implementation of infection control measures). Notably, participants in our sample displayed confidence that the government could manage the COVID-19 spread, and had high trust in official WhatsApp messages. Moving forward, future research will need to examine the extent to which these elements are crucial to WhatsApp effectiveness. To this end, we have provided detailed documentation on the context of our research, allowing the reader to make informed judgments regarding generalisability.

In conclusion, the COVID-19 pandemic has developed against a backdrop of innovative solutions for wide-spread communication. In unprecedented times, these solutions have the potential to boost psychological resilience – as we have found through the use of WhatsApp by a government to disseminate local updates. Given the promising nature of our findings, we encourage governments and trans-government bodies to explore these digital technologies. We further encourage researchers to empirically evaluate the impact of these solutions.

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Supplementary Files

Untitled.
URL: https://asset.jmir.pub/assets/57c86cf5d633ab4b874f8a9333f9184b.docx

Multimedia Appendixes

Means, standard deviation, and Spearman's rho for predictors related to official WhatsApp use.
URL: https://asset.jmir.pub/assets/611498d797f69e792e88c9ca329df673.docx