

Temporal changes in psychobehavioural responses during the early phase of the COVID-19 pandemic in Malaysia

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Abstract

Monitoring public psychological and behavioural responses during the early phase of the coronavirus disease 2019 (COVID-19) outbreak is important for the *management* of infection prevention and *control*. This study aims to investigate the temporal trend in preventive measures against severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection, fear, socio-economic impact, perception of susceptibility/severity and anxiety levels during the early phase of the COVID-19 pandemic. Between 25 January and 3 April 2020 a total of 962 survey responses were received. The majority of respondents had good levels of avoidance and protective behaviour. A high perception of severity (76.5%; 95%CI = 73.7–79.2) of SARS-CoV-2 infection was reported but perception of susceptibility was relatively low (30.6%; 95%CI = 27.7–33.6). A sizeable proportion of study participants were greatly impacted by the COVID-19 outbreak, with a total impact score of 9.1 (standard deviation 4.7) from a possible total score of 15, and 72.1% (95%CI = 69.2–75.0) reported moderate to severe anxiety as measured by the State-Trait Anxiety Inventory. Overall, the psychological and behavioural responses were found to increase with progression of the outbreak, however a slightly higher increase was observed for the socio-economic impact. These temporal trends during the early phase of the COVID-19 pandemic provide valuable insights for mitigation strategies to contain the current rapidly escalating outbreak.

Introduction

An outbreak of coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was initially detected in *Wuhan, China in December 2019*. In less than one month the outbreak has since resulted in an epidemic throughout China (Hui et al., 2020; Lu et al., 2020). The new coronavirus rapidly spread across Asian countries and subsequently all around the world within a month of its onset. Malaysia announced the *first three cases* of SARS-CoV-2 infection on 25 January 2020. At a later date, with increasing cases, various measures were undertaken by the Malaysian government to contain the spread of COVID-19, including extending travel bans for nationals from Iran, Italy and South Korea. On 17 March 2020 the number of confirmed cases in Malaysia had reached 673; this is also the date when the first death was reported and the country implemented a nationwide movement control order (MCO) to curb the outbreak.

Lessons from previous outbreaks, such as SARS, swine flu (H1N1) and Ebola, have gained international recognition for the importance of understanding and monitoring the lay public's psychobehavioural responses during infectious disease outbreaks. Monitoring of psychobehavioural response, particularly during the early phase of an outbreak, plays an important role in identifying behavioural gaps and provides important insights for immediate intervention, helping to bring the outbreak under control (Opere et al., 2000; Leung et al., 2005; Leppin and Aro, 2009). Empirical studies have provided some conceptual-theoretical frameworks regarding psychobehavioural responses during infectious disease outbreaks. For instance, during the SARS outbreaks, a positive association between anxiety level and personal protective

behaviour was found (Seto et al., 2003; Leung et al., 2005). During infectious disease outbreaks, tension may surge in the entire community and result in a significant disruption of general well-being, health and economy (Wishnick, 2010; Qiu et al., 2018; Smith et al., 2019). It is important to note that the public often judges personal risk based on their impressions of disease prevalence and death rates, therefore assessment of risk perception is important and changes in risk perception throughout the epidemic warrant appropriate understanding (Herrera and Meyers, 2019). Most recently, with the current COVID-19 outbreak, the psychological impact of the outbreak intensified when the community was placed under controlled movement or quarantine (Brooks et al., 2020).

Notwithstanding the prominent psychobehavioural consequences during a disease outbreak, to what extent epidemiologists and social scientists have understood the psychobehavioural aspect of the current COVID-19 outbreak in Malaysia is unknown. In the previous 2009 H1N1 pandemic, epidemic-related psychobehavioural responses of the Malaysian public were reported (Wong and Sam, 2010) and it is timely that a similar study should be carried out during the current COVID-19 outbreak. This study therefore aims to investigate psychobehavioural issues related to the COVID-19 outbreak, namely preventive measures against SARS-CoV-2 infection, fear, impact, perception of susceptibility/severity and anxiety levels. Likewise, this study also examines the temporal changes in psychobehavioural effects by following the psychobehavioural responses from the day of the first reported COVID-19 case until initiation of the MCO by the Malaysian government. These findings will provide insights for the formulation of mitigation measures to manage the negative impact in a timely manner.

Method

An anonymous Internet-based, cross-sectional survey was commenced on 25 January 2020, the day the first case of SARS-CoV-2 was reported in Malaysia. The survey was carried out over a period of 10 weeks up until 3 April 2020 and the responses were divided into three time periods of around 3 weeks: 25 January–21 February, 22 February–17 March and 18 March–3 April (the period of the MCO). The psychobehavioural responses were compared among the respondents from these three groups. Inclusion criteria were that the respondents were from the general public of Malaysia and aged 18–70 years. The researchers used social network platforms (Facebook, Instagram and Whatsapp) to disseminate and advertise the survey link. Those respondents who completed the survey received a note to encourage them to disseminate the survey link to all their contacts. All respondents were informed that their participation was voluntary and consent was implied through their completion of the questionnaire.

The questionnaire was developed in English and then translated into Bahasa Malaysia, the national language of Malaysia. Questions were presented in both English and Bahasa Malaysia. Local experts validated the content of the questionnaire and then it was pilot tested. The survey consisted of questions that assessed: demographic background; preventive measures against SARS-CoV-2 infection; perceived susceptibility and severity of becoming infected with SARS-CoV-2; 4) fear associated with SARS-CoV-2 infection; socio-economic impact; and anxiety level associated with the COVID-19 outbreak.

Questions on demographic characteristics assessed the participants' age, gender, ethnicity, highest educational level, average household income and locality. Questions on prevention practices were divided into two sections (11 items): avoidance behaviours (5 items) and protective behaviours (6 items). Questions on perceived susceptibility (1 item) and severity (1 item) asked participants to rate their level of likelihood of becoming infected with SARS-CoV-2 and their level of worry over SARS-CoV-2 infection, respectively. Both of these questions were based on constructs from the Health Belief Model (Becker, 1974; Rosenstock, 1974; Champion and Skinner, 2008). Perceived fear and socio-economic impact consisted of 4 items and 5 items, respectively. The response options for prevention practices, fear and impact were scored on a four-point Likert scale: 1, *strongly disagree*; 2, *disagree*; 3, *agree*; 4, *strongly agree*. The response options for perceived susceptibility and severity were also scored on a four-point Likert scale: 1, *not at all*; 2, *somewhat*; 3, *very*; 4, *extremely*. The scores were summed, with higher scores representing higher prevention measures, perceived severity/susceptibility, fear and impact. Apart from the questions on perception of susceptibility/severity, all the questions were adopted from a previous study (Wong and Sam, 2010).

Anxiety was measured using the 6-item state version of the State-Trait Anxiety Inventory (STAI-6: Marteau and Bekker, 1992; Hou et al., 2015). Respondents rated the frequency of experiencing six emotional states, namely being calm, tense, upset, relaxed, content and worried, connected with the current COVID-19 outbreak. A four-point scale was used (1, *not at all*; 2, *somewhat*; 3, *moderately*; 4, *very much*). The scores on the three positively worded items were reverse coded. The total summed scores were pro-rated (multiplied by 20/6) to obtain scores that were comparable with those from the full 20-item STAI (giving a range of 20–80) (Marteau and Bekker, 1992). A cut-off score of 44 was used to indicate moderate to severe symptoms (Knight et al., 1983; Leung et al., 2005).

Statistical analysis

The reliability of the scales used was evaluated by assessing the internal consistency of the items representing the scores. The avoidance and protective behaviour items had a reliability (Cronbach's α) of 0.921 and 0.707, respectively. The reliability of the fear and impact items was 0.779 and 0.906, respectively. The reliability computed for the STAI-6 items in the assessment of anxiety was 0.781. Multivariable logistic regression analysis, using a simultaneous forced-entry method, was used to determine the factors influencing moderate to severe anxiety. Odds ratios (OR), 95% confidence intervals (95%CI) and p values were calculated for each independent variable.

All statistical analyses were performed using the Statistical Package for the Social Sciences, version 20.0 (IBM Corp., Armonk, NY, USA). The level of significance was set at $p < 0.05$.

Ethical considerations

This research was approved by the University of Malaya Research Ethics Committee (UM.TNC2/UMREC – 847).

Results

A total of 962 completed responses were received. As shown in the first and second columns of Table 1, the mean age \pm standard deviation (SD) of the study participants is 35.5 ± 11.2 years. The study has a slightly higher representation of females (68.6%), participants with tertiary education level (91.3%) and from the Central region (67.7%). With regard to ethnicity, the majority were Malay (58.7%), followed by Chinese (29.3%). Figure 1 illustrates the proportions of each psychobehavioural response and Figure 2 displays the trend of these responses according to the three time periods.

Table 1 Socio demography, fear, impact, prevention behavior and anxiety level of COVID-19 (N=962)

	Overall n(%)	25 th Jan – 21 st Feb (n=581)	22 nd Feb- 17 th March (n=71)	18 th March – 3 rd April (n=310)	p-value
<i>Socio demography</i>					
Age group (mean±SD)	35.5±11.2	34.7±10.6	33.1±14.8	37.5±11.1	
Gender					
Male	302 (31.4)	156 (26.9)	21 (29.6)	125 (40.3)	
Female	660 (68.6)	425 (73.1)	50 (70.4)	185 (59.7)	
Ethnicity					
Malay	565 (58.7)	280 (48.2)	30 (42.3)	255 (82.3)	
Chinese	282 (29.3)	216 (37.2)	40 (56.3)	26 (8.4)	
Indian	53 (5.5)	38 (6.5)	1 (1.4)	14 (4.5)	
Bumiputera Sabah/Sarawak/Others	62 (6.4)	47 (8.1)	0 (0.0)	15 (4.8)	
Level of education					
Secondary school	84 (8.7)	28 (4.8)	5 (7.0)	51 (16.5)	
Tertiary	878 (91.3)	553 (95.2)	66 (93.0)	259 (83.5)	
Occupation					
Professional and managerial	551 (57.3)	368 (63.3)	21 (29.6)	162 (52.3)	
General worker	131 (13.6)	52 (9.0)	6 (8.5)	73 (23.5)	
Student	173 (18.0)	109 (18.8)	37 (52.1)	27 (8.7)	
Housewife/Retiree/ Unemployed/Others	107 (11.1)	52 (9.0)	7 (9.9)	48 (15.5)	
Average monthly household income (MYR)					
<2000	97 (10.1)	48 (8.3)	19 (26.8)	30 (9.7)	

2001-4000	308 (32.0)	172 (29.6)	15 (21.1)	121 (39.0)	
4001-8000	311 (32.3)	193 (33.2)	15 (21.1)	103 (33.2)	
>8000	246 (25.6)	168 (28.9)	22 (31.0)	56 (18.1)	
<i>Location</i>					
Urban	657 (68.3)	436 (75.0)	47 (66.2)	174 (56.1)	
Sub urban/Rural	305 (31.7)	145 (25.0)	24 (33.8)	136 (43.9)	
<i>Region[†]</i>					
Central	651 (67.7)	401 (69.0)	42 (59.2)	208 (67.1)	
Southern	71 (7.4)	42 (7.2)	5 (7.0)	24 (7.7)	
Northern	89 (9.3)	53 (9.1)	7 (9.9)	29 (9.4)	
East Coast	74 (7.7)	22 (3.8)	15 (21.1)	37 (11.9)	
Borneo Island	77 (8.0)	63 (10.8)	2 (2.8)	12 (3.9)	
<i>Prevention behaviour</i>					
Mean total avoidance behavior score (mean±SD)	12.1±3.5	11.2±3.7	11.8±3.2	13.9±2.2	p<0.001
Mean total protective behavior score (mean±SD)	15.0±2.8	14.6±3.0	14.5±2.7	16.0±2.1	p<0.001
<i>Fear of COVID-19</i>					
Mean total fear score (mean±SD)	10.0±2.3	9.6±2.4	9.3±2.5	10.9±1.7	p<0.001
<i>Impact from COVID-19</i>					
Mean total impact score (mean±SD)	9.1±4.7	7.6±4.7	9.2±4.8	11.9±2.9	p<0.001
<i>Perceived susceptibility</i>					
Very/Extremely	294 (30.6)	26.3 (95%CI 22.8-30.1)	18.3 (95%CI 10.1-29.3)	58.7 (95%CI 53.0-64.2)	p<0.001
<i>Perceived severity</i>					
Very/Extremely	736	72.6	70.4	85.2%	p<0.001

	(76.5)	(95%CI 68.8-76.2)	(95%CI 58.4-80.7)	(95%CI 80.7-88.8)	
<i>Anxiety</i>					
Total anxiety score	52.0±13.0	50.9±13.2	52.1±12.7	54.0±12.5	0.003
Moderate/Severe (score 44-80)	694 (72.1)	69.0 (95%CI 65.1-72.8)	74.6 (95%CI 62.9-84.2)	77.4 (95%CI 72.4-82.0)	0.026

†Central: Selangor, Kuala Lumpur, Putrajaya, Negeri Sembilan, Malacca; Southern: Johor; Northern: Perlis, Kedah, Pulau Pinang, Perak; East Coast: Terengganu, Kelantan, Pahang; Borneo Island: Sabah, Sarawak, Labuan

Avoidance behaviour

Figure 1.1 shows the proportion of *strongly agree/agree* responses for avoidance behaviour in the three successive time periods. All the avoidance behaviour items showed an increase in the proportion of *strongly agree/agree* across the three time periods. The highest avoidance behaviour was in relation to 'avoid going abroad'. The overall total avoidance behaviour score was 12.1 ± 3.5 out of a possible range of 0–15. The median was 13 (interquartile range IQR = 10–15). The avoidance behaviour scores were categorized as a score of 13–15 or 0–12 based on the median split; thus, 558 (58.0%; 95%CI = 54.8–61.1) were categorized as having a score of 13–15 and 404 (42.0%; 95%CI = 38.8–45.2) with a score of 0–12. Statistically significant differences were observed in the increase in mean total avoidance behaviour score for respondents during 25 January–21 February (11.2 ± 3.7), 22 February–17 March (11.8 ± 3.2) and 18 March–3 April (13.9 ± 2.2).

Protective behaviour

Figure 1.2 shows the proportion of *strongly agree/agree* responses for the three successive time periods. All the avoidance behaviour items showed an increase in the proportion of *strongly agree/agree* across the three time periods. The highest increment was seen for wearing a mask out in public for 18 March–3 April. The overall total protective behaviour score was 15.0 ± 2.8 out of the possible range 0–18. The total protective behaviour score of the responses in this study ranged from 4 to 18. The median was 16 (IQR = 13–17). The protective behaviour scores were categorized as a score of 16–18 or 4–15 based on the median split: thus, 524 (54.5%; 95%CI = 51.3–57.7) were categorized as having a score of 16–18 and 438 (45.5%; 95%CI = 42.3–48.7) with a score of 4–15. There is a statistically significant difference in the increase in the mean total protective behaviour score for respondents during 25 January–21 February (14.6 ± 3.0), 22 February–17 March (14.5 ± 2.7), and 18 March–3 April (16.0 ± 2.1).

Fear

Figure 1.3 shows that across the three time periods the highest level of fear was for eating wildlife animals whereas the lowest level was for eating out. The overall total fear score was 10.0 ± 2.3 out of a possible range of 0–12. The median was 11 (IQR = 9–12). The fear scores were categorized as a score of 11–18 or 0–10 based on the median split: thus, 511 (53.1%; 95%CI = 49.9–56.3) were categorized as having a score of 11–12 and 451 (46.9%; 95%CI = 43.7–50.1) with a score of 0–10. The mean total score for respondents during 18 March–3 April was significantly higher than those of the earlier time periods.

Impact

Figure 1.4 shows that the highest impact was on the family's daily routine. All the impact items showed an increase in proportion of *strongly agree/agree* across the three time periods. The overall total impact score was 9.1 ± 4.7 out of the possible range of 0–15. The median was 10 (IQR = 6–13). The impact scores were categorized as a score of 10–15 or 0–9 based on the median split: thus, 509 (52.9%; 95%CI = 49.7–56.1) were categorized as having a score of 10–15 and 453 (47.1%; 95%CI = 43.9–50.3) with a score of 0–9. There is a statistically significant increase in the mean total impact score for respondents during 25 January–21 February (7.6 ± 4.7), 22 February–17 March (9.2 ± 4.8), and 18 March–3 April (11.9 ± 2.9 .) Of note, Figure 2 shows that among all the psychobehavioural variables the trend line of the total impact scores showed a slightly greater upward slope over time.

Perception of susceptibility and severity

Respondents during 18 March–3 April reported a higher proportion of *extremely/very* responses for perception of susceptibility (41.3%) to becoming infected with SARS-CoV-2 compared to those of 25 January–21 February (26.3%) and 22 February–17 March (18.3%). Likewise, respondents during 18 March–3 April reported a higher proportion of *extremely/very* responses for perception of severity (83.2%) of SARS-CoV-2 infection compared to those of 25 January–21 February (70.4%) and 22 February–17 March (72.6%). On the whole, a higher proportion of participants expressed higher susceptibility than severity of SARS-CoV-2 infection across the three time periods.

Anxiety levels

Using a cut-off score of 44 for the STAI score, a total of 72.1% ($n = 694$, 95%CI = 69.2–75.0) of the overall respondents reported moderate to severe anxiety. The proportion of respondents with moderate to severe anxiety during 25 January–21 February, 22 February–17 March and 18 March–3 April was 69.0% (95%CI = 65.1–72.8), 74.6% (95%CI = 62.9–84.2) and 77.4% (95%CI = 72.4–82.0), respectively. All the

psychobehavioural variables were found to be significantly associated with anxiety levels in the univariate analyses. However, none of the demographic characteristics were significantly associated with anxiety levels. There was an inverse association between income and level of anxiety, although the association is not significant. Respondents with income below MYR2000 reported the highest proportion having moderate and severe anxiety (75.3%), followed by MYR2001–4000 (73.4%), MYR4001–8000 (71.1%) and above MYR8000 (70.7%; $p = 0.771$). A total of 73.9% females reported having moderate to severe anxiety compared to only 68.2% in males ($p = 0.075$). For ethnicity, a higher proportion of Indians reported moderate to severe anxiety (77.4%) compared to only 74.2% among the Malays and 69.1% among the Chinese ($p = 0.124$).

Table 2 shows the multivariable logistic regression analysis of factors associated with moderate to severe anxiety. In the multivariate model, the most important factor influencing moderate to severe anxiety is a high perception of severity (OR = 2.09; 95%CI = 1.48–2.94), followed by high perceived susceptibility (OR = 1.71; 95%CI = 1.17–2.50), high impact score (OR = 1.63; 95%CI = 1.17–2.26) and high fear score (OR = 1.47; 95%CI = 1.01–2.14).

Table 2 Multivariable logistic regression analysis of factors associated with moderate to severe anxiety (N=962)

		Univariate	Multivariable logistic regression
	Frequency (%)	Moderate/Severe anxiety (Score 44-80)	Score 44-80 vs 20-43 OR (95CI%)
<i>Perceived susceptibility</i>			
Likelihood to be infected by COVID-19			
Not at all/Somewhat	668 (69.4)	446 (66.8)	Ref
Very/Extremely	294 (30.6)	248 (84.4)	1.71 (1.17-2.50)**
<i>Perceived severity</i>			
Worry about consequences from COVID-19			
Not at all/Somewhat	226 (23.5)	119 (52.7)	Ref
Very/Extremely	736 (76.5)	575 (78.1)	2.09 (1.48-2.94)***
<i>Fear</i>			
Score 0-10	451 (46.9)	283 (62.7)	Ref
Score 11-12	511 (53.1)	411 (80.4)	1.47 (1.01-2.14)*
<i>Impact</i>			
Score 0-9	453 (47.1)	283 (62.5)	Ref
Score 10-15	509 (52.9)	411 (80.7)	1.63 (1.17-2.26)**
<i>Avoidance behavior</i>			
Score 0-12	404 (42.0)	257 (63.6)	Ref
Score 13-15	558 (58.0)	437 (78.3)	1.06 (0.73-1.53)
<i>Protective behaviour</i>			
Score 4-15	438 (45.5)	285 (65.1)	Ref
Score 16-18	524 (54.5)	409 (78.1)	1.18 (0.85-1.65)

*p<0.05**p<0.01, ***p<0.001

Hosmer–Lemeshow test, chi-square: 3.985, p-value: 0.858; Nagelkerke R² : 0.134

Discussion

In view of the urgency and importance of identifying current psychobehavioural issues, as well as providing information for those segments of the population that most need psychobehavioural interventions, our findings are summarized over a period of 10 weeks from the start of data collection and include 2 weeks when the country was under an MCO. We hope that the results from this study will provide insights for the health authorities to use when developing risk communication messages during the current escalating COVID-19 epidemic in Malaysia, so that appropriate intervention can be carried out to help curb the current escalating outbreak and also ensure the well-being of the public while the outbreak is ongoing.

In general, the study respondents during 18 March–3 April, which covers 2 weeks of the MCO, have a higher level of avoidance and protective behaviour compared to respondents in the two earlier periods of the study. The study identified some gaps in preventive measures, the most important being the wearing of masks. Less than one-third of participants before the MCO period were found to wear masks when they were out in public. Nearly 27% reported not wearing masks when out in public during the MCO period, which deserves serious attention. In view of the SARS-CoV-2 infection being extremely contagious, our findings underscore the importance of public health intervention to reach individuals with poor adherence to preventive measures, especially the wearing of masks. Earlier, the World Health Organization (WHO) recommended against wearing masks in community settings as no evidence is available for its usefulness (WHO, 2020a). However, its latest recommendation advises wearing face masks in public areas where social distancing can be difficult (WHO, 2020b), and this should be made known to the public. It is widely known that the shortage of face masks could be the reason why people are not using them, therefore the public should be advised to use another form of facial protection, such as cloth masks, when a face mask is not available. Although they are not as effective as surgical masks, research suggests that they can limit *droplet* transmission from infected individuals (Davies et al., 2013).

It is important for the public to have a certain level of fear towards the COVID-19 outbreak in order to enhance protective behaviour. Previous SARS epidemics and the 2015 Middle East Respiratory Syndrome (MERS) outbreak revealed that people's fear, anxiety and infection sensitivity appear to have a positive impact by trigger care-seeking and personal health protection (Leung et al., 2003; Chang et al., 2004; Lee et al., 2016). Importantly, this study has found that the feeling of fear was relatively low among the study respondents, particularly the fear of going to public eateries from the early phase of the COVID-19 outbreak up to and during the MCO period. Community messages encouraging people to stay at home, avoid visiting public places, practise social distancing and pack their food instead of eating outside have been widely circulated since the beginning of the MCO period. The public therefore should be enlightened to avoid public places, as it has been widely recommended that sustainable social distancing and *rigorous* implementation of *social distancing* are needed to contain the COVID-19 outbreak (Wilder-Smith et al., 2020).

Results from this study also indicated that a sizeable proportion of study participants were greatly impacted by the COVID-19 outbreak, particularly in their family's daily routine and both non-work and work-related travel. Although official data on the economic impact of COVID-19 in Malaysia are not yet

available, nationwide movement control has had a big impact on work-related travel and jobs, as found in this study. At the moment, with slightly over 2 weeks of the MCO, the financial impact is approaching 50%, indicating the potential catastrophic impact of COVID-19 to the economics of Malaysia in the coming future. There is thus an urgent need to *mitigate* any potential *economic* fallout of the *coronavirus economic* crisis. Furthermore, the trend line of the total impact scores showed a slightly greater upward slope over time compared to other psychobehavioural variables, implying *increasing social and economic impact as the outbreak progresses*. *These findings* warrant immediate mitigations to strengthen community resilience in order to endure these impacts during the COVID-19 outbreak.

Risk perception, or an individual's perceived susceptibility to a threat, is an important determinant of protective behaviour. Responses to the H1N1 influenza outbreak in 2009 showed that the success of public health intervention programmes is dependent on individual risk perception (Ibuka et al., 2010; Carlsen and Glenton, 2016). Importantly, the perceived severity of SARS-CoV-2 infection is higher than the perception of susceptibility. Since the beginning of the COVID-19 epidemic in the epicentre, Wuhan, the escalating confirmed cases and deaths from coronavirus in China have received extensive coverage in Malaysia. Of note, this survey commences on the day that the first case of SARS-CoV-2 infection was reported. Despite extensive media coverage and even after the first confirmed case in Malaysia, the perception of susceptibility remains low among participants.

The findings of over two-thirds of the study respondents suffering moderate to severe anxiety indicated that COVID-19 has a strong influence on the mental health of the people of Malaysia. A recent study conducted during the COVID-19 outbreak in China reported that females experience higher psychological impact than males (Wang et al., 2020) and a higher proportion of females reported moderate to severe anxiety than males; nevertheless, these differences were not significant. The current study is unable to provide recommendations on high-risk demographic groups for psychological intervention as there was no significant association between anxiety level and respondents' demographic characteristics. *Future research* involving a *larger sample* size is needed to *further explore* the potential socio-demographic differences in psychological impact associated with COVID-19.

The finding of an increased proportion of respondents with a moderate to severe perception of severity over time is worrisome. Currently, the number of COVID-19 cases is still increasing in Malaysia and the pandemic has yet to reach its peak. This may indicate that a higher proportion of the public may experience anxiety disorders as the epidemic progresses. Multivariable analysis showed that having a high perception of severity and susceptibility is an important determinant of a high anxiety level. The public is more likely to express higher anxiety levels if they perceive they are at risk of becoming infected with SARS-CoV-2: for instance, if someone in their community is infected. This finding supports the hypothesis that risk perception is higher when a health threat is high, uncontrollable or dreaded (Ferrer and Klein, 2015). Previous studies have reported the benefit of a higher perception of susceptibility and severity in triggering a higher practice of recommended prevention measures during disease outbreak (Lau et al, 2005; Leung et al., 2005; Rubin et al., 2009). There is therefore a need to develop appropriate

public educational messages that impart accurate information about the new COVID-19 outbreak yet at the same time do not overestimate the likelihood of infection or underestimate the risk of infection.

Furthermore, in this study the increase in anxiety among those with high socio-economic impact scores is anticipated. The COVID-19 outbreak has affected both the economic and social well-being of the public. On the whole, our findings support the crucial need for the development and implementation of mental health support, treatment and services for the public in Malaysia during the current COVID-19 outbreak (Xiang et al., 2020). It is particularly important for the public to maintain a moderate level of anxiety, as extreme anxiety may impair immune system functioning and increase the risk of infection (Marshall, 2011).

As with all studies, it is worth noting a few limitations of the present study, particularly concerning the study design and data collection method. Firstly, due to the cross-sectional methodology, the directionality of the association or the causal relationship, risk perception, fear, impact and anxiety levels could not be established; however, the findings provide a basis for acquiring and testing a causal hypothesis. Due to various resource limitations during the disease crisis and movement restriction in Malaysia, using an online web-based questionnaire via a social media platform may lead to selection bias, as reflected in the large sample of females and the majority being from the Central region. Despite the lack of representativeness, the current study provides useful first-hand information on public psychobehavioural responses during the new COVID-19 outbreak.

Conclusion

Overall, the public psychological and behavioural responses were found to increase with progression of the COVID-19 outbreak. The majority have a high level of preventive measures and perception of severity of SARS-CoV-2 infection but perception of susceptibility is relatively low. A sizeable proportion of study participants were greatly impacted by the COVID-19 outbreak in their family's daily routine and both non-work and work-related travel. The larger increase in social and economic impact as the outbreak progresses warrants immediate mitigations to strengthen community resilience in order to endure these impacts during the COVID-19 outbreak. A high anxiety level was observed during all three time periods. The factor influencing higher anxiety was a high perception of severity and susceptibility, impact and fear. This timely psychobehavioural assessment during the early phase of the current COVID-19 epidemic among the Malaysian public is valuable for providing insights into strategies for health risk communication and mental health intervention as the COVID-19 pandemic progresses.

Declarations

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Authors contribution

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Li Ping Wong and Haridah Alias. The first draft of the manuscript was written by Li Ping Wong and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Ethics declarations

Conflict of interest

The authors declare that they have no conflict of interest.

Human and animal rights

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee University of Malaya Research Ethics Committee (UM.TNC2/UMREC – 847).

Informed consent

Informed consent was obtained from all patients for being included in the study.

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Figures

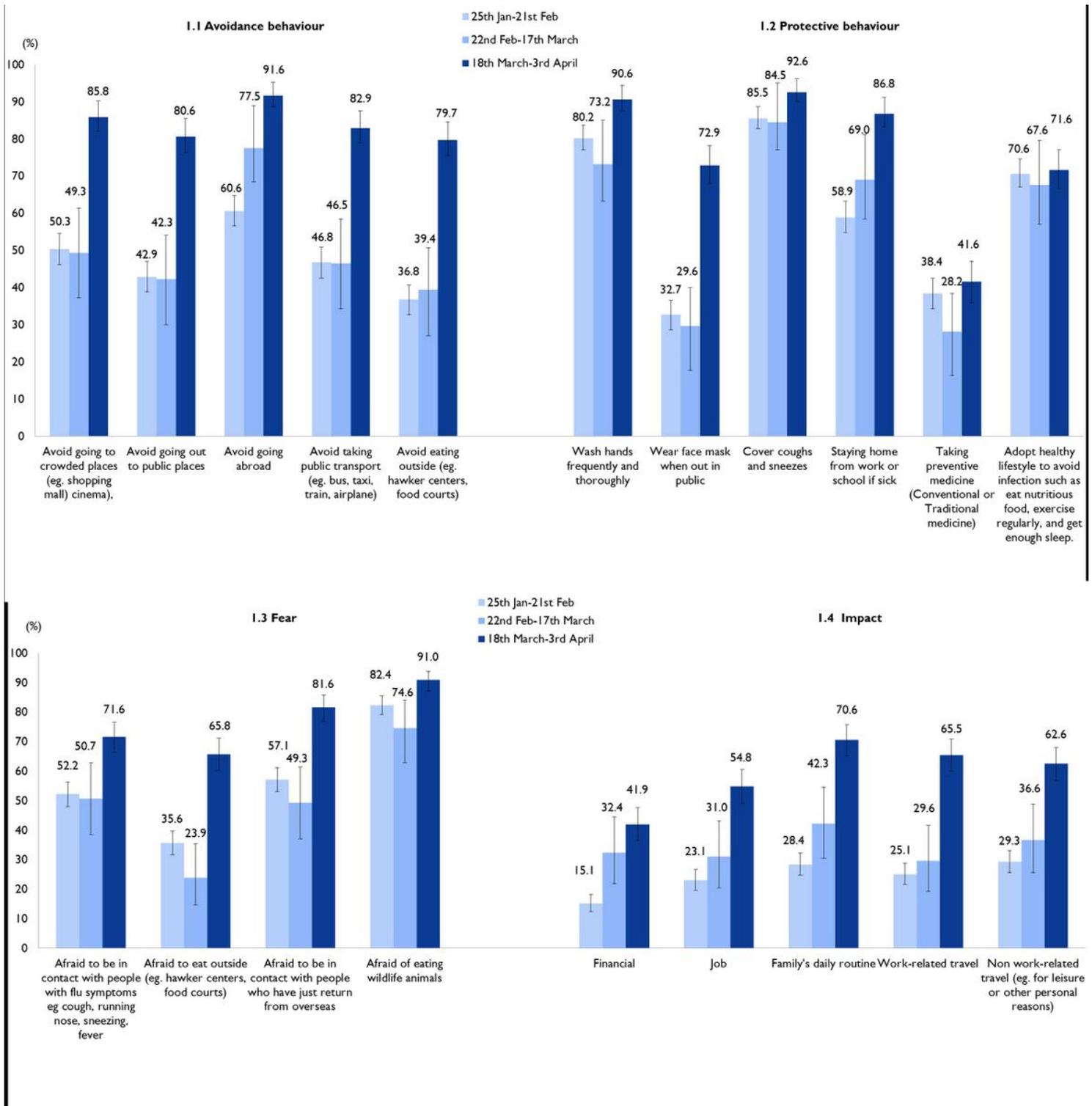


Figure 1

Proportion of strongly agree/agree for avoidance and protective behaviours, fear, and impact (N=962)

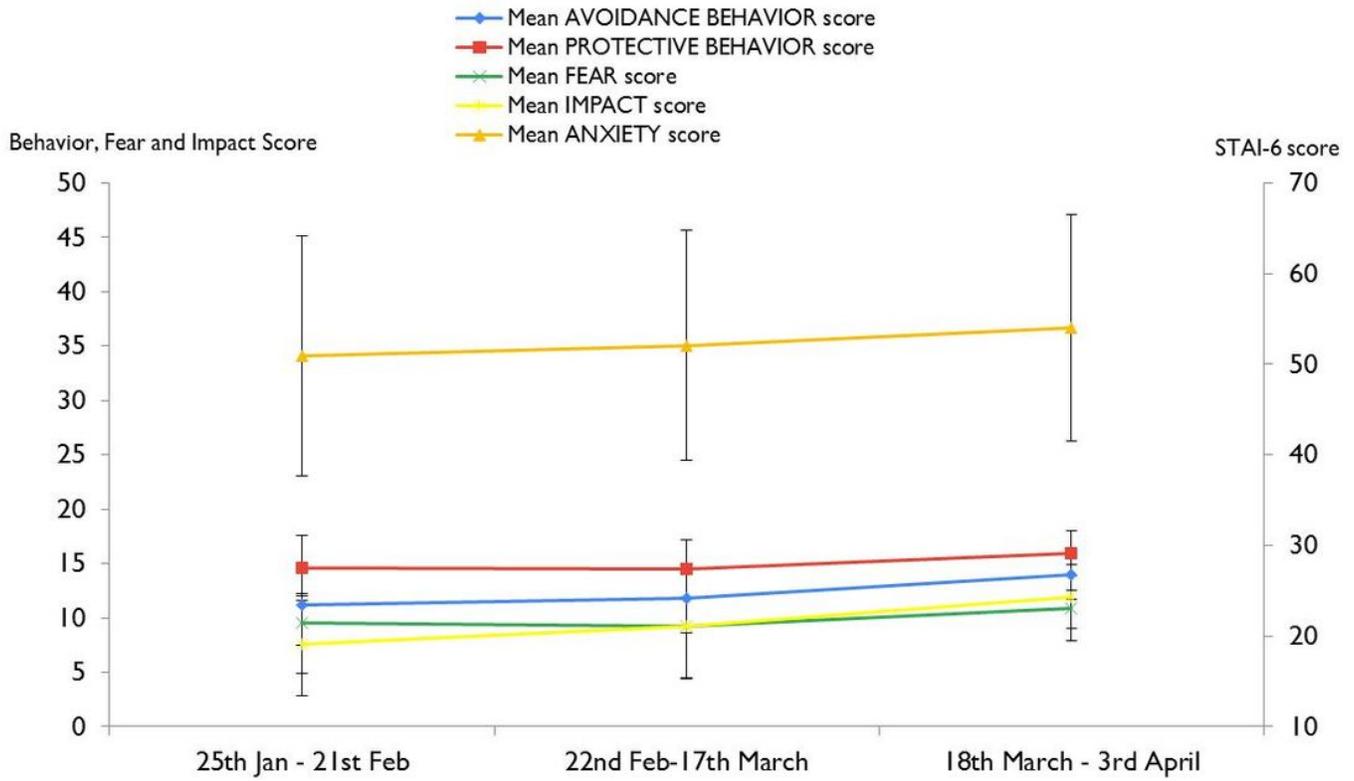


Figure 2

Trend of mean total score of avoidance and protective behaviours, fear, impact, and anxiety (N=962)