Original Article

Psychological Response & Perceived Risk Associated with Coronavirus Disease

Saima Khan¹, Yusra Saleem² & Syed A Aziz²,³

¹Laboratory of Skeletal Development and Regeneration, The Institute of Life Science, Chongqing Medical University, Chongqing-China
²Advance Educational Institute & Research Centre (AEIRC), Karachi-Pakistan
³University of Ottawa & Health Canada, Canada

Abstract

Background: The Coronavirus Disease 2019 (COVID-19) was declared a pandemic by WHO as it is found to be excessively transmissible & to spread throughout the world. The disease has caused a worldwide impact because of the need to establish worldwide activity by extensive social distancing and quarantine due to the daily rising death toll. Through this study, we examined intend to examine the psychological effects, perceptual vulnerability, and perceived stress developed among the general population.

Methodology: The study was conducted from 2nd March to 26th May 2020. A total of 2188 of subjects replied to our informal online survey internationally. The respondent's demographic details and data regarding precautionary measures, perceptual vulnerability, perceived stress, and level of susceptibility of COVID-19 was collected. The perceived stress scale (PSS-10) was used for assessment of perceived anxiety, stigmatization, and fear of developing COVID-19.

Results: As per the study findings, moderate perceived stress was observed among 66.6% of the respondents. Among the protective measures, washing hands was most frequent 56.2%, but the use of face mask wasn’t widespread, i.e. 48.9% rarely or never used face masks. 37.1% felt anxious around sick people, 58.5% were usually bothered by the people sneezing without covering their mouths. 32.3% occasionally felt agitated because of no control over the current situation & 18.6% frequently felt stressed and/or nervous. The contact history revealed that 11.2% had close contact, 20.9% had a non-close contact, and 12.9% were those who had suspected connection with a confirmed case.

Conclusion: Evidently, COVID-19 has numerous psychological impacts, and the responses vary due to perceived vulnerability & stress. The social distancing, disease fear, and quarantine may have some negative effects which may have some lasting consequences on general population.

Keywords

COVID-19, Perceived Vulnerability, Psychological Impacts, Perceived Stress, Disease Susceptibility.
Introduction

The novel outbreak of COVID-19 emerged from China by the end of 2019, followed by a continuous spread globally. Although it is not new for the medical community, the current pandemic is the 5th type of coronavirus infection, i.e. severe acute respiratory syndrome, SARS-CoV2 spread in 2002-2003 with 8,098 cases and a 10% death rate. However, the associated contingency of COVID-19 is reported to be more lethal with a higher rate of symptomatic and asymptomatic fatalities that directed immediate emergency to be led by the scientific and medical community. The virus has been known to cause a range of illnesses from a minor cold to severe complications like acute respiratory distress syndrome (ARDS), that were also observed in 2012 through Middle East Respiratory Syndrome (MERS-CoV) and the SARS-CoV in 2003. Still, this strain of COVID-19 is somewhat different from the ones previously identified among humans.

COVID-19 was declared a Pandemic by WHO due to its transmission mode and reported means of infection spread. An emergency has been announced to control global health, and severe preventive measures are being taken to prevent the disease from spreading globally. According to the World Health Organization (WHO), there were almost 1,133,681 confirmed cases of COVID-19 globally by April 5, 2020, and 62,784 confirmed deaths from 209 affected countries, areas, or territories with confirmed cases. Moreover, specific guidelines for both biomedical and psychological management of this pandemic have been issued by WHO. They are recommending that preventive measures are as necessary as medical aid during this physiological health crisis. The global scenario that is considered a threat to any healthy individual's well-being has created much psychological stress globally and already generated fear among individuals. This might be due to the daily news depiction indicating rising figures of suspected and confirmed COVID-19 cases and pertinacious quarantine.

Apart from physical suffering, it is not uncommon for confirmed or suspected patients of COVID-19 to deal with psychological pressure and other health-related problems. The mental health of the affectees has not been adequately assessed. Many of the academic institutes are now providing counselling services for such psychologically affected individuals. The negative psychological impact of the epidemic and social distancing includes Post-Traumatic Stress (PTS) symptoms, depression, anxiety, and anger confirmed amongst individuals.

Moreover, numerous studies have presented that front-line healthcare workers and patients are more susceptible to the emotional influences of COVID-19. Additionally, rejection, loneliness, depression, insomnia, anxiety, and hopelessness were also experienced. Increased risk of aggression and suicide were also reported but rarely. It is noteworthy that this disease is not only disrupting the physical state of humans but also demolishing our psychological well-being.

Furthermore, mass quarantine is expected to elevate anxiety significantly for several reasons. This raised anxiety might also have follow-on consequences for further health dealings, as the general population is encountering disappointment, boredom, and irritability under the isolation measures. Moreover, strict social distancing and compulsory contact tracing policies by health specialists could cause discrimination, societal rejection, financial loss, inability to perform routine work, and stigmatization. A recent study, including 4,607 individuals of Chinese descent, disclosed that these individuals' cognitive evaluations, particularly their perceived severity of COVID-19, are associated with increased negative emotions and behavioural reactions.
Furthermore, the health experts are of no exception during the crucial time as they are on the forefront, in direct and close contact with the infected patients, suspected cases, families and are also answerable to the public inquiries7.

Competent efforts are required concerning all disciplines to combat COVID-19, both medically and psychologically. There is little to no known evidence on mental health and psychological influences due to the COVID-19 pandemic within the general population11. Most of the COVID-19 related research emphasizes epidemiology and the clinical features of the diseased persons12, the genomic description13 and the challenges faced by the global health authorities9. There is no ongoing research investigating the psychological influence of COVID-19 on the general population to the best of our knowledge. Hence, the current study aimed to stimulate research on the psychological impacts of the COVID-19 pandemic. It is intended to explore the incidences of psychological distress and identify the perceived risks and protectiveness among general the population. This might support the healthcare authorities in preserving the mental health of the community during this pandemic.

Methodology

The survey was created and distributed using online survey administration app (Google Forms). Data was collected from March 2 to May 26, 2020. A total of 2188 subjects replied to our informal online survey globally. Participants were notified that they would not be compensated for their participation in the study and could stop taking the study at any time. They were also informed that the purpose of the study was to investigate their attitudes about COVID-19. The institutional ethics committee approved survey procedures. Subjects completed the online survey by using their phone or computer. The survey was advertised through social media (e.g., Facebook, Twitter). The respondent's demographic details were inquired, and the data regarding precautionary measures, perceptual vulnerability, perceived stress, and level of susceptibility of COVID-19 were collected. The Perceived Stress Scale (PSS-10) was used to assess perceived anxiety, stigmatization, and fear of developing COVID-19.

The collected data were analyzed using SPSS version 22.0, and all qualitative variables like gender, regional distribution, protective measures, personal habits, perceptual vulnerability, and perceived stress subscale scoring, etc. were given as frequency and percentages. All quantitative variables like age and perceived stress scores were presented using mean and standard deviation (SD).

Result

Respondents' characteristics

Overall, 2188 responders from 21 different countries globally took part in the electronic survey. Of the total, 68.1% were females, and 31.9% were males with a mean age of 28.22±9.42 years. Most of the respondents included post-graduate students (40.3%), followed by under-graduates (24.3%) and graduates (21.5%). The majority of responses were obtained from the Eastern Mediterranean Region (27.90%), i.e. Pakistan, Saudi Arabia, Tunisia, and The United Arab Emirates, followed by countries from The European Region (27.51%), namely Belgium, Finland, France, Germany, Greece, Poland, Portugal and The United Kingdom (Table 1). The demographic characteristics of the study participants are displayed in table 1.

Predictors for implementation of precautionary measures

Regarding the protective measures taken by the responders and personal habits developed after the declaration of the COVID-19 pandemic, the most reported action and the most frequently established practice was washing hands with soap, i.e. 56.2% of respondents washed their hands very often. Moreover, 54% cover their mouth habitually while coughing or sneezing, and
28.2% would immediately wash their hands after while 32.7% of respondents would sometimes wash their hands after sneezing, coughing, or rubbing their nose. The essential protective measure of wearing face masks wasn’t ubiquitous, as only 22.9% of respondents were using face masks frequently, while 26.9% of the respondents never used face masks.

Table 1: Demographic characteristics & Regional distribution of the study participants along with Protective measures, personal habits and various aspects of perceptual vulnerability.

| Variables                        | n=2188 |
|----------------------------------|--------|
| Gender                           |        |
| Female                           | 1491(68.1) |
| Male                             | 697(31.9) |
| Age (Years) Mean ± Standard deviation | 28.22±4.92 |
| Education                        |        |
| Graduate                         | 470(21.5) |
| Post-Graduate                    | 882(40.3) |
| Under-Graduate                   | 532(24.3) |
| Others                           | 304(13.8) |
| Countries                        |        |
| Western Pacific Region           |        |
| Australia                        | 86(3.9) |
| East African Region              |        |
| Tanzania                         | 69(3.2) |
| East Asian Region                |        |
| Taiwan                           | 86(3.9) |
| South Asian Region               |        |
| Bangladesh                       | 82(3.7) |
| South-East Asia Region           |        |
| India                            | 151(6.9) |
| Eastern Mediterranean Region     |        |
| Pakistan                         | 342(15.6) |
| Saudi Arabia                     | 71(3.2) |
| Tunisia                          | 108(4.9) |
| United Arab Emirates             | 90(4.1) |
| European Region                  |        |
| Belgium                          | 63(2.9) |
| Finland                          | 66(3) |
| France                           | 60(2.7) |
| Germany                          | 106(4.8) |
| Greece                           | 62(2.8) |
| Poland                           | 103(4.7) |
| Portugal                         | 56(2.6) |
| United Kingdom                   | 86(3.9) |
| Region of the Americas           |        |
| Canada                           | 108(4.9) |
| United States of America         | 167(7.6) |
| Western Pacific Region           |        |
| Malaysia                         | 95(4.3) |
| New Zealand                      | 73(3.3) |
| Philippines                      | 58(2.7) |
| Habits                           |        |
| Wearing face masks               |        |
| Fairly Often                     | 291(13.3) |
| Never                            | 588(26.9) |
| Rarely                           | 480(22) |
| Sometime                         | 617(28.2) |
| Very Often                       | 212(9.7) |
| Washing hands with soaps         |        |
| Fairly Often                     | 606(27.7) |
| Never                            | 81(3.7) |
| Rarely                           | 271(12.4) |
| Sometime                         | 1230(56.2) |
| Very Often                       |        |
| Covering mouth while coughing or sneezing |        |
| Fairly Often                     | 445(20.3) |
| Never                            | 59(2.7) |
| Rarely                           | 96(4.4) |
| Sometime                         | 406(18.6) |
| Very Often                       | 1182(54) |
The perceptual vulnerability of respondents
The respondents' perceived vulnerability was assessed. It was found that 14.7% of the respondents reported that their immune system protects them from most illnesses that often affect others. Moreover, 10.3% of the respondents were not very anxious around the sick people, while 37.1% sometimes felt anxious. Around 7.7% of the respondents thought they were more likely to catch infectious diseases, 5.8% were sure of disease susceptibility, and 9.4% believed that they were less likely to get sick (Table 1).

Perceived Stress among the respondents
The respondents' level of perceived stress due to the COVID-19 outbreak was assessed through the Perceived Stress Scale (PSS-10). Both negative and positive subscales were used except for items 4 & 5. As per the analysis, the mean PSS score was 19.98±6.08, indicating that most of the respondents had moderate perceived stress (66.6%). Moreover, 17.9% were those displaying high perceived stress and 15.4% with low perceived pressure. The descriptive summary shows that 58.5% of the respondents reported that people who sneeze without covering their mouths make them anxious. While 32.3% sometimes felt agitated because the things happened were outside their control, and 29.4% reported that they sometimes felt difficulties piling up so high that they could not recover. 18.6% frequently felt stressed and nervous and fearful, and 17.6% believed they were unable to control the essential things in their life. Moreover, 25% very often felt upset because of the unexpected happenings of COVID-19, followed by 23.4% reporting it fairly often and 27% sometimes (Table 2).

Table 2: Shows the Perceived Stress among the respondents

| PSS-10 score (Mean ± SD) | 19.98±6.08 |
|-------------------------|------------|
| **Subscale Scoring**    | n(%)       |
| Low Perceived Stress (≤ 13) | 338(15.4) |
| Moderate Perceived Stress (14-26) | 1458(66.6) |
| High Perceived Stress (≥ 27) | 392(17.9) |

| Descriptive Results | Fairly Often | Never | Rarely | Sometimes | Very Often |
|---------------------|--------------|-------|--------|-----------|------------|
| In the last month, how often have you been upset because of... | 512(23.4) | 204(9.3) | 334(15.3) | 590(27) | 548(25) |

*Values are given as n(%)*
something that happened unexpectedly?

| In the last month, how often have you felt that you could not control the essential things in your life? | 456(20.8) | 188(8.6) | 474(21.7) | 680(31.1) | 384(17.6) |
| In the last month, how often have you felt nervous and stressed? | 454(20.7) | 160(7.3) | 452(20.7) | 712(32.5) | 406(18.6) |
| In the last month, how often have you found that you could not cope with all the things you had to do? | 456(20.8) | 270(12.3) | 498(22.8) | 624(28.5) | 320(14.6) |
| In the last month, how often have you been able to control irritations in your life? | 554(25.3) | 136(6.2) | 334(15.3) | 896(41) | 246(11.2) |
| In the last month, how often have you felt that you were on top of things? | 424(19.4) | 286(13.1) | 562(25.7) | 750(34.3) | 150(6.9) |
| In the last month, how often have you been angered because of things that happened that were outside of your control? | 456(20.8) | 298(13.1) | 498(22.8) | 624(28.5) | 320(14.6) |
| In the last month, how often have you felt difficulties were piling up so high that you could not overcome them? | 446(20.4) | 322(14.7) | 536(24.5) | 644(29.4) | 238(10.9) |

It bothers me when people sneeze without covering their mouths

| In the last month, how often have you felt that you were on top of things? | 424(19.4) | 286(13.1) | 562(25.7) | 750(34.3) | 150(6.9) |

*For item 1-3, 6, 9 (0 – never; 1 - almost never; 2 – sometimes; 3 - fairly often; 4 - very often)
*For item 7 & 8 (4 – never; 3 - almost never; 2 – sometimes; 1 - fairly often; 0 - very often)

**Level of direct and indirect contact history with diagnosed COVID19 cases**

| Contact History | Yes | No | May Be |
|-----------------|-----|----|-------|
| Close contact with a confirmed case | 78.2% | 11.2% | 10.5% |
| Non-close contact with a confirmed case | 59.8% | 20.9% | 19.3% |
| Indirect contact with a confirmed case | 69.4% | 9.6% | 21% |
| Suspected contact with a case / infected materials | 53.9% | 12.9% | 33.2% |

**Figure 1: Shows the level of susceptibility of the respondents following their contact history**
Respondents reported their level of susceptibility as per their experience and understanding. Around 11.2% of the respondents reported that they had close contact with a confirmed case, and 10.5% were not very sure of any such incident, while 78.2% faced no such circumstances. 20.9% had a non-close contact, 9.6% had an indirect connection with a confirmed case, while 12.9% had contact with a hypothetical case.

**Discussion**

The outcome of this study has expanded our limited understanding about the influence of the coronavirus pandemic and the associated psychological impacts\(^\text{14}\), raising a key concern against the negative impact held by the news, social distancing and quarantine in modern times. As it has been identified that COVID-19 spreads mainly through close contact from the droplets generated during spitting and sneezing from infected individuals\(^\text{15}\). Although quarantine and social distancing are recommended to lessen the disease transmission, the long-lasting implications associated with the diseases affecting people psychologically must also be considered before implementing these protective measures. We have the evidence indicating a positive history of psychological distress among the SARS survivors back in 2004\(^\text{16}\). After the SARS outbreak in 2003, the survivors suffered from stress and anxiety even after one year of the outbreak\(^\text{16}\). Despite knowing the adverse and long-term impacts of these preventive measures, we continue to follow the trend. Social distancing & quarantine has been accepted and implemented globally to minimize the disease spread.

Unstable mental health is prominent among the general public and the sufferers of COVID-19\(^\text{17}\). It was revealed that more than 32.3% felt agitated because the things that happened were outside their control, and 18.6% frequently felt stressed, nervous and fearful because of the unprecedented happening of COVID-19. The study reveals an association between participants' risk perceptions built on individual experiences and existing circumstances. A wide range of literature depending on health actions and risk of communication provides a context for understanding this link. The risk of transmission should be considered as a critical element in encouraging people to adopt healthy behaviors\(^\text{18}\). That has been proven by both the health belief model and protective motivation theory, indicating that positive behavioural change is associated with risk prevention. Belief in one's ability to make the necessary change and belief that making the change may result in the health benefits for oneself has long been known and practiced\(^\text{19}\).

Some of the respondents also ignored protective measures; for instance, 26.9% were not wearing masks, whereas others created new stricter rules for themselves. For example, 45% revealed washing hands after touching possibly contaminated objects, 56% showed washing hand with soap, while 54% cover their mouth while sneezing or coughing (Figure 1). Similar studies indicated that societal, psychological, and cultural influences modulate risk perceptions\(^\text{20,21}\). Literature suggests that the perceived level of risk associated with any event can be overstated compared to the originality, which might be due to the unmanageability of the associated risks\(^\text{22,23}\).

The psychological health influence of COVID-19 among the patients, caretakers, and hospital employees is overwhelming compared to those disasters where contact to a threat was brief. Moreover, the perceptual vulnerability, stress, and psychological responses to COVID-19 significantly differ amongst people as per the present study's findings. Previously, research conducted on
perception-related responses to the SARS epidemic indicated that increased fear, sense of social isolation, and occupational stress were significantly associated with PTS symptom levels\textsuperscript{24}. We also assessed the level of suppressibility of COVID-19 among the general population as per their understanding. It appears that 11.2\% of the respondents had close contact with a confirmed case in the last two months while 78.2\% had no close contact, 20.9\% had a non-close contact, and 9.6\% had an indirect connection with a confirmed case (Figure 1). The study presenting the epidemiological analysis of COVID-19 among different age groups indicated that the infection rate and associated mortality is high among older age groups\textsuperscript{25}.

Moreover, the stress induced by the COVID-19 outbreak is evident and accepted. WHO states that this pandemic has widely increased the general population's stress levels, mainly due to unfamiliarity and high mortality within a short duration of time\textsuperscript{5}. The mean PSS score was 19.98 ± 6.08, which lies under the moderate category, i.e. most of the respondents (66.6\%) had mild perceived stress due to this pandemic for helping the psychological sufferers. WHO highly recommends minimizing the exposure to COVID-19 associated news is the primary reason behind anxiety and depression\textsuperscript{5}. Moreover, the exposure must only be limited and acquired only at certain times in a day or two and only from a reliable source giving practical and authentic information\textsuperscript{5}. During this health crisis, it is imperative to bring up facts to combat fear among the population. The information regarding the disease, either related to spreading, prevention, or protective measures, must be scrutinized before implementation and dissemination. One must be very careful while sharing the news, as the intensity of the disinformation and myths depends on how many people believe it and share it.

This article outlines the perceived and psychological concerns associated with COVID-19 that must be known and considered by healthcare providers, front-line personnel, and the general population while taking preventive measures. Social distancing and quarantine are more likely to induce psychological distress because of increased fear of disease, limited knowledge, and altered risk perceptions due to varying emotional states\textsuperscript{7}. The incomplete and evolving understanding of this catastrophic condition has promoted psychological suffering among the general population.

**Conclusion**

In conclusion, COVID-19 has shown to be a strong reason for psychological distress within the global population as perceived by many with moderate intensity. Moreover, the state of fear, perceived vulnerability, social distancing, and global panic seem to major contributing factors in causing this stress that can further impact the general population's health and well-being. One of the primary reasons behind the fact is an unknown and unusual situation as the current generations face a pandemic for the first time. The reactions are more precisely associated with one's psychological response towards a new threat. The study can help get some insight and propose any interventional measures to combat the psychological impacts of COVID-19 that will curtail the sufferings during this period of uncertainty.

**Acknowledgement**

We would like to acknowledge all the responders for their time and cooperation. The study was designed & supported by the Advance Educational Institute & Research Centre (AEIRC).

**References**

1. Government of Pakistan, Ministry of National Health Services, Regulation and coordination. National Action Plan for
Coronavirus disease (COVID-19) Pakistan. 2020 [Cited March 4, 2020]. Available at: https://www.nih.org.pk/wp-content/uploads/2020/03/COVID-19-NAP-V2-13-March-2020.pdf

2. Frontiers Research Topics. Coronavirus Disease (COVID-19): Psychological, Behavioral, Interpersonal Effects, and Clinical Implications for Health Systems. 2020. [Cited March 4, 2020]. Available at: https://www.frontiersin.org/research-topics/13561/coronavirus-disease-covid-19-psychological-behavioral-interpersonal-effects-and-clinical-implication

3. World Health Organization (WHO). Infection prevention and control during health care for probable or confirmed cases of Middle East respiratory syndrome coronavirus (MERS-CoV) infection: Interim guidance. 2019. [Updated October, 2019] [Cited March 5, 2020]. Available at: https://www.who.int/csr/disease/coronavirus_infections/ipc-mers-cov/en/

4. World Health Organization (WHO). Coronavirus disease (COVID-19) Pandemic. 2020. [Updated: April 5th 2020]. Available at: https://www.who.int/emergencies/diseases/novel-coronavirus-2019

5. World Health Organization. Mental health and psychosocial considerations during the COVID-19 outbreak. 2020 [Updated March 18, 2020] [Cited March 5, 2020]. Available at: https://www.who.int/docs/default-source/coronaviruse/mental-health-considerations.pdf

6. Brooks SK, Webster RK, Smith LE, Woodland L, Wessely S, Greenberg N, Rubin GJ. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. The Lancet. 2020, 395(10227), 912-920.

7. Xiang YT, Yang Y, Li W, Zhang L, Zhang Q, Cheung T, Ng CH. Timely mental health care for the 2019 novel coronavirus outbreak is urgently needed. Lancet Psych. 2020;7(3):228-229.

8. Zhao X, Zhang B, Li P, Ma C, Gu J, Hou P, Guo Z, Wu H, Bai Y. Incidence, clinical characteristics and prognostic factor of patients with COVID-19: a systematic review and meta-analysis. medRxiv. 2020.

9. Rubin GJ, Wessely S. The psychological effects of quarantining a city. BMJ. 2020;368.

10. Li JB, Yang A, Dou K, Cheung RY. Self-control moderates the association between perceived severity of the coronavirus disease 2019 (COVID-19) and mental health problems among the Chinese pub. 2020.

11. Wang C, Pan R, Wan X, Tan Y, Xu L, Ho CS, Ho RC. Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in china. Int. J. Environ. Res. Public Health. 2020; 17(5):1729.

12. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, Zhang L, Fan G, Xu J, Gu X, Cheng Z. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. The Lancet. 2020, 395(10223), 497-506.

13. Lu R, Zhao X, Li J, Niu P, Yang B, Wu H, Wang W, Song H, Huang B, Zhu N, Bi Y. Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. The Lancet. 2020; 395(10224):565-574.

14. Hawryluck L, Gold WL, Robinson S, Pogorski S, Galea S, Styra R. SARS control and psychological effects of quarantine, Toronto, Canada. Emerg. Infect. Dis. 2004; 10(7):1206.

15. Booth TF, Kournikakis B, Bastien N, Ho J, Kobasa D, Stadnyk L, Li Y, Spence M, Paton S, Henry B, Mederski B. Detection of airborne severe acute respiratory
syndrome (SARS) coronavirus and environmental contamination in SARS outbreak units. J Infect. Dis. 2005; 191(9):1472-1477.

16. Lee AM, Wong JG, McAlonan GM, Cheung V, Cheung C, Sham PC, Chu CM, Wong PC, Tsang KW, Chua SE. Stress and psychological distress among SARS survivors 1 year after the outbreak. Can J Psychiat. 2007; 52(4):233-240.

17. Nickell LA, Crighton EJ, Tracy CS, Al-Enazy H, Bolaji Y, Hanjrah S, Hussain A, Makhlouf S, Upshur RE. Psychosocial effects of SARS on hospital staff: survey of a large tertiary care institution. Cmaj. 2004; 170(5):793-798.

18. Rothman AJ, Kiviniemi MT. Treating people with information: an analysis and review of approaches to communicating health risk information. JNCI monographs. 1999;25:44-51.

19. Floyd DL, Prentice-Dunn S, Rogers RW. A meta-analysis of research on protection motivation theory. J. Appl. Soc. Psychol. 2000; 30(2):407-429.

20. Kowalewski MR, Henson KD, Longshore D. Rethinking perceived risk and health behavior: a critical review of HIV prevention research. Health Educ. Behav. 1997;24(3):313-325.

21. Lion R, Meertens RM, Bot I. Priorities in information desire about unknown risks. Risk Anal. 2002; 22(4):765-776.

22. Marshall RD, Galea S, Kilpatrick D. Psychological reactions to terrorist attacks. Findings from the National Study of Americans’ reactions to September 11: comment. JAMA, 2002; 288(21): 2683–2684.

23. Marshall RD, Bryant RA, Amsel L, Suh EJ, Cook JM, & Neria Y. The psychology of ongoing threat: relative risk appraisal, the September 11 attacks, and terrorism-related fears. Am. Psychol. 2007; 62(4): 304-315.

24. Maunder RG, Lancee WJ, Rourke S, Hunter JJ, Goldbloom D, Balderson K, Petryshen P, Steinberg R, Wasylenki D, Koh D, Fones CS. Factors associated with the psychological impact of severe acute respiratory syndrome on nurses and other hospital workers in Toronto. Psychosom. Med. 2004; 66(6):938-942.

25. Sun K, Chen J, Viboud C. Early epidemiological analysis of the coronavirus disease 2019 outbreak based on crowdsourced data: a population-level observational study. The Lancet Digital Health. 2020;2(4): e201-e208.