Travel behaviour prediction amid covid-19 underlaying situational awareness theory and health belief model

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ABSTRACT

Travel and tourism have been hard-hit by COVID-19, and people have been forced to cancel travel plans due to governments being forced to implement travel bans to curb infection dissemination. Therefore, this study investigates the influence of situational awareness for adopting health-protective behaviours such as postponed travel plans. We used the theory of situational awareness (SAT) coupled with the health belief model (HBM) to analyze health-related behaviors. Data from a cross-sectional survey of 705 Pakistani and international adults were analyzed using Structural Equation Modelling, during the peak of the COVID-19. The results confirmed that perceived understanding of COVID-19 cause influences perceived severity, understanding of contracting COVID-19 influences perceived susceptibility, and perceived understanding of COVID-19 prevention influences both perceived barriers and perceived benefits. The results further showed that perceived understanding of COVID-19 prevention is a strong predictor of self-efficacy, which ultimately influences health-protective behaviour. In addition, the sentiment analysis revealed that as COVID-19 continues to rise, people are becoming more sentimental and avoiding travel, even during festivals. The outcome of this study demonstrates that situational awareness has an effect on the postulates of health-protective measures and plays a key role in the implementation of protective measures such as canceling travel plans to ensure protection.

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1. Introduction

In the past six months since the emergence of the first case of COVID-19 and its rapid global spread, nations have introduced many strategies of community easing to lower the COVID-19 trajectory by implementing the protocols that can lead to lowered transmission and protect health care systems from being overwhelmed. The current pandemic has a clinical profile that is comparable to seasonal influenza, although initially, it appeared to be more severe. Since its emergence, the world has realised that now is the time to ensure that people's health risk prevention is well maintained (Belingheri, Paladino, and Riva 2020; World Health Organization 2020a). Many countries around the globe have implemented restrictions and control measures in multiple sectors such as education and distance learning (Qazi et al. 2020; Qazi et al. 2021b; Qazi et al. 2021c; Taghizadeh et al. 2021), shopping (Sarkar, Debnath, and Reang 2021), and travel (Oum and Wang 2020), which has led to limiting the spread of infection. Particularly in the transportation and tourism sectors, travel plans have been severely hampered. International and domestic travel are considered major routes for the spread of COVID-19 infections (Sharun et al. 2020). Consequently, this has become a risk associated with travel plans and decisions. Travel risk perceptions, especially about travel destinations, have been shown to influence travel intentions and decision making (Fuchs 2013; Lepp and Gibson 2003; Reisinger and Mavondo 2005; Matyas et al. 2011). Such travel risk perceptions are likely to be formed based on awareness of the risk condition (COVID-19) at the destination. Furthermore, self-efficacy is relevant in terms of the ability to take action to limit one's susceptibility to that risk.

Meanwhile, people are unlikely to be well-prepared for the changing situation of COVID-19 since the situation develops over days and weeks rather than months and years. In situations such as these, situational awareness and health belief determinants are critical to adopt any health-protective measure (Qazi et al. 2020; Everett et al. 2020). The predictors for the adoption of health-protective behaviours during pandemics are being studied (Bish and Michie 2010; Rubin et al. 2009; Tang and Wong 2005; Webster et al. 2020; Wise et al. 2020), however, a related theory is still emerging. A robust theory is essential to effectively predict health-protective behaviour during future pandemics. This study, therefore, combines the situational awareness theory (Endsley 1995), Bandura's concept of self-efficacy (Bandura, Freeman, and Lightsey 1999), and the health belief model (HBM) (Janz and Becker 1984; Rosenstock, Strecher, and Becker 1988; Champion and Skinner 2008) to predict avoidance of travel as a necessary preventive measure against the COVID-19 pandemic. Combining theoretical paradigms can yield effective models that enable the comprehensive prediction of health-protective behaviours. Section 2 explains the proposed model. Section 3 details the methodology. Section 4 explains the results, while Section 5 discusses the results. Implications are provided in Section 6 and Section 7 concludes the study.

2. Proposed model and hypothesis

This study expanded the HBM in the sense of COVID-19 by adding three external variables, namely, three levels of situational awareness (understanding of COVID-19 cause, understanding of contracting, and understanding of prevention), based on previous studies and theoretical concepts. The dependent variable for this study is action, which is represented by postponed travel plans, whereas self-efficacy is one of the factors that influence action based on the perceived understanding of COVID-19 prevention.

Situational awareness (SA) is described by the Endsley model. It has three levels and has been widely used (Endsley 1995). The first level is perception, which makes the base of SA. The second level is comprehension, while the third is projection. This theory has been used by researchers in health care emergency management (Seppänen et al. 2013), and to determine factors that influence health-protective behaviour during the Influenza (H1N1) pandemic (Liao et al. 2010) and the CVOID-19 pandemic (Qazi et al. 2020). In this study, we have assessed the SA about COVID-19 as follows: basic understanding of COVID-19 cause at the first level, understanding of contracting COVID-19 at the second level, and understanding of COVID-19 prevention at advanced level three, and linked SA to health behaviour.

The HBM, on the other hand, is the most well-known socio-behavioural model, which was developed by social psychologists Godfrey Hochbaum and Irwin Rosenstock in the early1950s (Strecher and Rosenstock 1997). The HBM is the most popular and influential theoretical model in health risk reduction and health promotion and focuses on people's beliefs about their decisions. HBM predicts two forms of behavioural beliefs: perceived threat and perceived effectiveness (Champion and Skinner 2008). The two sub-components of perceived threat are perceived susceptibility and perceived severity. Perceived susceptibility describes how individuals consider the risk or the chances of contracting health problems (Witte 1992), while perceived severity refers to how severe an individual considers the medical and social effects to be. The belief that enacting healthy behaviour will reduce the risk of health problems (perceived benefit) and the obstacles an individual believes can prevent them from enacting healthy behaviour (perceived barriers) constitute the perceived effectiveness. To enhance the predictability of behaviour, other constructs including self-efficacy were later added to the model (Rosenstock, Strecher, and Becker 1988). Self-efficacy is defined as the belief in one's ability to successfully execute any behaviour necessary to produce an expected outcome (Bandura 1977). HBM has been used by many researchers that study healthy behaviours (Umaki, Umaki, and Cobb 2012; Rahnavard et al. 2011). It has been recently used to show how community pharmacists can reinforce behaviours that limit the spread of the COVID-19 pandemic (Carico, Sheppard, and Thomas 2021) and to determine the mental health and emotional impact of healthcare workers in Pakistan (Mukhtar 2020).

Underlying the theoretical paradigm, the proposed model hypothesised the relationship between situational awareness, health-related beliefs and preventive health behaviours. In this study, situational awareness is assessed through three independent variables (understanding COVID-19 causes, understanding of contracting COVID-19 and understanding COVID-19 prevention). Perceived threat (perceived severity and perceived susceptibility), perceived effectiveness (perceived benefits and perceived barriers) and self-efficacy are the mediating variables, and the decision to postpone travel plans is the dependant variable. Perceived threat and perceived effectiveness are important predictors of protective health behaviour (Rosenstock 1974), which are in turn influenced by several

characteristics such as unfamiliarity, invisibility, inequity, demographics, trust and awareness (Qazi et al. 2020; Liao et al. 2010; Slovic 1987; Slovic 1999). Therefore, understanding the causes of COVID-19 can help to perceive its severity and understanding how the virus is contracted can help to perceive one's susceptibility to the virus. Likewise, understanding COVID-19 prevention can help to perceive the benefits and barriers associated with enacting a particular healthy behaviour, as well as one's confidence in their efficacy to enact such healthy behaviour. Consequently, people's adherence to health-protective measures such as wearing nose masks, gloves, maintain social distancing or modifying travel plans might be indicative of a high level of situational awareness and belief to adopt health-protective behaviours (Dzisi and Dei 2020; Doung-ngern et al. 2020; Chiu et al. 2020; Xiao et al. 2020; Venigalla, Vagavolu, and Chimalakonda 2020). Furthermore, an individual's awareness about the pandemic situation can enable them to effectively assess their own abilities in performing successful actions concerning their health, as evident in the literature (Liao et al. 2010; Walrave, Waeterloos, and Ponnet 2020).

By looking into the importance of these constructs, this study attempts to fill a gap by investigating the relationships among travellers' awareness of COVID-19, their health beliefs, self-efficacy and risk prevention behaviours. To the best of our knowledge, this is the first study in the field that has tested this model against data collected during the COVID-19 pandemic to determine whether situational awareness and travel risk perceptions were linked to health-protective behaviour. Figure 1 shows a graphical representation of the proposed hypothesis.

3. Methods

3.1. Cross-sectional online survey

Between 18 and 23 May 2020, we conducted an online survey targeted at Pakistan residents as well as overseas Pakistanis and other nationals. The sample for the study was determined by first, computing an *a priori* minimum sample size using the statistical application G*Power version 3.1.9.7. The following input parameters were applied: effect size = 0.1, power value = 0.80, and alpha value = 0.05. This generated a recommended minimum sample size of 614. Our online survey, however, yielded 705 responses which were used for the analysis. The demographic data for the respondents include their age, gender, and frequency of travel per year to determine if they are frequent travellers (Figure 2A-C).

3.2. Survey design

The survey questions were adapted from published studies conducted during the 2009 influenza H1N1/A pandemic (Seale et al. 2010), and the COVID-19 pandemic (Qazi et al. 2020; Carico, Sheppard, and Thomas 2021; Walrave, Waeterloos, and Ponnet 2020; Seale et al. 2020; Abdullah et al. 2020; Walrave, Waeterloos, and Ponnet 2020), which used a Likert scale to assess respondent's attitudes about the COVID-19 pandemic, level of awareness, health beliefs measures, self-efficacy and health-protective behaviour, with the Likert response options ranging from 1 for strongly disagree, through to 5 for strongly agree.

Respondents were asked to rate their perceived level of awareness of COVID-19 using eight items. The next set of 13 items were related to their perceived health beliefs, four more items were related to their self-efficacy beliefs of COVID-19 protection, and another four items were related to the adoption of health-protective behaviour. At the end of the questionnaire, respondents were asked through optional open-ended questions to comment regarding the impact of being placed in self-isolation (at home) and not being able to travel. The awareness of COVID-19 was measured in terms of perceived understanding of COVID-19 causes, contraction and prevention, and perceived susceptibility was assessed by the estimated likelihood of an individual's potential risk of being infected. The perceived severity was inferred as the personal viewpoint of the possible impact if infected by the virus. Furthermore, the perceived benefit was estimated as the perceived efficiency of defensive actions that can be taken to reduce risk and perceived barriers are obstacles a person thinks might prevent them from taking action. The items and scales, as well as all predictor variables, are defined in the supplementary materials TS1.

3.3. Data analysis

The proposed health-protective model (Figure 1) was validated by the structural equation modelling (SEM) using Smart PLS. SEM explains the relationships among multiple variables and allows a complete picture of the model that consists of complicated variable relationships (Gefen and Straub 2005). We used Smart PLS Version 2.M to analyse the data in two stages: measurement model evaluation (reliability and validity) and structural model evaluation (interpreting the path coefficients).

Internal consistency of the measurement model was validated using composite reliability (CR), with a threshold value of 0.70 (TS1), and discriminant validity

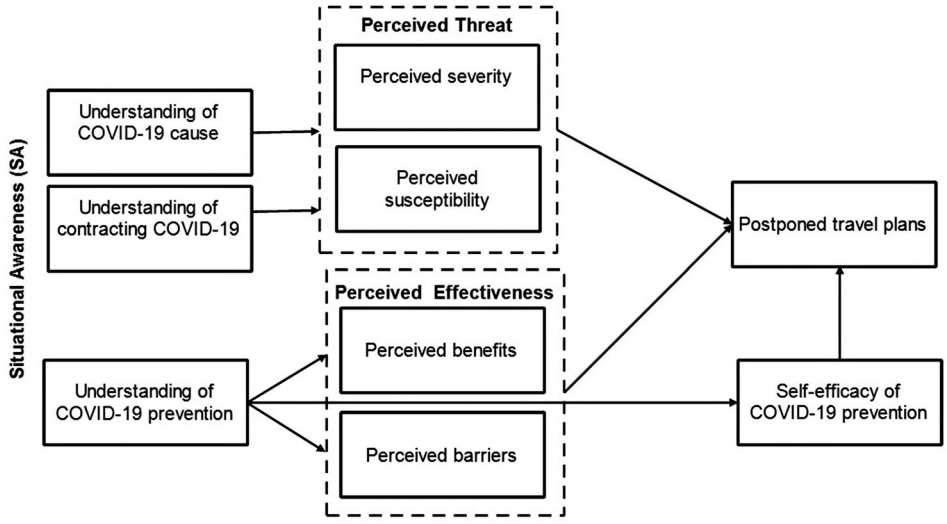

Figure 1. Proposed health-protective model for travel decisions.

was assessed using Fornell-Larcker threshold of 0.85 (Fornell and Larcker 1981) (Table 1) and Henseler (Henseler, Ringle, and Sarstedt 2015) heterotrait-monotrait (HTMT) ratio of correlations (Table 2). The structural model was examined for testing the hypothesised relationships and was measured using path coefficient (Cohen 1992), determination coefficient (R^2), effect size (F^2), and the predictive relevance (Q^2) using the Stone-Geisser test (Chin 1998). F^2 values of 0.02, 0.15, and 0.35 manifest small, medium, and large effects. A value greater than zero for Q^2 indicates that the model is predictively relevant. The path coefficients *P*-values were <0.05, noting a significant relationship (Chin 2010).

3.4. Ethical considerations

Respondents were informed about the purpose of the study and assured that their participation was voluntary and that they are free to withdraw their participation at any point of responding to the questionnaire. No incentive package was, therefore, offered to the respondents.

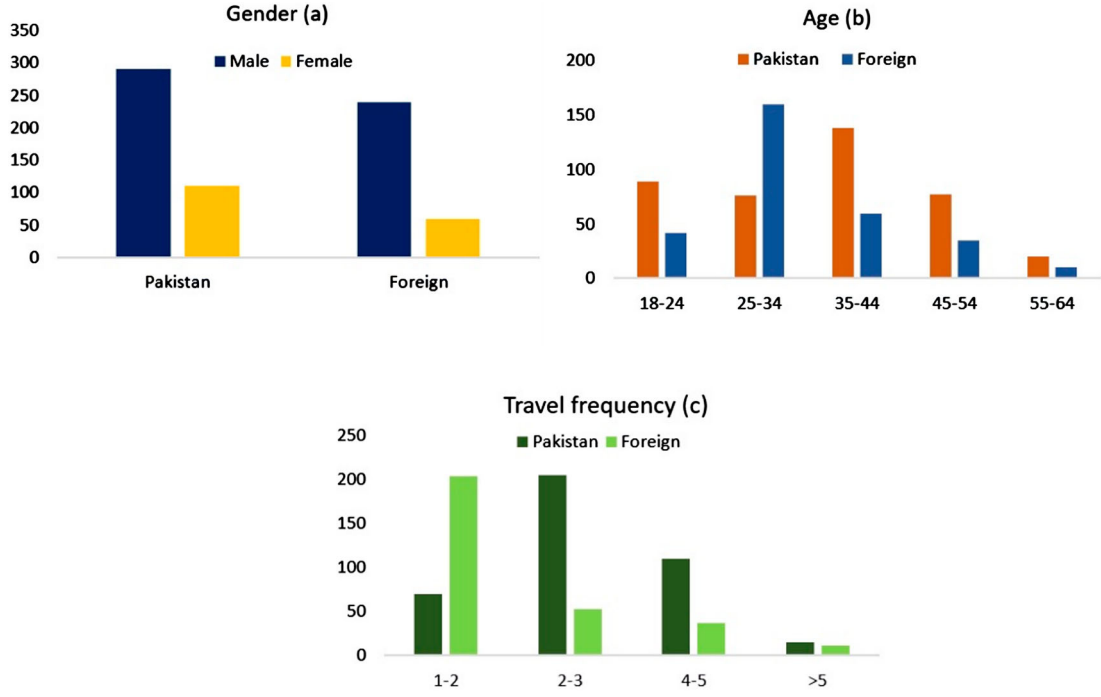

Figure 2. Demographic characteristics of people.

Table 1. Discriminant validity Fornell and Larcker.

Constructs	1	2	3	4	5	6	7	8	9
HPB	**0.775**								
Perceived_ barriers	0.326	**0.800**							
Perceived_ benefits	0.057	0.140	**0.775**						
Perceived_ severity	0.339	0.275	0.112	**0.788**					
Perceived_ susceptibility	0.188	0.154	0.131	0.195	**0.887**				
Perceived_ cause	0.087	0.273	0.458	0.205	0.102	**0.825**			
Self-efficacy	0.351	0.377	0.099	0.115	0.128	0.320	**0.781**		
Perceived_ contracting	0.227	0.259	0.140	0.184	0.620	0.191	0.072	**0.725**	
Perceived_ prevention	0.190	0.281	0.694	0.129	0.219	0.141	0.179	0.203	**0.775**

Informed consent was sought from each respondent as they were further assured of their anonymity and confidentiality by ensuring that no personal identifying information was collected. Since the data collection for this study was done at the height of the pandemic, the researchers were committed to adhering to the COVID-19 protocols, therefore, the online survey was considered the suitable data collection method.

3.5. Sentiment analysis

People's perceptions and attitudes concerning any situation can be assessed by sentiment analysis, which has become a prevalent information source (Qazi et al. 2017a, 2019). Sentiment analysis is often performed on public opinions that are available through a variety of domains and has been used extensively to gauge public sentiment towards ongoing situations (Qazi, Fayaz, and Raj 2014a; Qazi et al. 2021a; Abo, Raj, and Qazi 2019). Therefore, in addition to SEM, we performed sentiment analysis on the 220 open-ended responses using a manual approach similar to card sorting (Nelson 1976), and classified the opinions into positive and negative sentiments (Figure 3). Also, we have provided a word cloud of these opinions and people's emotions on the current pandemic situation for visualisation (Figure 4). The subsequent section presents and discusses the results of the study.

4. Results

The results are presented in four sections: respondents' characteristics, measurement model, structural model, and sentiment analysis. Figure 2A–C depicts the description of the demographic characteristics of the respondents who completed the online survey. These are age, gender, nationality, and travel frequency. The demographic characteristics show that more Pakistani nationals responded to the online survey compared to other nationals. Most of the respondents were males, below 45 years and travel at least between two to three times annually, indicating that most of our respondents could be considered as frequent travellers.

4.1. Measurement model

Items loading, Composite Reliability (CR), and Average Variance Extracted (AVE) are all shown in Table S1. This indicates that all the items exceed the 0.6 threshold value for items loading, ensuring adequate loadings (Ali, Kim, and Ryu 2016). To satisfy internal consistency reliability, the values exceeded the recommended value of 0.7 for CR, while AVE exceeded the recommended value of 0.5 (Hair, Ringle, and Sarstedt 2013). Subsequently, discriminant validity is summarised in Table 1 (Fornell and Larcker 1981). An alternative approach based on the multitrait-multimethod matrix, the heterotrait-monotrait (HTMT) ratio of correlations and the results mentioned in Table 2, which meet the HTMT 0.85 threshold, was used to ensure more discriminant validity (Henseler, Ringle, and Sarstedt 2015).

4.2. Structural model

We investigate R^2, beta, and corresponding p-values for the structural model using a bootstrapping technique with a resample of 5,000 people (Hair, Ringle, and Sarstedt 2013). The predictive relevance (Q^2) and the effect sizes (f^2) were also stated additionally. Firstly, the relationship between the variables is described. For this, the perceived understanding of COVID-19 cause and perceived severity shows a positive and significant relationship (β=0.205, t=3.440, p<0.01). Perceived understanding of contracting COVID-19 and perceived susceptibility (β=0.620, t=16.985, p<0.01) also shows a positive and significant relationship. In addition, perceived understanding of COVID-19 prevention and perceived benefits (β=0.694, t=30.567, p<0.01) and perceived barriers (β=0.136, t=3.145, p<0.01) show a positive and significant relationship. Moreover, perceived health belief measures: perceived severity and health-protective behaviour (HPB) (β=0.296, t=5.528, p<0.01)

Table 2. Discriminant validity HTMT.

Constructs	1	2	3	4	5	6	7	8	9
HPB									
Perceived_ barrier	0.546								
Perceived_ benefit	0.225	0.163							
Perceived_ severity	0.677	0.409	0.280						
Perceived_ susceptibility	0.293	0.472	0.218	0.169					
Perceived_ cause	0.298	0.271	0.274	0.416	0.339				
Self-efficacy	0.629	0.477	0.179	0.485	0.180	0.286			
Perceived_ contracting	0.336	0.233	0.879	0.197	0.528	0.274	0.212		
Perceived_ prevention	0.291	0.145	0.287	0.861	0.074	0.170	0.178	0.804	

such as postponing and/or cancellation of travel plans show a positive relationship. Perceived susceptibility with HPB (β=0.149, t=3.083, p<0.01 and self-efficacy belief of COVID-19 prevention to HBM (β=0.322, t=5.140 p<0.01) show a positive significant relationship. Perceived benefits were also positive and significant with HPB (β = 0.065, t=2.203, p<0.01). Perceived barriers (β=0.385, t=7.546, p<0.01) were also significant, as suggested with HPB and perceived COVID-19 prevention with self-efficacy belief of COVID-19 prevention (β=0.073, t=1.41, p<0.05).

As discussed, the P-value shows the significance of the relationships to report substantive significance. Next, effect size (f^2) was calculated using Cohen's guidelines (Cohen 1988). Table 3 shows that relationships had small, medium, and large effects. The predictive sample reuse technique (Q^2), in addition to the scale of R^2 and f^2, effectively demonstrate predictive relevance (Urbach and Ahlemann 2010). The value for Q^2 for HPB is 0.084, Perceived barrier is 0.036, Perceived benefits is 0.267, Perceived severity is 0.014, Perceived susceptibility is 0.293, and Self-efficacy is 0.052. These values are greater than zero for endogenous variables, hence prove the predictive relevance.

4.3. Sentiment analysis

The sentiment analysis results revealed that people carry more negative sentiments than positive ones, with a few being neutral toward the current pandemic situation and taking health-protective measures (Figure 3). Most people have postponed or cancelled foreign and domestic travels to avoid the risk of COVID-19 infection. However, it is reflected that although the adoption of health-protective measures sounds stressful, at the same time, it gives the feeling of hope and relaxation to avoid contracting COVID-19. Words such as Hari Raya, Eid, festivals, function, joy, happy, vacation, family, gathering, holiday were frequently seen in the positive class. The words cancel, negative, stress, jobless, lockdown, barrier, postponed, missed, waste, jobless, death, and disease fall in the negative category. We have presented the word cloud in Figure 4. The word cloud shows the most dominant words and or

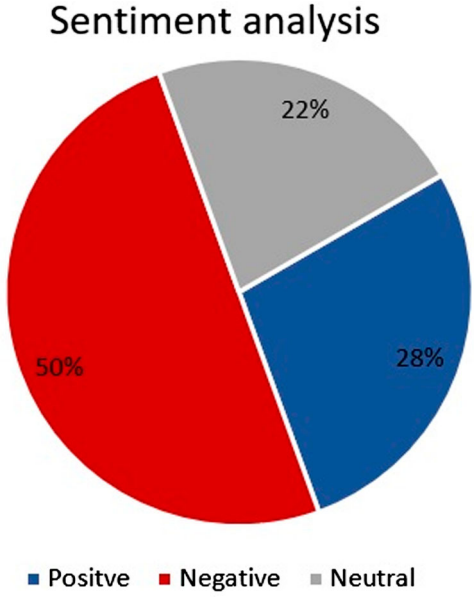

Figure 3. Sentiment analysis.

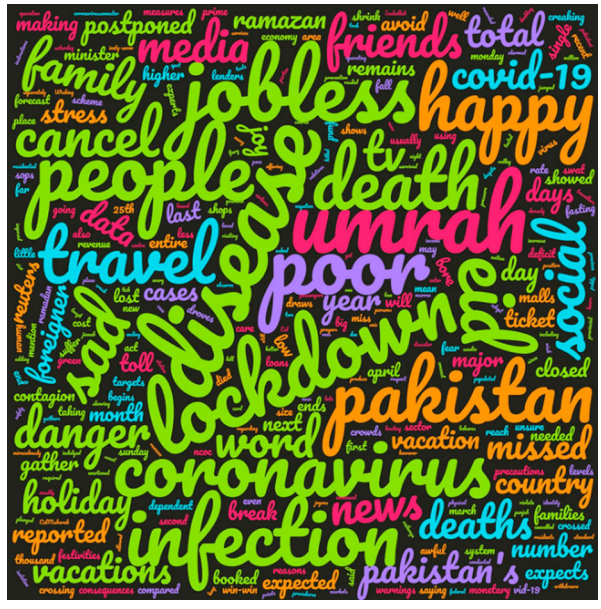

Figure 4 Word cloud based on frequency analysis.

Table 3. The structural model results for path coefficient.

Hypotheses	Beta	*T* Value	*P* Values	F-square
Perceived_ barrier →HPB	0.385	7.546	0.000	0.177
Perceived_benefit → HPB	0.065	2.203	0.004	0.023
Perceived_ severity → HPB	0.296	5.528	0.000	0.108
Perceived_ susceptibility → HPB	0.149	3.083	0.002	0.027
Perceived_ cause → Perceived severity	0.205	3.44	0.001	0.044
Self-efficacy → HPB	0.322	5.14	0.000	0.129
Perceived_contracting→Perceived_susceptibility	0.620	16.985	0.000	0.625
Perceived_ prevention → Perceived_ barrier	0.136	3.145	0.004	0.023
Perceived_ prevention → Perceived_ benefit	0.694	30.567	0.000	0.930
Perceived_ prevention → Self-efficacy	0.073	1.41	0.020	0.033

sentiments expressed in the open-ended responses. People feel stressed in the current situation, as the festivities of Muslims and Christians were also tarnished, and people could not travel for Umrah to the Holy Kabah, Eid or for the Easter pilgrimage (Ebrahim and Memish 2020a, 2020b, 2020c; Ahmed and Memish 2020).

The high negative sentiments expressed are to be expected given that the infection situation seems unabated (World Health Organization 2020b), coupled with the fact that the unprecedented nature and uncertainties surrounding the lockdown has severely affected the daily mental wellbeing of the people, leading to increased stress (Kayis et al. 2021). As cases are increasing, people are becoming more sentimental. Thus, sentiment analysis studies can help predict the outcomes of the COVID-19 pandemic on a larger scale.

5. Discussion

A theoretical model evaluates the impact of different levels of situational awareness on the COVID-19 pandemic, with health belief measures and the ultimate impact on health-protective behaviour. Although recent research has highlighted a need to investigate social distancing and the effect of situational awareness on adopting health-protective behaviour, meagre data is available on the topic. This current study is one of the few initial studies that aims to establish a link between awareness level and health-protective behaviour through perceived health beliefs. The results of the structural equation modelling support the proposed path models, so we determine that situational awareness of infectious disease indeed influences people's health beliefs and the ultimate adoption of health-protective behaviour, which is evident from previous research findings (Qazi et al. 2020; Liao et al. 2010). HBM conceptualises infection beliefs to comprise perceptions of the severity and susceptibility of the health threat, perceptions of the benefits and barriers associated with action, and a person's inherent capacity to take action. When considering COVID-19 interventions based on the HBM, health authorities will be in a position to act on these constructs more clearly and powerfully.

The results confirmed that perceived understanding of COVID-19 cause influences perceived severity, perceived understanding of contracting COVID-19 influences perceived susceptibility, and perceived understanding of COVID-19 prevention influences perceived barriers, perceived benefits and one's self-efficacy beliefs. In terms of health-protective measures, people are supposed to stay at home, work from home and avoid crowded locations. This act of staying at home may present an opportunity to spend quality time at home and avoid interacting with the virus. Consequently, if people perceive the threat of COVID-19 as serious, they are more likely to take effective action. However, the clearer the understanding about the cause of and risk of contracting COVID-19, the more the disease is regarded as a serious problem. Therefore, the greater the perceived threat, the more likely an individual will adopt a health-protective measure such as modifying or cancelling their travel plans. This association is supported by previous research findings relating to COVID-19 in that awareness, perceived severity, perceived susceptibility, perceived benefits and perceived barriers were found to influence health-protective behaviour (Qazi et al. 2020; Carico, Sheppard, and Thomas 2021).

Our results are supported in the literature that self-efficacy impacts adopting health-protective behaviour for COVID-19 prevention (Liao et al. 2010; Carico, Sheppard, and Thomas 2021; Huang, Dai, and Xu 2020). People can reinforce self-efficacy beliefs by an increase in awareness level. Ultimately, it will be vital to understand the situation through useful information sources (Seppänen and Virrantaus 2015). Outcomes of this study prove that prevention is the main measure in the treatment and control of the COVID-19 pandemic. It also shows that situational awareness affects the postulates of the HBM, and is crucial in the adoption of protective and preventive health measures such as the cancellation of travel plans to ensure safety.

The sentiment analysis results suggest that although people mostly have negative feelings towards the impact

of COVID-19 and stay at home directives, nonetheless, people share some positive sentiments as well, particularly concerning spending quality time at home with their families. It is, therefore, to be expected that people adopted health-protective measures like cancelling their travel plans to stay safe with their families at the height of the COVID-19 pandemic. Sentiment analysis can help healthcare authorities to devise and plan appropriate management strategies following public sentiments. Sentiment plays a crucial role in judging peoples' opinions and attitudes toward a situation (Qazi et al. 2014b), and hence is a key influencer of their behaviour (Qazi et al. 2014c, 2020). Public opinion becomes a prevalent information source for policy and decision-makers, who can harness such information to implement appropriate interventions (Qazi et al. 2017b, 2019; Kim, Maslowska, and Tamaddoni 2019; Yang, Yao, and Qazi 2020). The sentiments are expressed as positive, negative, and neutral (Qazi et al. 2014b, 2017a). Most people are restricted and cannot travel home amid semester breaks, and have to remain departed from families due to travel bans. The Muslim community embarks on the religious journey of Umrah in large numbers in the month of Ramadan, but since the Umrah has been called out this year, Muslims feel deserted and desolated (Ahmed and Memish 2020). These are plausible explanations for the high negative sentiments expressed by the respondents in this study.

6. Implications

The primary contribution of this study to the current situation of the COVID-19 pandemic is to highlight the influence of situational awareness on the cancellation of travel plans. Based on the results, the study offers significant implications. In this study, from a theoretical point of view, the most significant contribution was the combination of the two important theories: SAT and HBM, which were used together for the first time to predict health-protective behaviour. Our observations have shed light on the tangled nature of the phenomenon, i.e. health beliefs and all its associated significant dimensions, the multi-level nature of situational awareness, and self-efficacy. These perspectives are critical and significant to inquire into, as they are related to people's health behaviour in a lockdown state. This study thus provides an inclusive view of understanding the link between situational awareness and the adoption of the postulates of health beliefs including self-efficacy, and health-protective behaviours. Overall, it was found that the SAT is supported by health belief factors of the HBM. This aids in the conceptualisation of a comprehensive model that estimates risk perceptions and offers a developmental perspective on SAT and HBM's fundamental constituents.

Consequently, the study offers some practical implications. Although the COVID-19 pandemic seems uncontrollable at the moment, if no preventive measures are taken, the situation will continue unabated. Our study contributes to understanding what aspects needs to be given attention to, in terms of COVID-19 interventions if public health experts want to increased people's adherence to stay at home orders and their commitment to cancelling travel plans as a health-protective measure against the ongoing pandemic. It is by so doing that the disease incidence may be reduced drastically for normal life to be restored.

Furthermore, it is critical to comprehend the situation using reliable information sources (Seppänen and Virrantaus 2015). This study suggests that travel agencies and health officials should offer necessary health education for their communities. Such education, particularly about COVID-19 prevention will enhance people's self-efficacy beliefs to implement protective behaviour against COVID-19, as our study confirms the strong and positive association between self-efficacy and health-protective behaviour. For policy-makers', the results of the study should help to better understand public perceptions about the current pandemic and their related health beliefs, in other to develop appropriate health-protective measures that will involve increasing public awareness and understanding about the current pandemic.

Finally, sentiment analysis provides a practical approach for policymakers and decision-makers to gauge people's sentiments, attitudes and opinions about the pandemic. These sentiments, if they are mostly negative may be indicative of a high level of stress and anxiety for which people need more information and education (Kayis et al. 2021). The provision of such information will improve awareness which will in turn influence health behaviour. Therefore to reduce the stress and anxiety among people, health professionals and experts need to console people and inform them through awareness programmes that protective behaviours are effective for them, and they can adapt them to prevent infectious diseases.

7. Conclusion

To reinforce health-protective behaviour, situational awareness and health beliefs are crucial determinants. By integrating the situational awareness theory and the health belief model, this study investigated the relationships among situational awareness, health

beliefs, self-efficacy, and health-protective behaviour such as the cancellation of travel plans during the COVID-19 pandemic. According to the findings of this study, people's health beliefs and self-efficacy have an important impact on their preventive behaviour. This research used SAT and HBM to investigate the links between situational awareness, health beliefs and self-efficacy, and health-protective behaviour such as cancelling travel plans during the COVID-19 pandemic. The outcomes of this study prove that prevention is the main measure in the treatment and control of the COVID-19 pandemic. It demonstrates that situational awareness has an effect on the HBM's postulates, and plays a key role in the adoption of protective and preventive measures, including cancelling travel plans to ensure protection.

Disclosure statement

No potential conflict of interest was reported by the author(s).

References

Abdullah, M., C. Dias, D. Muley, and M. Shahin. 2020. "Exploring the Impacts of COVID-19 on Travel Behavior and Mode Preferences." *Transportation Research Interdisciplinary Perspectives* 8: 100255.

Abo, M. E. M., R. G. Raj, and A. Qazi. 2019. "A Review on Arabic Sentiment Analysis: State-of-the-Art, Taxonomy and Open Research Challenges." *IEEE Access* 7: 162008–162024.

Ahmed, Q. A., and Z. A. Memish. 2020. "The Cancellation of Mass Gatherings (MGs)? Decision Making in the Time of COVID-19." *Travel Medicine and Infectious Disease* 34: 101631.

Ali, F., W. G. Kim, and K. Ryu. 2016. "The Effect of Physical Environment on Passenger Delight and Satisfaction: Moderating Effect of National Identity." *Tourism Management* 57: 213–224.

Bandura, A. 1977. "Self-Efficacy: Toward a Unifying Theory of Behavioral Change." *Psychological Review* 84 (2): 191.

Bandura, A., W. Freeman, and R. Lightsey. 1999. *Self-Efficacy: The Exercise of Control*. Springer.

Belingheri, M., M. E. Paladino, and M. A. Riva. 2020. *COVID-19: Health Prevention and Control in Non-Healthcare Settings*. UK: Oxford University Press.

Bish, A., and S. Michie. 2010. "Demographic and Attitudinal Determinants of Protective Behaviours During a Pandemic: A Review." *British Journal of Health Psychology* 15 (4): 797–824.

Carico, Jr., R., J. Sheppard, and C. B. Thomas. 2021. "Community Pharmacists and Communication in the Time of COVID-19: Applying the Health Belief Model." *Research in Social and Administrative Pharmacy* 17 (1): 1984–1987.

Champion, V. L., and C. S. Skinner. 2008. "The Health Belief Model." In *Health Behavior and Health Education: Theory, Research, and Practice. 4*, edited by K. Glanz, B. K. Rimer, and K. Viswanath, 45–65. San Francisco, CA: Jossey-Bass.

Chin, W. W. 1998. "Commentary: Issues and Opinion on Structural Equation Modeling." *MIS Quarterly* 22 (1): vii–xvi.

Chin, W. W. 2010. "How to Write Up and Report PLS Analyses." In *Handbook of Partial Least Squares. Springer Handbooks of Computational Statistics*, edited by Esposito Vinzi V., W. Chin, J. Henseler, and H. W, 655–690. Berlin, Heidelberg: Springer.

Chiu, N.-C., H. Chi, Y.-L. Tai, C.-C. Peng, C.-Y. Tseng, C.-C. Chen, B. F. Tan, and C.-Y. Lin. 2020. "Impact of Wearing Masks, Hand Hygiene, and Social Distancing on Influenza, Enterovirus, and All-Cause Pneumonia During the Coronavirus Pandemic: Retrospective National Epidemiological Surveillance Study." *Journal of Medical Internet Research* 22 (8): e21257.

Cohen, J. 1988. *Statistical Power Analysis for the Behavior Science*. 2nd ed. New York: Lawrance Eribaum association.

Cohen, J. 1992. "Statistical Power Analysis." *Current Directions in Psychological Science* 1 (3): 98–101.

Doung-ngern, P., R. Suphanchaimat, A. Panjangampatthana, C. Janekrongtham, D. Ruampoom, N. Daochaeng, et al. 2020. Associations between Wearing Masks, Washing Hands, and Social Distancing Practices, and Risk of COVID-19 Infection in Public: A Cohort-Based Case-Control Study in Thailand.

Dzisi, E. K. J., and O. A. Dei. 2020. "Adherence to Social Distancing and Wearing of Masks Within Public Transportation during the COVID 19 Pandemic." *Transportation Research Interdisciplinary Perspectives* 7: 100191.

Ebrahim, S. H., and Z. A. Memish. 2020a. "COVID-19 – The Role of Mass Gatherings." *Travel Medicine and Infectious Disease* 34: 101617.

Ebrahim, S. H., and Z. A. Memish. 2020b. "COVID-19: Preparing for Superspreader Potential among Umrah Pilgrims to Saudi Arabia." *The Lancet* 395 (10227): e48.

Ebrahim, S. H., and Z. A. Memish. 2020c. "Saudi Arabia's Drastic Measures to Curb the COVID-19 Outbreak: Temporary Suspension of the Umrah Pilgrimage." *Journal of Travel Medicine* 27 (3): taaa029.

Endsley, M. R. 1995. "Toward a Theory of Situation Awareness in Dynamic Systems." *Human Factors* 37 (1): 32–64.

Everett, J. A., C. Colombatto, V. Chituc, W. J. Brady, and M. Crockett. 2020. The Effectiveness of Moral Messages on Public Health Behavioral Intentions during the COVID-19 pandemic.

Fornell, C., and D. F. Larcker. 1981. "Structural Equation Models with Unobservable Variables and Measurement Error: Algebra and Statistics." *Journal of Marketing Research* 18 (3): 382–388.

Fuchs, G. 2013. "Low Versus High Sensation-Seeking Tourists: A Study of Backpackers' Experience Risk Perception." *International Journal of Tourism Research* 15 (1): 81–92.

Gefen, D., and D. Straub. 2005. "A Practical Guide to Factorial Validity Using PLS-Graph: Tutorial and Annotated Example." *Communications of the Association for Information Systems* 16 (1): 91–109.

Hair, J. F., C. M. Ringle, and M. Sarstedt. 2013. "Partial Least Squares Structural Equation Modeling: Rigorous Applications, Better Results and Higher Acceptance." *Long Range Planning* 46 (1-2): 1–12.

Henseler, J., C. M. Ringle, and M. Sarstedt. 2015. "A new Criterion for Assessing Discriminant Validity in Variance-Based Structural Equation Modeling." *Journal of the Academy of Marketing Science* 43 (1): 115–135.

Huang, X., S. Dai, and H. Xu. 2020. "Predicting Tourists' Health Risk Preventative Behaviour and Travelling Satisfaction in Tibet: Combining the Theory of Planned Behaviour and Health Belief Model." *Tourism Management Perspectives* 33: 100589.

Janz, N. K., and M. H. Becker. 1984. "The Health Belief Model: A Decade Later." *Health Education Quarterly* 11 (1): 1–47.

Kayis, A. R., B. Satici, M. E. Deniz, S. A. Satici, and M. D. Griffiths. 2021. "Fear of COVID-19, Loneliness, Smartphone Addiction, and Mental Wellbeing among the Turkish General Population: A Serial Mediation Model." *Behaviour & Information Technology*, 1–13. doi:10.1080/0144929X.2021.1933181.

Kim, S. J., E. Maslowska, and A. Tamaddoni. 2019. "The Paradox of (Dis)Trust in Sponsorship Disclosure: The Characteristics and Effects of Sponsored Online Consumer Reviews." *Decision Support Systems* 116: 114–124.

Lepp, A., and H. Gibson. 2003. "Tourist Roles, Perceived Risk and International Tourism." *Annals of Tourism Research* 30 (3): 606–624.

Liao, Q., B. Cowling, W. T. Lam, M. W. Ng, and R. Fielding. 2010. "Situational Awareness and Health Protective Responses to Pandemic Influenza A (H1N1) in Hong Kong: a Cross-Sectional Study." *PLoS One* 5 (10): e13350.

Matyas, C., S. Srinivasan, I. Cahyanto, B. Thapa, L. Pennington-Gray, and J. Villegas. 2011. "Risk Perception and Evacuation Decisions of Florida Tourists Under Hurricane Threats: A Stated Preference Analysis." *Natural Hazards* 59 (2): 871–890.

Mukhtar, S. 2020. "Mental Health and Emotional Impact of COVID-19: Applying Health Belief Model for Medical Staff to General Public of Pakistan." *Brain, Behavior, and Immunity* 87: 28–29.

Nelson, H. E. 1976. "A Modified Card Sorting Test Sensitive to Frontal Lobe Defects." *Cortex* 12 (4): 313–324.

Oum, T. H., and K. Wang. 2020. "Socially Optimal Lockdown and Travel Restrictions for Fighting Communicable Virus Including COVID-19." *Transport Policy* 96: 94–100.

Qazi, A., C. Bhowmik, F. Hussain, S. Yang, U. Naseem, A.-A. Adebayo, A. Gumaei, and M. Al-Rakhami. 2021a. "Analyzing the Public Opinion as a Guide for Renewable-Energy Status in Malaysia: A Case Study." *IEEE Transactions on Engineering Management* 1–15.

Qazi, A., H. Fayaz, and R. G. Raj, eds. 2014a. "Discourse on Data Mining Applications to Design Renewable Energy Systems." Proceedings of International Conference on Advances in Engineering and Technology (ICAET'2014), Singapore.

Qazi, A., G. Hardaker, I. S. Ahmad, M. Darwich, J. Z. Maitama, and A. Dayani. 2021b. "The Role of Information & Communication Technology in Elearning Environments: A Systematic Review." *IEEE Access* 9: 45539–45551.

Qazi, A., F. Hussain, N. A. Rahim, G. Hardaker, D. Alghazzawi, K. Shaban, and K. Haruna. 2019. "Towards Sustainable Energy: a Systematic Review of Renewable Energy Sources, Technologies, and Public Opinions." *IEEE Access* 7: 63837–63851.

Qazi, A., J. Qazi, K. Naseer, M. Zeeshan, G. Hardaker, J. Z. Maitama, J. Z. Maitama, and K. Haruna. 2020. "Analyzing Situational Awareness through Public Opinion to Predict Adoption of Social Distancing Amid Pandemic COVID-19." *Journal of Medical Virology* 92 (7): 849–855.

Qazi, A., J. Qazi, K. Naseer, M. Zeeshan, S. Qazi, O. Abayomi-Alli, A. I. Said, et al. 2021c. "Adaption of Distance Learning to Continue the Academic Year Amid Covid-19 Lockdown." *Children and Youth Services Review* 126: 106038.

Qazi, A., R. G. Raj, G. Hardaker, and C. Standing. 2017a. "A Systematic Literature Review on Opinion Types and Sentiment Analysis Techniques." *Internet Research* 27 (3): 608–630.

Qazi, A., R. G. Raj, M. Tahir, E. Cambria, and K. B. S. Syed. 2014b. "Enhancing Business Intelligence by Means of Suggestive Reviews." *The Scientific World Journal* 2014: 1–11.

Qazi, A., R. G. Raj, M. Tahir, M. Waheed, S. U. R. Khan, and A. Abraham. 2014c. "A Preliminary Investigation of User Perception and Behavioral Intention for Different Review Types: Customers and Designers Perspective." *The Scientific World Journal* 2014: 1–8.

Qazi, A., A. Tamjidyamcholo, R. G. Raj, G. Hardaker, and C. Standing. 2017b. "Assessing Consumers' Satisfaction and Expectations through Online Opinions: Expectation and Disconfirmation Approach." *Computers in Human Behavior* 75: 450–460.

Rahnavard, Z., M. Mohammadi, F. Rajabi, and M. Zolfaghari. 2011. "An Educational Intervention Using Health Belief Model on Smoking Preventive Behavior among Female Teenagers." *Journal of Hayat* 17 (3): 15–26.

Reisinger, Y., and F. Mavondo. 2005. "Travel Anxiety and Intentions to Travel Internationally: Implications of Travel Risk Perception." *Journal of Travel Research* 43 (3): 212–225.

Rosenstock, I. M. 1974. "The Health Belief Model and Preventive Health Behavior." *Health Education Monographs* 2 (4): 354–386.

Rosenstock, I. M., V. J. Strecher, and M. H. Becker. 1988. "Social Learning Theory and the Health Belief Model." *Health Education Quarterly* 15 (2): 175–183.

Rubin, G. J., R. Amlôt, L. Page, and S. Wessely. 2009. "Public Perceptions, Anxiety, and Behaviour Change in Relation to the Swine Flu Outbreak: Cross Sectional Telephone Survey." *BMJ* 339: b2651.

Sarkar, P., N. Debnath, and D. Reang. 2021. "Coupled Human-Environment System Amid COVID-19 Crisis: A Conceptual Model to Understand the Nexus." *Science of the Total Environment* 753: 141757.

Seale, H., A. E. Heywood, J. Leask, M. Steel, S. Thomas, D. N. Durrheim, K. Bolsewicz, and R. Kaur. 2020. COVID-19 is Rapidly Changing: Examining Public Perceptions and Behaviors in Response to This Evolving Pandemic. *PLoS ONE* 15 (6): e0235112.

Seale, H., A. E. Heywood, M.-L. McLaws, K. F. Ward, C. P. Lowbridge, D. Van, and C. R. MacIntyre. 2010. "Why do I Need it? I Am Not at Risk! Public Perceptions towards

the Pandemic (H1N1) 2009 Vaccine." *BMC Infectious Diseases* 10 (1): 99.

Seppänen, H., J. Mäkelä, P. Luokkala, and K. Virrantaus. 2013. "Developing Shared Situational Awareness for Emergency Management." *Safety Science* 55: 1–9.

Seppänen, H., and K. Virrantaus. 2015. "Shared Situational Awareness and Information Quality in Disaster Management." *Safety Science* 77: 112–122.

Sharun, K., R. Tiwari, S. Natesan, M. I. Yatoo, Y. S. Malik, and K. Dhama. 2020. "International Travel During the COVID-19 Pandemic: Implications and Risks Associated with 'Travel Bubbles'." *Journal of Travel Medicine* 27 (8): taaa184.

Slovic, P. 1987. "Perception of Risk." *Science* 236 (4799): 280–285.

Slovic, P. 1999. "Trust, Emotion, Sex, Politics, and Science: Surveying the Risk-Assessment Battlefield." *Risk Analysis* 19 (4): 689–701.

Strecher, V. J., and I. M. Rosenstock. 1997. "The Health Belief Model." In *Cambridge Handbook of Psychology, Health and Medicine*, edited by A. Baum, S. Newman, J. Weinman, R. West, and C. McManus, 113–117. Cambridge: Cambridge University Press.

Taghizadeh, S. K., S. A. Rahman, D. Nikbin, M. M. D. Alam, L. Alexa, C. Ling Suan, and S. Taghizadeh. 2021. "Factors Influencing Students' Continuance Usage Intention with Online Learning During the Pandemic: A Cross-Country Analysis." *Behaviour & Information Technology*, 1–20.

Tang, C. S.-K., and C.-Y. Wong. 2005. "Psychosocial Factors Influencing the Practice of Preventive Behaviors Against the Severe Acute Respiratory Syndrome among Older Chinese in Hong Kong." *Journal of Aging and Health* 17 (4): 490–506.

Umaki, T. M., M. R. Umaki, and C. M. Cobb. 2012. "The Psychology of Patient Compliance: a Focused Review of the Literature." *Journal of Periodontology* 83 (4): 395–400.

Urbach, N., and F. Ahlemann. 2010. "Structural Equation Modeling in Information Systems Research Using Partial Least Squares." *Journal of Information Technology Theory and Application* 11 (2): 5–40.

Venigalla, A. S. M., D. Vagavolu, and S. Chimalakonda. 2020. SurviveCovid-19–A Game for Improving Awareness of Social Distancing and Health Measures for Covid-19 Pandemic. arXiv.

Walrave, M., C. Waeterloos, and K. Ponnet. 2020. "Adoption of a Contact Tracing App for Containing COVID-19: A Health Belief Model Approach." *JMIR Public Health and Surveillance* 6 (3): e20572.

Webster, R. K., S. K. Brooks, L. E. Smith, L. Woodland, S. Wessely, and G. J. Rubin. 2020. "How to Improve Adherence with Quarantine: Rapid Review of the Evidence." *Public Health* 182: 163–169.

Wise, T., T. D. Zbozinek, G. Michelini, C. C. Hagan, and D. Mobbs. 2020. "Changes in Risk Perception and Self-Reported Protective Behaviour During the First Week of the COVID-19 Pandemic in the United States." *Royal Society Open Science* 7 (9): 200742.

Witte, K. 1992. "Putting the Fear Back Into Fear Appeals: The Extended Parallel Process Model." *Communications Monographs* 59 (4): 329–349.

World Health Organization. 2020a. Infection Prevention and Control during Health Care When Novel Coronavirus (nCoV) Infection Is Suspected Interim Guidance, 19 March. https://apps.who.int/iris/rest/bitstreams/1272420/retrieve.

World Health Organization. 2020b. Rolling Updates on Coronavirus Disease (COVID-19). Updated 20.03.2020. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen.

Xiao, H., W. Shu, M. Li, Z. Li, F. Tao, X. Wu, Y. Yu, H. Meng, S. H. Vermund, and Y. Hu. 2020. "Social Distancing among Medical Students During the 2019 Coronavirus Disease Pandemic in China: Disease Awareness, Anxiety Disorder, Depression, and Behavioral Activities." *International Journal of Environmental Research and Public Health* 17 (14): 5047.

Yang, S., J. Yao, and A. Qazi. 2020. "Does the Review Deserve More Helpfulness When Its Title Resembles the Content? Locating Helpful Reviews by Text Mining." *Information Processing & Management* 57 (2): 102179.