

RESEARCH ARTICLE

Analyzing situational awareness through public opinion to predict adoption of social distancing amid pandemic COVID-19

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Abstract

COVID-19 pandemic has affected over 100 countries in a matter of weeks. People's response toward social distancing in the emerging pandemic is uncertain. In this study, we evaluated the influence of information (formal and informal) sources on situational awareness of the public for adopting health-protective behaviors such as social distancing. For this purpose, a questionnaire-based survey was conducted. The hypothesis proposed suggests that adoption of social distancing practices is an outcome of situational awareness which is achieved by the information sources. Results suggest that information sources, formal ($P = .001$) and informal ($P = 0.007$) were found to be significantly related to perceived understanding. Findings also indicate that social distancing is significantly influenced by situational awareness, $P = .000$. It can, therefore, be concluded that an increase in situational awareness in times of public health crisis using formal information sources can significantly increase the adoption of protective health behavior and in turn contain the spread of infectious diseases.

KEYWORDS

COVID-19, information sources, situational awareness, social distancing

1 | INTRODUCTION

An outbreak of pneumonia of unknown etiology was reported from Wuhan, Hubei, China.^{1,2} This endemic outbreak gradually spread to many nations across the globe and ultimately on 11 March 2020, WHO declared the COVID-19 as a pandemic.³ Up to 17 March 2020, 199 184 cases of infection with 7994 mortalities from over 115 nations⁴ were reported. The WHO officials also raised serious concerns that Pakistan might emerge as the next epicenter of this pandemic.⁵ In Pakistan, the first case of COVID-19 was travel-associated; infected individuals returned from Iran on 26 February 2020.⁶ As the first case surfaced, the Ministry of Health began implementing the COVID-19 control framework which included isolation of suspects and quarantining of infected individuals. However, the situation worsened gradually and on 17 March, total cases rose to 237.⁷ In response to the looming fears of an emerging epidemic,

officials took additional steps to control COVID-19 community transmission. Important measures that were taken included quarantine, urging the healthy public to self-isolate and practice social distancing strategies to avoid COVID-19 infection.⁸

Formal (newspapers, press releases, and educational messages) and informal sources (social media, online reviews, views of family and peers) of information play a role in improving situational awareness in times of public health emergencies.⁹⁻¹³ Retaining situational awareness comprises of perception which relies on these information sources.¹⁰ Effective and timely management of infections is greatly dependent on social distancing behavior; perception plays a vital role in the adoption of protective behavioral response.¹⁴⁻¹⁶

In this study, we have used situational awareness theory (SAT) in conjunction with the theory of planned behavior (TPB). The Endsley model describes SA at three levels: perception which makes the base of SA; perceived information, that is, comprehension is the second

level, and projection is the third level.¹⁷ This theory has been used by researchers for gaining improved awareness for the management of emergencies in health care.¹⁷⁻²⁰ TBP does not take into account effect of social awareness on infectious diseases.^{21,22} Therefore, where this theory has been used for existing behavior change theoretical frameworks, which have been adapted for prediction of health-related behavior change in chronic and noncommunicable diseases, there is a lack of a comprehensive evidence-based model of protective behavior against infectious disease threat.

The SAT has been used earlier during the severe acute respiratory syndrome (SARS) epidemic by research groups for reporting public perception of SARS outside the affected region. Studies carried out in the initial phase of outbreak reported lower SA, that is, 9%-30%; however, as information became widespread, later studies reported greater awareness among masses. The hypothesis proposed in this study has been devised after careful consideration of previously reported literature (Figure 1).²³⁻²⁵

2 | METHODS

2.1 | Research design

A questionnaire-based survey was carried; for details of the questionnaire see Table S1. For the measurement of responses 5-point Likert scale was used. Age, sex, location, and education were the demographic characteristics of the study population. An open-ended question was also added at the end of the questionnaire to record the general opinion of participants on COVID-19.

The designed questionnaire was then reviewed by two PhD students and two molecular virologists, in terms of construct items, understanding the ability and contextual relevance after a few changes as suggested after the pilot test, an online link was generated for response collection. A total of 210 responses was received.

2.2 | Measurement model

Collected responses were screened, and both multivariate and univariate outliers were detected and deleted.²⁶ Also, skewness and kurtosis analysis were performed; a reflective measurement model requires three tests, that is, internal consistency, convergent,

and discriminant validity.²⁷ The internal consistency was validated using composite reliability (CR), threshold value: 0.70.

Fornell and Larcker²⁷ and Henseler et al,^{28,29} were used for the assessment of discriminant validity using a multitrait-multimethod matrix. Specifically, heterotrait-monotrait ratio (HTMT) value, 0.85, is considered a threshold to ensure discriminant validity (Table 1).

2.3 | Structural model

The structural model was measured using path coefficient, determination coefficient (R^2), effect size (F^2), and the predictive relevance (Q^2).³⁰ The structural model involves two basic preliminary assessments of R^2 and path coefficient³¹; according to the hypothesized relationship and is assessed by 5000 bootstrapping resampling technique.

F^2 values of 0.02, 0.15, and 0.35 manifest small, medium, and large effects, respectively.³² Q^2 was evaluated using Stone-Geisser test.³³ The predictive relevance is explained as "measure of how well-observed values are reconstructed by the model and its parameter estimates."³⁴ Q^2 is established through blindfolding, and a value greater than zero signifies that the model has predictive relevance.

2.4 | Data analysis

Partial least squares (PLS) was used to test the study model. PLS is a well-established technique with path analytics modeling and is used for testing causal models through both reflective and formative constructs.³⁵⁻³⁸ The model proposed here was tested by Smart PLS Version 2.M to perform analysis in two stages using structural equation modeling: the measurement model (first-order confirmatory factor analysis) and structural model assessment (Table 2).

2.5 | Sentiment analysis

We analyzed sentiments for 82 responses against the open-ended question. The sentiment analysis becomes a dominant information source in people's daily life which helps in decision-making.³⁹ We used a manual approach to assign a specific category to each opinion based on its inherent meaning (semantics). Degree of prediction (so that a review belongs to a certain category) was measured by assigning labels

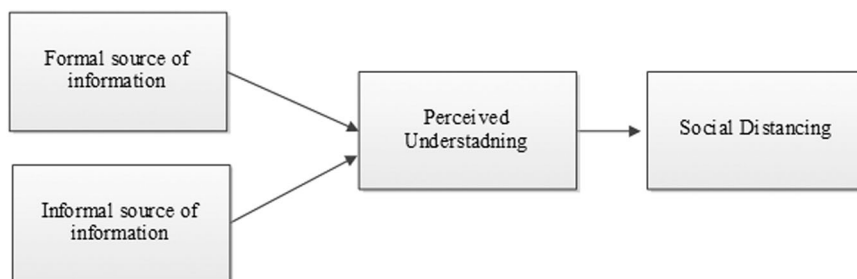


FIGURE 1 The proposed health care protective model. This figure represents the hypothesis on which the survey was conducted. It shows that formal and informal sources of information play a significant role in developing awareness which, in turn, impacts the adoption of social distancing behavior

TABLE 1 Fornell and Larcker discriminant validity and HTMT

	Formal	Informal	Perceived understanding	Social distancing
(a) Fornell-Larcker discriminant validity				
Formal information	0.809			
Informal information	0.073	0.763		
Perceived understanding	0.200	0.248	0.723	
Social distancing	-0.037	0.136	0.340	0.804
(b) HTMT				
Formal information				
Informal information	0.400			
Perceived understanding	0.261	0.315		
Social distancing	0.117	0.243	0.421	

Note: Bold values indicate statistical significance.

Abbreviation: HTMT, heterotrait-monotrait ratio.

manually: A, B, and C for regular, comparative, and suggestive reviews, respectively.⁴⁰ This method resembles the closed card sorting method.⁴¹

3 | RESULTS

3.1 | Characteristics of respondents

Figure 2A-C show a summary of the demographic characteristics, that is, age, sex, and education of the respondents who filled in the online survey.

3.2 | Measurement model

Table 2 indicates that all variables have values lower than the threshold, that is, 0.70 and therefore CR has adequate loadings to

TABLE 2 Factor loading, CR, and AVE

Construct	Items	Loadings	CR	AVE
Formal information	FM01	0.830	0.850	0.655
	FM02	0.792		
	FM03	0.806		
Informal information	IFM01	0.996	0.705	0.583
	IFM02	0.417		
Perceived understanding	PU01	0.707	0.814	0.523
	PU02	0.714		
	PU03	0.697		
	PU04	0.771		
Social distancing	SD01	0.677	0.900	0.646
	SD02	0.856		
	SD03	0.865		
	SD04	0.765		
	SD05	0.839		

Note: Bold values indicate statistical significance.

Abbreviations: AVE, average variance explained; CR, composite reliability.

satisfy internal consistency reliability. Hence, convergent validity evaluation ensures that items put together explain 50% construct.

We used the average variance explained (AVE) threshold value, 0.50, as suggested by Rasoolimanesh et al.³⁰ All values are greater than 0.50 to justify the convergent validity of the items. Results of this study reveal that the studied variable fall within threshold range indicating that the constructs used in the survey were constructive.

Therefore, this study proposes a theoretical model that incorporates the influence of information sources on COVID-19 awareness and its impact on distancing behavior (Figure 1).

In essence, the study fully satisfies all necessary tests to ensure fit and satisfactory measurement model, as identified above.

3.3 | Structural model

The R^2 value of the obtained responses fell in a weak category for perceived understanding (0.095) and social distancing (0.116), respectively. Specifically, exogenous variables identified in this study explain 10% and 12% variances. To assess a reliable path coefficient, bootstrapping and percentile bootstrap confidence interval (95%) were used. Accordingly, the path coefficient relationship between information dimensions and perceived understanding performance was also tested.

It was found that formal and informal information sources significantly affect perceived understanding. Formal information has a statistically significant effect on perceived understanding ($\beta = .183$; $t = 3.067$, $P = .001$). Informal information is also significantly associated with perceived understanding ($\beta = .234$; $t = 2.440$; $P = .007$) (Table 3). Statistical analysis also shows that perceived understanding ($\beta = .340$; $t = 4.794$; $P = .000$) is significantly related to the adoption of social distancing (Figure 3). These results lead to the acceptance of the proposed hypothesis.

Once the basic requirements of the inner model were fulfilled; F^2 and Q^2 were analyzed to determine the effect of an exogenous variable on the endogenous variable and predictive relevance of the whole model. In this study, it is identified that formal and informal

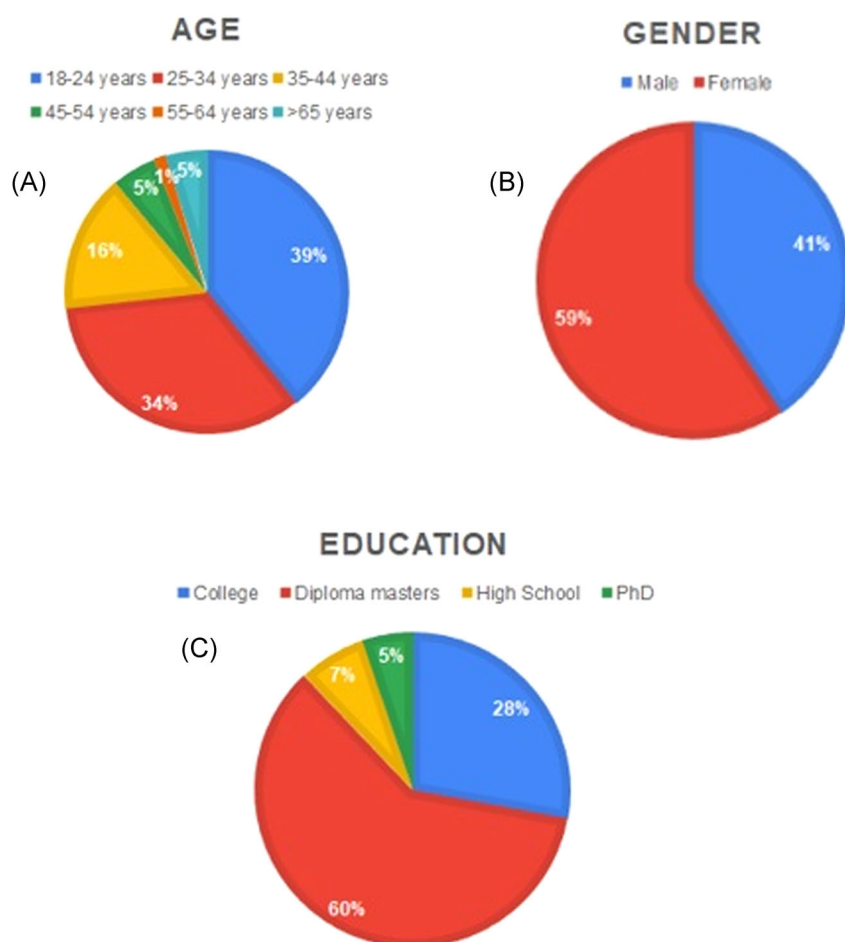


FIGURE 2 Demographics of respondents. The pie charts show the demographics of the respondents in terms of sex, age, and education. A, Age; 39% participants belonged to 18 to 24 (blue) years of age, followed by 25 to 34 years (red). Other age groups were 35 to 44 years, 45 to 54 years, 55 to 64 years, and above 65. B, Sex; 59% females (red) and 41% males (blue) participated in the study. C, Education; majority of the participants, that is, 60% were diploma or masters holders (red)

information has a small effect, that is, 0.037 and 0.060, while perceived understanding has a medium effect, that is, 0.131. For this study, the model has predictive relevance because it recorded a Q^2 value of 0.028 and 0.067 for perceived understanding and social distancing, respectively, which are greater than zero.

3.4 | Sentiment analysis

Results indicate that more than 50% of opinions are suggestive. People in urban areas are strongly opinionated that serious protective measures are needed, some of them are satisfied with the health-protective

behavior (HPB) and few shared their concerns and appear to be panicked. Some of the respondents have compared the behavior of the general public with government policies while others have shared concerns about the future strategic development of COVID-19.

4 | DISCUSSION

A hypothetical model that evaluated the effect of formal and informal sources of information on situational awareness (perceived understanding) and ultimately adoption of protective behavior (social distancing) was studied. Results obtained suggest that both

TABLE 3 Model path coefficient

Hypotheses	β	Standard deviation	t statistics	P values
Formal information > perceived understanding	.183	0.060	3.067	.001
Informal information > perceived understanding	.234	0.096	2.440	.007
Perceived understanding > social distancing	.340	0.071	4.792	.000

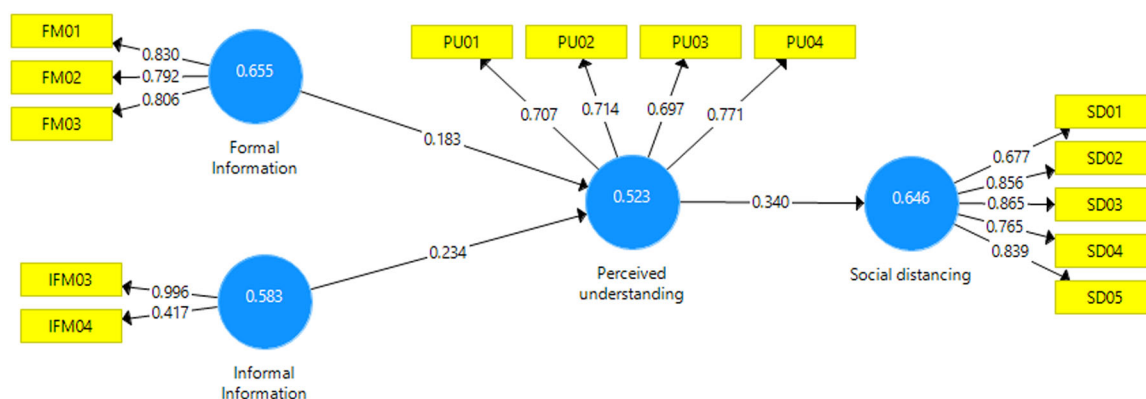


FIGURE 3 Structural model. The figure is a visual representation of the structural model developed using the responses collected by gathering public opinion on situational awareness of COVID-19 to adopt social distancing behavior

formal and informal sources of information affect situational awareness on HPB, that is, social distancing. The findings of this study are consistent with the previous reports which have suggested that HPB is linked directly to situational awareness during a public health emergency.⁴²

When comparing the trust of the general public on information sources, it was revealed that trust in the formal sources is slightly higher in comparison with informal sources. Moreover, another outcome of this study, that is, situational awareness affects the adoption of social distancing behavior which is also consistent with the previously reported surveys conducted to evaluate the effect of formal information sources on the adoption of HPB during A/H1N1 influenza pandemic 2009.⁹ Rubin and his colleagues reported that information from media sources increased the adoption of hygiene behavior which led to increased tissue and sanitizer use among British masses during the endemic swine flu.⁴²

The model developed in this study suggested that social distancing is not linked with formal messages. This outcome supports the fact that social distancing is adopted when a perceived health threat is high.²² Another outcome suggests that when friends and peers behave responsibly, a person also adopts protective behavior. However, mixed signals from peers and friends led to the declined utility of informal information sources. This behavior is common in the early epidemic spread and awareness increases with advances in the transmission of infection which ultimately leads to widespread adoption of HPB. However, only an increase in formal information sources led to increased adoption of HPB. Adoption of HPBs is a good choice to remain safe from viral contamination. Contrarily, the practice of social distancing necessitates an activity of constant public education. Different divisions of populations share varying information in their circles.

In addition, the sentiment analysis was carried out on a few textual opinions to find some useful insights. This may guide future studies to explore in depth the opinions on a large scale and provide help to policymakers to look into highlighted threats and to control COVID-19. The sentiment analysis performed on the

responses collected via open-ended questions suggests that people are not much concerned for avoiding avoid mass gatherings and adopting social distancing practices; however, when influenced by informative tools they tend to adopt HPB to avoid acquiring any infection.⁴³

The outbreak of any emerging infectious agent leads to the emergence of dynamic and uncertain situations; therefore, such emergencies need prompt and appropriate response.¹⁶ This implies that protective health behavior in case of emerging infectious diseases is more likely to be dependent on situational responses taking into account known preventive actions like social distancing rather than using intention-based response like the decision to visit a doctor.⁸

A few limitations of this study are that as the sample size is limited to the number of participants from one region and relatively small to generalize the findings of this study for a larger population, a bigger population-based study should be carried out. Moreover, this study takes into consideration substantial factors that create situational awareness for the adoption of HPB; however, other factors such as the adoption of hand hygiene, knowledge of COVID-19, and self-efficacy in the prevention of COVID-19 can also be added in the large sample size-based study.

COVID-19 is a new pandemic prevailing around the world. It is expanding rapidly in North America, Europe, the Middle East, and Asia. In South Asia, Pakistan is the first country to experience a high severity of COVID-19 infection. Our study concludes that at the time of such a public health crisis formal information sources (formal and informal) play a significant role in increasing awareness among masses and cognitively influence the adoption of social distancing practices.

5 | CONCLUSION

The world is facing serious COVID-19 pandemic; this necessitates situational awareness for the adoption of health care protective practices. We believe that the variables studied have

theoretical and logical support for their potential importance in the context of COVID-19. Our findings suggest that different information sources (formal and informal) influence situational awareness. Findings suggest that formal information sources are associated with greater compliance with preventive measures; however, informal information sources might not help much until preventive behaviors are adopted readily by the community. Finally, social distancing practices can be increased by increasing awareness about COVID-19 through trustworthy information sources.

CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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