

Public health awareness: knowledge, attitude and behaviors of the public on health risks during COVID-19 pandemic in sultanate of Oman

Fadi Abdel Muniem Abdel Fattah and Khalid Abed Dahleez
Department of Management, A'Sharqiyah University, Ibra, Oman

Abdul Hakim H.M. Mohamed
*Department of Management Information System, A'Sharqiyah University,
Ibra, Oman*

Mohammad Khaleel Okour
Business Department, Luminus Technical University College, Irbid, Jordan, and

Abrar Mohammed Mubarak AL Alawi
Department of Management, A'Sharqiyah University, Ibra, Oman

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Abstract

Purpose – This study aims to measure the level of public awareness about the threat of the emerging coronavirus (COVID-19) pandemic among the Omani population. It also aims to investigate the mediating effect of the Omanis' attitudes and behaviors with underlying conditions of COVID-19.

Design/methodology/approach – A cross-sectional study was conducted to collect data via an online survey of Omani citizens and residents from various geographic areas in Oman, 305 responses were received. SPSS and partial least square-structural equation modeling were used for data analysis.

Findings – The study revealed that public awareness regarding the COVID-19 pandemic was significantly influenced by people's perceived risk, information source and health-related knowledge. Further, preventive behavior during the disease spread has a significant direct and indirect impact on their awareness. However, an insignificant mediation effect of public attitude was found between the source of information and public awareness.

Research limitations/implications – This study is limited by the scarcity of related literature in the Omani context. It is recommended that future research complete an in-depth study of public awareness regarding COVID-19, using other constructs and/or other data collection techniques.

Practical implications – This research will provide governmental health authorities and policymakers with a guideline to establish more efficient pandemic containment strategies to control public behavior toward the COVID-19 pandemic and curb viral prevalence.

Social implications – This research will help in improving prevention measures against COVID-19 are recommended to be more educated through a more effective mechanism to raise public attitude regarding pandemic prevalence positively.

Originality/value – The originality of this research can be drawn from key findings that indicate that people overall gained knowledge about how to deal with the COVID-19 pandemic and the accuracy of information significantly impacts public awareness.

Keywords Attitude, Awareness, Health knowledge, Covid-19, Preventive behavior, Pandemic outbreak

Paper type Research paper



1. Introduction

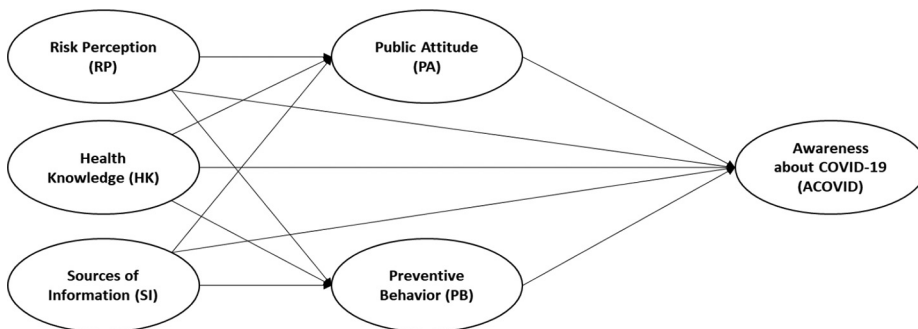
In December 2019, the coronavirus disease (COVID-19) emerged as a pandemic initiated in Wuhan city, China, which threatened the world's population health (Bedford *et al.*, 2020; Deng and Peng, 2020; Li *et al.*, 2020; Phelan *et al.*, 2020). COVID-19 is a disease that has been evolving and has exacerbated from a coronavirus to an acute respiratory syndrome (Malik *et al.*, 2020; Strunk *et al.*, 2014). However, the common symptoms of COVID-19 are abrupt onset of fever, for 44%–98% of patients; 68%–76% of patients have a non-productive cough; 18% of Coronavirus patients have accompanying fatigue (Kliger and Silberzweig, 2020).

Previous researchers have recognized other symptoms that could be used as risk measurements of a COVID-19 infection such as sore throat, headache and myalgia (Ahmed and Ali, 2019; Anusha, 2018; Strunk *et al.*, 2014). Aging and chronic diseases such as diabetes, organ and coagulation dysfunction, hypertension and neutrophilia were deemed as risk factors that exacerbate COVID-19 complications (Afzal *et al.*, 2020; Ahmed and Ali, 2019; Deng and Peng, 2020; Sari *et al.*, 2020). COVID-19 patients gradually develop respiratory distress syndrome, which, in turn, raises the chance of death (Carter *et al.*, 2020; Kliger and Silberzweig, 2020; Malik *et al.*, 2020; Strunk *et al.*, 2014).

As of August 16, 2020, the aggregate of infected patients worldwide reached more than 21 million confirmed cases and 761,779 reported deaths; the COVID-19 pandemic now has reached more than 200 countries across the world. In Oman, there have been 126,240 infected cases and 1,471 confirmed deaths by mid of December 2020 (WHO, 2020a). Because of that, a debate has been recently developed on what people know about COVID-19 symptoms, infection and pertinent risk, as well as prevention (Deng and Peng, 2020; Kandel *et al.*, 2020; Venkatesan *et al.*, 2019; WHO, 2020a). On the other hand, the literature shows that behavioral differentiation is remarkably evident among various cultures, based on observable studies of their responses in dealing with the pandemic outbreak (Qian *et al.*, 2020; Rogers *et al.*, 2018). Moreover, containment of COVID-19 from the outbreak in Oman is critically affected by individuals' knowledge of this pandemic (Abdelfattah *et al.*, 2015; Deng and Peng, 2020; La *et al.*, 2020; Li *et al.*, 2020) and attitudes toward preventive behaviors against the pandemic (Bonilla-alDana *et al.*, 2020; Kliger and Silberzweig, 2020; La *et al.*, 2020). To address and evaluate this phenomenon, a conceptual model was formulated by the authors to explore the association among various constructs, which, in turn, determines public awareness about COVID-19, including the direct and indirect effect of risk perception, health knowledge, source of information and the mediating effects of public attitude and preventive behavior. The theoretical framework is presented in Figure 1.

To alleviate the current pandemic outbreak, spreading awareness is vital due to the key role of knowledge in mitigating COVID-19 prevalence modes (Ahmed and Ali, 2019; Deng and Peng, 2020; Rogers *et al.*, 2018). Betsch *et al.* (2020) argued that numerous people are saturated by inaccurate information and rumors regarding the emerging pandemic. Meanwhile, strict guidelines imperatively must be followed to control the potential of COVID-19 transmission, including frequent hand washing and close-contact avoidance with humans and animals (Dharmshaktu, 2020; La *et al.*, 2020; WHO, 2020b). Therefore, providing accurate information during pandemic emergencies is the cornerstone to reducing the risk of COVID-19 infection (Louis-Jean *et al.*, 2020; Nathan and Scobell, 2012; Rogers *et al.*, 2018; WHO, 2020a). Given the scarcity of published conceptual and empirical research on public health awareness regarding the COVID-19 pandemic and based on reviewing the literature, questions about the public level of awareness in front of dealing with the emerging COVID-19 epidemic have been raised.

In this regard, the evident core gap in knowledge and awareness of the risk factors associated with the pandemic transmission in the Sultanate of Oman context is very clear (Hoseinpour Dehkordi *et al.*, 2020; Yue *et al.*, 2020). Therefore, this study primarily aims to measure the level of public awareness about the threat of the emerging COVID-19 pandemic



Public health awareness

Notes: RP.: Risk Perception; HK.: Health knowledge; SI: Source of Information; PA: Public Attitude; PB.: Preventive Behaviour; ACOVID: Awareness about COVID-19, the development of the conceptual model was based on an extensive review of previous literature

Figure 1.
Conceptual model

among the Omani population. This study also aims to investigate the mediating effects of Omanis' attitudes and behavior with underlying conditions of COVID-19 (e.g. social distancing, quarantines). Moreover, it examines the role of media in spreading knowledge and awareness on the right preventive behaviors against viral infection (COVID-19).

Section 2 debates a critical review of the related and most recent literature and hypothesis development. To accomplish the research objectives, Section 3 presents study methods. The study also analyzed the proposed model in Section 4. The main results, practical implications, limitations and further research suggestions are presented in Section 5. Finally, Section 6 presents a study conclusion.

2. Literature review

2.1 Risk perception

Infectious diseases such as chikungunya, dengue, H1N1 influenza (also known as swine flu) and dog flu (H3N2), exhibited over the past few decades, have caused a global pandemic (Poletto *et al.*, 2016; Wang *et al.*, 2020). More recently, COVID-19 evolved as a severe respiratory infection caused by the emerged coronavirus (La *et al.*, 2020; McKibbin and Fernando, 2020; Strunk *et al.*, 2014). Coronavirus initially evolved in China. This virus has been endemic in animals (Hoseinpour Dehkordi *et al.*, 2020; WHO, 2020b). The viral infection transmitted to humans and gained momentum until COVID-19 was prevalent all over the world (Bedford *et al.*, 2020; Kliger and Silberzweig, 2020; Villela, 2020). Accordingly, a pandemic alert was elevated by the World Health Organization, illustrating the imminent risk associated with the current pervasive epidemic (Chinazzi *et al.*, 2020; McKibbin and Fernando, 2020; Villela, 2020). COVID-19 has affected public health for a short period and circulated rapidly, leading to the outbreak of the disease across numerous territories, which caused a panic concerning population health regarding the COVID-19 pandemic (Betsch *et al.*, 2020; Li *et al.*, 2020).

However, the crisis, along with the risk perceived, demonstrated an evidence-based response when facing an emergency or epidemic outbreak (Elkind *et al.*, 2020; Quinn *et al.*, 2013). Adhikari *et al.* (2020) suggested that the planned dissemination of information through trusted sources with clear and reliable messages constitutes an influential defensive

role in mitigating the perceived risk among potentially affected people. Researchers elucidated that the way people perceive risk may not firmly represent the absolute risk associated with the pandemic outbreak (Bavel *et al.*, 2020; He *et al.*, 2020; McKibbin and Fernando, 2020; Nicomedes and Avila, 2020; Rahman *et al.*, 2020). The overstatement of perceived risk among people often occurs because of unclear information or the misuse of social media (Jain and Kumar, 2015; La *et al.*, 2020; Yasir *et al.*, 2020). Therefore, behaviors pertinent to the perceived risk during the COVID-19 epidemic critically impact the fluctuation of infection numbers (Abdelhafiz *et al.*, 2020; Felice *et al.*, 2020; Garrido *et al.*, 2020).

Extant research showed that COVID-19 pandemic containment is revealed after a factual realization of the risk associated with the current situation (Arshad Ali *et al.*, 2020; Li *et al.*, 2020; Lim and Nakazato, 2020). This realization will, in reflection, change how people act and consequently will remarkably adjust their preventive behavior in a way that suits pandemic conditions (Abdel Wahed *et al.*, 2020; Del Brutto *et al.*, 2020; Liao *et al.*, 2010; Poletto *et al.*, 2016).

2.2 Health knowledge

The acquired knowledge about the COVID-19 pandemic guides the overall response during the global epidemic outbreak (Bhatnagar *et al.*, 2018; Suresh *et al.*, 2020). Researchers have ascertained that the viral infection is easily transferred from person to person, devolving to others through coughing or sneezing droplets (Malik *et al.*, 2020; WHO, 2020b); greeting with contaminated hands; or touching polluted surfaces, as the virus survives for more than 8 h (Hui *et al.*, 2018; WHO, 2020b). As such, La *et al.* (2020) suggested that using preventive procedures such as avoiding face touching, covering of the nose and mouth when sneezing or coughing and throwing away a tissue after one use must be taught to well-educated youths who can spread awareness among the community. This is similar to previous epidemics' preventive instructions attained that contained the viral infections of H1N1 and H3N2 (Al-Tawfiq *et al.*, 2014; Chinazzi *et al.*, 2020; Dharmshaktu, 2020; Johnson and Hariharan, 2017).

Parallel to this, the better knowledge or education acquired about the pandemic, the better stimulation toward prevention commitment (Bakhtiari *et al.*, 2020; Gambhir *et al.*, 2016; Nemati *et al.*, 2020; Rahman *et al.*, 2020). Meanwhile, many researchers found that the attitude of knowledgeable individuals on viral transmission modes and measures of prevention differ notably in comparison to unaware people. The accomplishment of the objective of COVID-19 pandemic containment dramatically varies, along with the public's acquired knowledge and its positive attitude toward dealing with the epidemic outbreak (Ahmed and Ali, 2019; Bawazir *et al.*, 2018; Johnson and Hariharan, 2017; Singh *et al.*, 2020; Thabit, 2011). To assess the related-health knowledge of the specific population, a better understanding of the techniques used to educate the public about pandemic dispersal modes and prevention is vital (Peters *et al.*, 2020; Woodall, 2020).

Empirically, knowledge on the health consequences pertinent to COVID-19 infection was found to have a significant impact on individuals' self-motivation to decide committedly to isolate and protect themselves (Benajiba *et al.*, 2020; Al Omari *et al.*, 2020). As mentioned from the literature, earned health-related knowledge influences overall public awareness toward the COVID-19 pandemic, as evidenced by the public's attitude and behavior such as cough etiquette, social distancing and quarantining (Hamza *et al.*, 2020; Li *et al.*, 2020; Pandey *et al.*, 2020).

2.3 Source of information

Media channels represented by television, journalists and some social media platforms formulate a useful source of information (Hoseinpour Dehkordi *et al.*, 2020; La *et al.*, 2020; Nathan and Scobell, 2012; Stout *et al.*, 2020) that is keen to influence the community knowledge by transferring accurate information about COVID-19's nature, identifiable symptoms and preventive behaviors required to deal with the deadly pandemic (Bedford *et al.*, 2020; Strunk *et al.*, 2014). Nevertheless, Omani citizens receive a disparate range of information about COVID-19 epidemic propagation (Hoda, 2016; Hoseinpour Dehkordi *et al.*, 2020; La *et al.*, 2020); also, knowledge related to viral transmission modes is unclearly received (Cuc *et al.*, 2015; Malik *et al.*, 2020). The chaotic propagation of sufficient information about COVID-19 has created a lack of clarity between community members (Aker and Midik, 2020; Li *et al.*, 2020; Nathan and Scobell, 2012; Strunk *et al.*, 2014) and sheds light on the imperative need to provide an adequate amount of information regarding any case of the epidemic outbreak (Betsch *et al.*, 2020). Hence, offering useful communication modes essentially enables information providers to deliver critical messages.

Interestingly, people excessively access the internet to search for information about the newly emerged COVID-19 epidemic (Clements, 2020; Effenberger *et al.*, 2020; Farooq *et al.*, 2020). More specifically, the threat of COVID-19 infection grasps public attention, as social media accounts are vastly used to share information and experiences regarding COVID-19 pandemic infection and related risks (Bulmash *et al.*, 2020; Farooq *et al.*, 2020; Wang *et al.*, 2020). Bawazir *et al.* (2018) found that individuals use the internet as a source of information more frequently than other sources of information such as television, radio and newspaper to search about viral infection symptoms. This noticeable use of internet networks makes the use of other communication tools with the public ineffective; it also has an active role in changing communication instrument of the official sources of information for health institutions' declarations about the virus transmission modes (La *et al.*, 2020; Qazi *et al.*, 2020; Quinn *et al.*, 2013; Wilder-Smith and Freedman, 2020), protection procedures that need to be followed, isolation and social distancing and treatment (Liao *et al.*, 2010; Rogers *et al.*, 2018; Wilder-Smith and Freedman, 2020).

Further, protection motivation is influenced by the accuracy of the received information. Consequently, an individual's intention to keep social distance and adhere to quarantine is affected by the information's trustworthiness (Farooq *et al.*, 2020). The source of information demonstrates a substantial effect on people's attitude, behavior and awareness to weather the disease propagation (Aslan and Bakan, 2020; El-Zoghby *et al.*, 2020).

2.4 Public attitude as a mediator

Public attitude toward pandemic containment dramatically determines the country's situation during the health crisis (McKibbin and Fernando, 2020; Wang *et al.*, 2020). A combination of health-related knowledge, perception of the potential threat and information trustworthiness constitute public attitude toward prevention behaviors and result in an alteration in their practices (Guo *et al.*, 2020; Nicomedes and Avila, 2020; Rosenbaum, 2020). Seale *et al.* (2009) and Peters *et al.* (2020) argued that knowledge is associated with the public attitude toward the disease, which represents their awareness concerning COVID-19 epidemic diffusion severity, as an elevation in health knowledge alters their attitude toward dealing with the epidemic.

Thus, individuals' attitudes toward the newly emerged COVID-19 epidemic reflect the received guidance and information on modes of viral transmission, symptoms and infected-patient numbers (Gostic *et al.*, 2020; Guo *et al.*, 2020; Sun *et al.*, 2020). However, pandemic seriousness, as declared by the World Health Organization, emphasizes the importance of

raising the public awareness level to reach a stage of recovery from the COVID-19 pandemic (Khader *et al.*, 2020; Poletto *et al.*, 2016; Reuben *et al.*, 2020).

2.5 Preventive behavior as a mediator

Prevention behavior is a significant protective factor against COVID-19 epidemic infection. Rigorous preventive actions, articulated by preserving personal hygiene, frequent hand washing (Andualem and Sisay, 2017; Bakhtiari *et al.*, 2020), practicing social distancing by refraining close human interaction, as well as quarantines adherence, could significantly help the county to overcome the health crisis and curb the rapid spread of COVID-19 (Khose *et al.*, 2020; Seidel *et al.*, 2020). The scope of perceived risk is widely related to people's preventive behavior, but not necessarily pertinent to the actual level of risk (Betsch *et al.*, 2020; Gardner *et al.*, 2016; Quinn *et al.*, 2013).

In this respect, it is necessary to deliver accurate knowledge of the disease to raise public awareness and correct the misconceptions regarding the relevant pandemic diagnosis and preventive practices (Deng and Peng, 2020; Hoda, 2016; Rogers *et al.*, 2018). Several studies have demonstrated that the paradigms of illness prevention and enhancement of public health essentially are predicated on understanding appropriate healthy behaviors and their reflection on community health (Hoseinpour Dehkordi *et al.*, 2020; Wang *et al.*, 2020).

2.6 Awareness about COVID-19

Generally, individuals' awareness and knowledge are the keys to preventing infection and surviving in any pandemic (Bharadva *et al.*, 2018; Krenke *et al.*, 2015; Poletto *et al.*, 2014). Bonilla-alDana *et al.* (2020) elaborated that spreading awareness is the springboard to curb the COVID-19 outbreak. The Ministry of Health in Oman recommends citizens isolate themselves by staying at home, reduce public transportation use (Bonilla-alDana *et al.*, 2020; Hoseinpour Dehkordi *et al.*, 2020; Mahajan and Kaushal, 2020; McKibbin and Fernando, 2020) and refrain from crowded venues or events in an attempt to maintain the community health and successively control illness diffusion (Bonilla-alDana *et al.*, 2020; Hoseinpour Dehkordi *et al.*, 2020; Kayhan Tetik *et al.*, 2020; McKibbin and Fernando, 2020; Nusbaum, 2020).

The wide spread of the newly evolving COVID-19 epidemic is associated mainly with social communication, especially in the Middle East region, as one miter is the minimal distance that could prevent individuals from the threat of COVID-19 infection, in light of vaccines' unavailability (Andualem and Sisay, 2017; Bedford *et al.*, 2020; Phelan *et al.*, 2020; Poletto *et al.*, 2014). Meanwhile, undesirable social practices have been widely noticed during the pandemic's initial peak (McKibbin and Fernando, 2020; Phelan *et al.*, 2020). Villela (2020) found out that awareness of diseases commonly prevailed between the older age group, who are characterized by a better level of education and socioeconomic status. However, public education and awareness in the context of health promotion and education may play an insufficient but significant role in protecting citizens from viral infection (Brebán *et al.*, 2013; Gardner *et al.*, 2016; Li *et al.*, 2020). Spreading knowledge on the needed precautions and prevention driving citizens' attitudes toward change and formulating an immunity against a COVID-19 outbreak (Dharmshaktu, 2020; James *et al.*, 2020; McKibbin and Fernando, 2020; Villela, 2020; WHO, 2020c). Various research studies have been conducted globally to investigate the direct and indirect effect of risk perception (Gardner *et al.*, 2016; Johnson and Hariharan, 2017; Klinger and Silberzweig, 2020); and people's knowledge, behaviors and attitudes; on the pandemic outbreak among distinct population categories (Khader *et al.*, 2020; Poletto *et al.*, 2016; Qazi *et al.*, 2020).

3. Research model and hypotheses development

The below model, depicted in [Figure 1](#), is developed based on the above literature review to guide this study investigation. The conceptual framework posits that public awareness regarding the COVID-19 pandemic could be measured by the direct influence of risk perception, health knowledge and source of information and indirectly by the multi-mediate effect of public attitude and preventive behavior:

- H1a.* Significant relationship exists between risk perception and public attitude.
- H1b.* Significant relationship exists between risk perception and public awareness regarding the COVID-19 pandemic.
- H1c.* Significant relationship exists between risk perception and preventive behavior.
- H2a.* Significant relationship exists between health knowledge and public attitude.
- H2b.* Significant relationship exists between health knowledge and public awareness regarding the COVID-19 pandemic.
- H2c.* Significant relationship exists between health knowledge and preventive behavior.
- H3a.* Significant relationship exists between the source of information and public attitude.
- H3b.* Significant relationship exists between the source of information and public awareness regarding the COVID-19 pandemic.
- H3c.* Significant relationship exists between the source of information and preventive behavior.
- H4a.* Public attitude mediates the relationship between risk perception and public awareness regarding the COVID-19 pandemic.
- H4b.* Public attitude mediates the relationship between health knowledge and public awareness regarding the COVID-19 pandemic.
- H4c.* Public attitude mediates the relationship between the source of information and public awareness regarding the COVID-19 pandemic.
- H5a.* Preventive behavior mediates the relationship between risk perception and public awareness regarding the COVID-19 pandemic.
- H5b.* Preventive behavior mediates the relationship between health knowledge and public awareness regarding the COVID-19 pandemic.
- H5c.* Preventive behavior mediates the relationship between the source of information and public awareness regarding the COVID-19 pandemic.
- H6a.* Significance relationship exists between public attitude and public awareness regarding the COVID-19 pandemic.
- H6b.* Significance relationship exists between preventive behavior and public awareness regarding the COVID-19 pandemic.

4. Research methodology

To achieve research objectives, the techniques and instruments used to gather and analyze data are vital. A quantitative research approach was adopted, where a cross-sectional study

was conducted through the utilization of a random sampling approach to collect data via an online survey. The structured, close-ended questionnaire was designed by using the "Google form" link. Further, the selection of an online survey was for social distancing during the quarantine period in light of the pandemic outbreak. Researchers distributed the survey from June 13, 2020, to July 10, 2020, by using social media platforms such as WhatsApp, Twitter and email. The research population was Omani citizens and residents from various geographic areas infected by the COVID-19 epidemic in Oman, including Ad Dakhiliyah, Ad Dhahirah, Al Batinah, Al Buraymi, Al Wusta, Ash Sharqiyah and Muscat. The research used convenience sampling due to the complexity in controlling the population, limited interaction and social distancing imposed due to the wide spread of COVID-19. Convenience sampling is widely used in situations where the purpose of the research is to get ideas about respondents' opinions in a specific situation in a short period of time (Saunders *et al.*, 2020). The questionnaire consists of two sections: the first section, designed to study respondents' demographic characteristics including age, sex, residents, education, income; and the second section, containing 23 items designed to examine public awareness regarding the COVID-19 pandemic using a Likert scale to assess respondents' agreement or disagreement, as 1 = strongly disagree and 5 = strongly agree. Also, researchers ensure the data provided will be kept confidential as respondents agreed to participate and complete the questionnaire.

The questionnaire was distributed to Omani citizens and residents in Oman. Due to the mixed nationalities of our targeted sample, researchers provide an English version of the survey for foreigners and the Arabic version for domestic respondents. The questionnaire's validity and reliability were assessed by conducting a pilot study. The questionnaire takes about 8 to 11 min. Furthermore, the sources of constructs items used in this study are shown in Table 1. A sample of 320 responses was examined using SPSS for data screening and testing. After the data screening, 305 out of 320 were valid and used for further descriptive analysis as per the recommendations in Hair *et al.* (2019).

Moreover, the use of partial least structural equation modeling has notably increased in the approaches of multivariate analysis, especially in predictive studies and investigative research (Götz *et al.*, 2010; Sarstedt *et al.*, 2011). Therefore, the employment of SEM-PLS V3.3 was the best choice for our research. The measurement of the study model and the proposed hypothesis was based on the guidelines recommended by Henseler *et al.* (2016). To assess model constructs, validity and reliability tests were applied. Moreover, this study used a structural model assessment to investigate discriminant validity and model fit. It also used a 5,000-bootstrapping technique to test for multiple mediating effects, examine study hypotheses, examines the magnitude and strength of mediation to check the power of proposed mediation hypotheses and, finally, draw the impact-performance map analysis.

5. Data analyzes and results

5.1 Socio-demographic characteristics

A total of 320 respondents fills the questionnaire. In total, 15 responses were excluded after data screening using SPSS due to statistical errors, missing values and outliers. Only 305 responses were valid and deemed suitable for further analysis. The main demographic determinants of the study sample were statistically measured gender, age, income, marital status, nationality, region of residence, educational attainment, occupation, salary, COVID-19 transmission mode, source of information and the level of infection worry. In response, our research respondents were majorly female with 55.7%. Most of the participants were in the age range between 30 and 39 years old (45.2%) and (65.9%) were married. However, the majority of participants were Omanis from Ash Sharqiyah (41%) and Muscat (21.6%). Most of the participants have a bachelor's degree (40.7%) and 29.2% were unemployed. In total,

Constructs	Items and sources
Risk perception	Reason for scaring, risk, anxiety and health-care resources (Bharadva <i>et al.</i> , 2018; Nicomedes and Avila, 2020)
Health knowledge	Causes, symptoms and transmission modes (Bawazir <i>et al.</i> , 2018)
Source of information	Clarity, consistency and understanding of information, Ministry openness, sufficient information (Bawazir <i>et al.</i> , 2018; Quinn <i>et al.</i> , 2013)
Public attitude	Wash hands, seeking information, avoid crowded areas and visit a doctor (Anusha, 2018; Suresh <i>et al.</i> , 2020)
Preventive behavior	Throw the used tissue, wearing a facemask, using soap and avoid handshaking (Suresh <i>et al.</i> , 2020)
Awareness about COVID-19	Understanding the risk, protection and transmission modes, aware of social considerations (Bullock <i>et al.</i> , 2020; Shi <i>et al.</i> , 2020)

Table 1.
Scale development

31.8% receive a salary between 500 and 900 monthly. Further, the majority of respondents know about COVID-19 transmission mode with (76.1%) and the primary source of information was the internet (33.1%). Participants were mostly a bit worried about COVID-19 infection (37.4%). Respondent's demographic characteristics are presented in [Table 2](#).

5.2 Measurement model assessment

For the assessment of the study measurement model, we examined construct concurrent validity, composite reliability (C.R) and discriminant validity. The square root values of average variance extracted (AVE) were also measured and compared to the correlations to assess the discriminant validity. The results demonstrate that item factor loading is greater than 0.70, as recommended by [Hair *et al.* \(2019\)](#). To assess construct validity, the value of AVE, C.R., rho_A should be greater than 0.5, 0.7 and 0.7, respectively, as suggested by [Naranjo-Zolotov *et al.* \(2019\)](#).

Moreover, the results revealed that Cronbach's alpha values were all above threshold (0.7) indicating an acceptable internal consistency. Construct reliability was also assessed by testing the value of variables rho_A; we found that rho_A was greater than 0.7 for all variables, which is consistent with the suggested criterion. The scores of C.R. were above the recommended 0.7. AVE also implies excellent convergent validity, where values were more than 0.5. [Table 3](#) shows construct's reliability and validity.

Additionally, values of Fornell-Larcker Criterion were higher than values of its correlation with other variables vertically, which implies discriminant validity and acceptable external consistency. This also examined using the Heterotrait-Monotrait Ratio (HTMT) test, scores demonstrate adequate discriminant validity as suggested by [Shmueli *et al.* \(2019\)](#). [Tables 4 and 5](#) presents the Fornell-Larcker Criterion test and HTMT test to distinguish constructs divergent validity.

5.3 Structured model assessment

PLS Algorithm test was conducted for assessing the structural model and examining the association between study constructs. Path coefficient results are significant as shown in [Figure 2](#). To assess the model structure and test for hypotheses, we used a bootstrapping test using (5,000 resamples).

[Table 6](#) presents fit statistics and direct relationship effects between the study constructs. The results of hypothesis testing are shown in [Figures 2 and 3](#). The direct effects imply definite and significant precursor between dependent and their independent construct,

GKMC

Variable	No.	(%)
<i>Gender</i>		
Female	170	55.7
Male	135	44.3
<i>Age (years)</i>		
Less than 30	91	29.8
30–39	138	45.2
40–49	50	16.4
50 and above	26	8.5
<i>Marital status</i>		
Married	201	65.9
Single	104	34.1
<i>Nationality</i>		
Non-Omani	51	16.7
Omani	254	83.3
<i>Region of residence</i>		
Ad Dakhiliyah	26	8.5
Ad Dhahirah	41	13.4
Al Batinah	34	11.1
Al Buraymi	13	4.2
Ash Sharqiyah	125	41.0
Muscat	66	21.6
<i>Educational attainment</i>		
Master's/PhD degree	45	14.8
Bachelor's degree	124	40.7
Diploma	72	23.6
General diploma	48	15.7
Junior school and below	16	5.2
<i>Occupation</i>		
Business owner	46	15.1
Government employee	96	31.5
Private sector employee	74	24.3
Unemployed	89	29.2
<i>Monthly salary (OR)</i>		
1,000–1,999	89	29.2
2,000 and above	38	12.5
500–999	97	31.8
Less than 500	81	26.6
<i>COVID-19 transmission mode</i>		
Knowledgeable	232	76.1
Not knowledgeable	73	23.9
<i>Source of information</i>		
Family	16	5.20
Friends	24	7.90
Health-care workers	14	4.60
Internet	101	33.1
Newspaper	39	12.8
Radio	27	8.90
Television	74	24.3
Other	10	3.30
<i>Worry of infection</i>		
Not worried	83	27.2
A bit worried	114	37.4
Worried	81	26.6
Very worried	27	8.90

Table 2.
Socio-demographic
characteristics of the
participants

Construct	Item	Factor loading	α	rho_A	CR	AVE	Public health awareness
Risk perception	RP01	0.756	0.724	0.845	0.833	0.627	
	RP 02	0.731					
	RP 03	0.880					
Health knowledge	HK01	0.852	0.915	0.924	0.940	0.797	
	HK02	0.890					
	HK03	0.917					
	HK04	0.912					
Source of information	SI01	0.872	0.896	0.903	0.924	0.708	
	SI02	0.801					
	SI03	0.761					
	SI04	0.872					
	SI05	0.896					
Public attitude	PA01	0.867	0.850	0.852	0.899	0.690	
	PA02	0.818					
	PA03	0.844					
	PA04	0.791					
Preventive behavior	PB01	0.902	0.911	0.913	0.937	0.789	
	PB02	0.883					
	PB03	0.888					
	PB04	0.879					
Public awareness	ACOV1D01	0.816	0.836	0.841	0.902	0.754	
	ACOV1D02	0.895					
	ACOV1D03	0.891					

Table 3. Reliability and validity of measurement scales

Notes: R.P.: risk perception; H.K.: health knowledge; SI: source of information; PA: public attitude; P.B.: preventive behavior; ACOV1D: awareness regarding COVID-19. α : Cronbach's α ; C.R.: composite reliability; AVE: average variance extracted

Variables	H.K.	PB	PA	ACOV1D	RP	SI
HK	<i>0.893</i>					
PB	0.789	<i>0.888</i>				
PA	0.785	0.856	<i>0.830</i>			
ACOV1D	0.733	0.866	0.785	<i>0.868</i>		
RP	0.494	0.490	0.485	0.381	<i>0.792</i>	
SI	0.787	0.786	0.809	0.758	0.450	<i>0.842</i>

Table 4. Fornell-Larcker criterion

Notes: Italic values are the square root of average variance extracted (AVE), which should be greater than the values in the same column to assure variable validity. R.P.: risk perception; H.K.: health knowledge; SI: source of information; PA: public attitude; P.B.: preventive behavior; ACOV1D: awareness regarding COVID-19

thereby supporting *H1a*, *H1c*, *H2a*, *H2b*, *H2c*, *H3a*, *H3b*, *H3c* and *H6b*. Whereas, risk perception and public attitude direct relationships with public awareness regarding COVID-19 were insignificant; thus *H1b* and *H6a* are not supported.

The confidence interval is presented to determine the significance of the path coefficient structure (Sarstedt *et al.*, 2020). However, there is no zero that appears in any of the confidence intervals which adds support to our results. We investigated the accuracy of the

proposed model fit using PLS path modeling by using various test instruments. [Henseler et al. \(2016\)](#) illustrate that an ideal fit is attained when SRMR has a value of zero while a value less than 0.05 indicates a good fit. R^2 ranges from zero to one, as the higher the value of R^2 , the greater the strength of variables' prediction. The R^2 value of 0.25 indicates weak predictive power, 0.50 moderate and 0.75 implies substantial descriptive strength ([Hair et al., 2014](#)). As suggested by [Selya et al. \(2012\)](#), R^2 values indicate that variables are significance predictors (PA = 0.718, PB = 0.701, ACOVID = 0.772). A satisfactory fit implies by SRMR less than 0.08 (SRMR= 0.055). Thus, values of SRMR and R^2 imply that the model-independent variable's direct effects on the dependent variables are within the recommended cut-offs.

Variables	H.K.	PB	PA	ACOVID	RP	SI
HK						
PB	0.856					
PA	0.881	0.968				
ACOVID	0.828	0.991	0.926			
RP	0.567	0.553	0.574	0.423		
SI	0.862	0.863	0.924	0.869	0.507	

Table 5.
Heterotrait-Monotrait Ratio (HTMT)

Notes: R.P.: risk perception; H.K.: health knowledge; SI: source of information; PA: public attitude; P.B.: preventive behavior; ACOVID: awareness regarding COVID-19

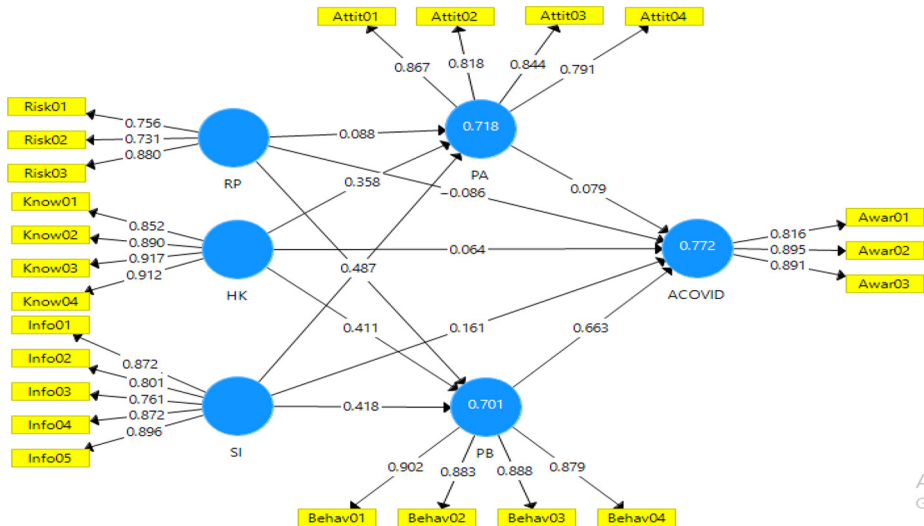


Figure 2.
Structural model assessment

Notes: R.P.: Risk Perception; H.K.: Health Knowledge; SI: Source of Information; PA: Public Attitude; P.B.: Preventive Behaviour; ACOVID: Awareness regarding COVID-19

Hypothesis	Relationship	Direct effect	<i>t</i> -value	Result	F2
<i>H1a</i>	RP → PA	0.088	2.455	Supported	0.021
<i>H1b</i>	RP → ACOVID	-0.014	0.285	Not supported	0.023
<i>H1c</i>	RP → PB	0.099	2.477	Supported	0.024
<i>H2a</i>	HK → PA	0.358	5.609	Supported	0.163
<i>H2b</i>	HK → ACOVID	0.365	4.592	Supported	0.005
<i>H2c</i>	HK → PB	0.411	6.259	Supported	0.201
<i>H3a</i>	SI → PA	0.487	7.429	Supported	0.316
<i>H3b</i>	SI → ACOVID	0.477	6.011	Supported	0.031
<i>H3c</i>	SI → PB	0.418	6.033	Supported	0.220
<i>H6a</i>	PA → ACOVID	0.079	1.177	Not supported	0.006
<i>H6b</i>	PB → ACOVID	0.663	10.187	Supported	0.429

Notes: R.P.: risk perception; H.K.: health knowledge; SI: source of information; PA: public attitude; P.B.: preventive behavior; ACOVID

Table 6.
Structured model

5.4 Effect size and predictive relevance

The effect of an exogenous latent variable on endogenous latent variable was investigated by checking the effect size (f^2) (Selya *et al.*, 2012). Indications of predictive constructs are assessed by examining the value of cross-validated redundancy (Q^2), as Q^2 greater than zero implies that pertinent variables of the model are predictive (Selya *et al.*, 2012). To determine our proposed model predictive power, we checked in-sample and out-sample prediction, the significance of Q^2 values, as well as considering the results of R^2 . Vital factors for assessment were used, represented in the values of path coefficient, R^2 , Q^2 and f^2 . The effect size ranges from zero 0 to one, where complete accuracy in prediction implies by the value of 1 (Park and Nicolau, 2015), as shown in Table 7.

To determine the effect size, Cohen's f^2 values were calculated for each of the three path models (when other independent constructs were removed, Figures 4, 5 and 6). F^2

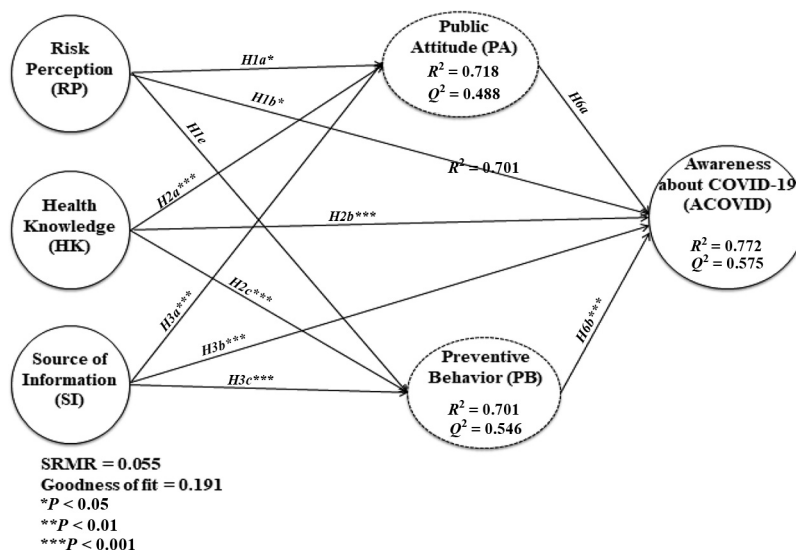


Figure 3.
Structural model and direct effects

GKMC

Endogenous variables	Q ²	R ²	Exogenous variables	Effect size f ²
PA	0.488	0.718	RP	0.021
			HK	0.163
			SI	0.316
PB	0.546	0.701	RP	0.024
			HK	0.201
			SI	0.220
ACOVID	0.575	0.772	RP	0.023
			HK	0.005
			SI	0.031
			PA	0.006
			PB	0.429

Table 7. Effect size and predictive relevance

Notes: PA: public attitude; P.B.: preventive behavior and ACOVID: awareness regarding COVID-19 are dependent variables; R.P.: risk perception; H.K.: health knowledge and SI: source of information are independent variables

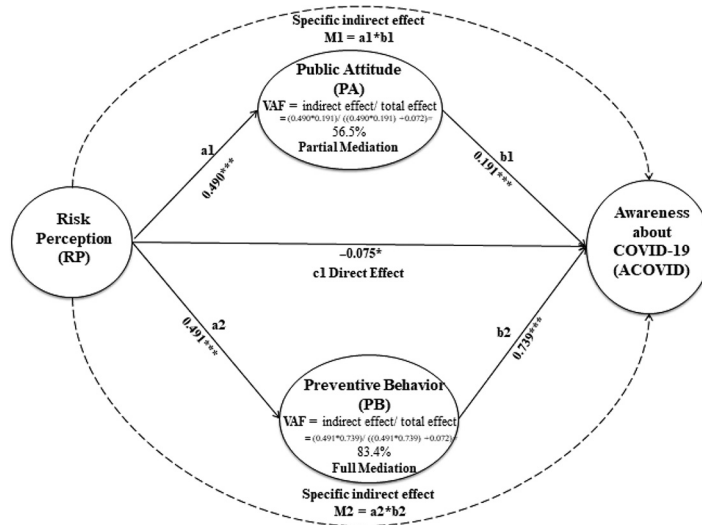


Figure 4. Mediation magnitude of H4a and H5a

was calculated without any adjustment to the value of R². The neglected constructs effect size pertinent to endogenous variable could be explored on the basis of effect size value f² by following the standard values for large (0.35), medium (0.15) and small effect (0.02) (Shmueli et al., 2019). This debate adds more support to the proposed direct and intervening effects of our model.

5.5 Multiple mediating effect tests

Mediator constructs in the PLS path model play a role in absorbing exogenous variable’s influence on the endogenous variable (Carrion et al., 2017). Several instruments and methods could be used to study the mediation effect (Sarstedt et al., 2020). The PLS-SEM test was used to explore the effect of multi-mediation in our model. Table 8 demonstrates the mediating effects of independent variables, namely, risk

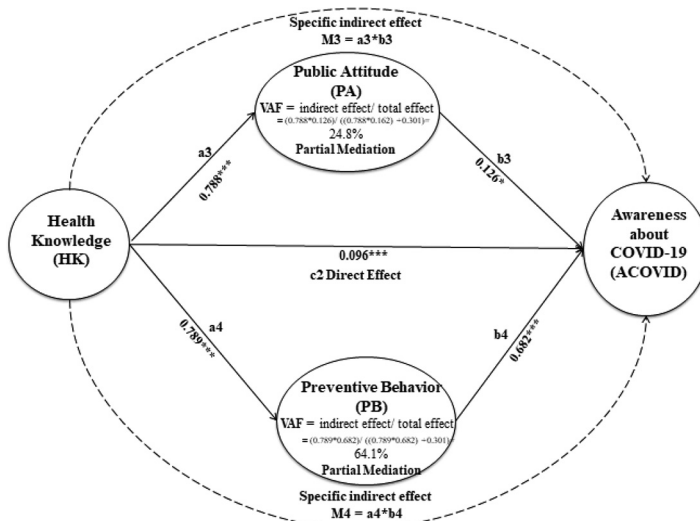


Figure 5. Mediation magnitude of *H4b* and *H5b*

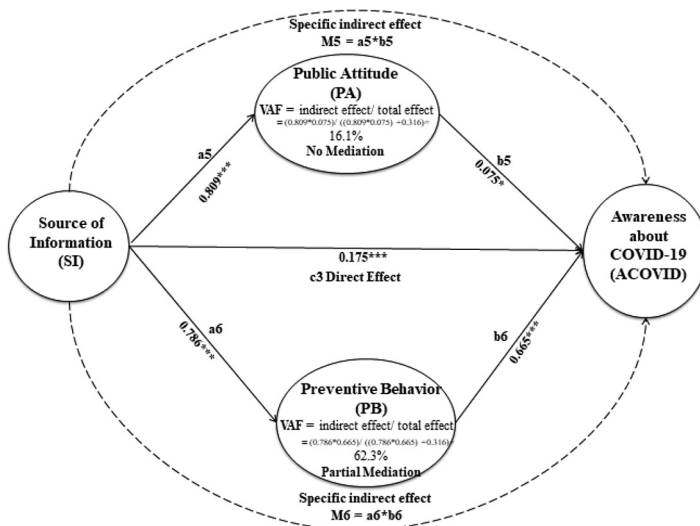


Figure 6. Mediation magnitude of *H4c* and *H5c*

perception, health knowledge and source of information on public awareness regarding COVID-19. Also, multi-mediation effects are shown in Figures 3, 4 and 5. A (5,000 resamples) bootstrapping was used to check for indirect effects. The influence of risk perception, health knowledge and source of information significantly affect public awareness when preventive behavior play a mediating role, which supports *H5a*, *H5b* and *H5c*. While the proposed mediating effect of public attitude was insignificant, and hence *H4a*, *H4b* and *H4c* were not supported.

Hypothesis	Mediation path	Specific indirect effects	<i>t</i> -value	<i>p</i> -value	Total effect
<i>H5c</i>	SI → PB → ACOVID	0.277	5.775	0.000	
<i>H4a</i>	RP → PA → ACOVID	0.007	0.957	0.338	0.072**
<i>H5a</i>	RP → PB → ACOVID	0.065	2.277	0.023	
<i>H4b</i>	HK → PA → ACOVID	0.028	1.231	0.218	0.301***
<i>H5b</i>	HK → PB → ACOVID	0.273	4.991	0.000	
<i>H4c</i>	SI → PA → ACOVID	0.038	1.078	0.281	0.316***

Table 8.
Mediation analysis

Notes: PA: public attitude and P.B.: preventive behavior are mediate variables; R.P.: risk perception; H.K.: health knowledge and SI: source of information are independent variables; ACOVID: awareness regarding COVID-19 is a dependent variable. ** indicates moderate mediation; *** indicates intense mediation

5.6 Magnitude and strength of mediation

In addition to the previous discussions regarding the mediation analysis, we also followed the guidance suggested by [Shmueli et al. \(2019\)](#) for further mediation analysis. Mediator's amount and magnitude were calculated to check the mediation influence and strength by using the technique of Variance Accounted For (VAF). [Rigdon \(2012\)](#) mentioned that there is no mediation effect when the value of (VAF) is 0.2 or less, while partial mediation exists if the value of (VAF) equal or less than 0.8, whereas a value higher than 0.8 for VAF represent a full mediation. [Figure 4](#) shows the strength and the magnitude of public attitude (*H4a*: a1b1) and preventive behavior (*H5a*: a2b2) on the relationship between risk perception and public awareness regarding COVID-19. The results show that public attitude has a partial mediation influence on risk perception and public awareness related to COVID-19 as its associated VAF value (0.565) is higher than 0.2. Therefore, the results show that *H4a* is supported when the relationship between risk perception and public awareness about COVID-19 was studied independently from the complete model. Moreover, the results indicate that preventive behavior fully mediates the relationship between risk perception and public awareness about COVID-19 as it has a VAF value of (0.834). The results add more support to *H5a*.

The mediation strength and magnitude of public attitude (*H4b*) and preventive behavior (*H5b*) on the relationship between health knowledge and public awareness regarding COVID-19 are presented in [Figure 5](#). The results show that both public attitude and preventive behavior mediate partially the relationship between health knowledge and public awareness about COVID-19 as their associated VAF values are (0.248) and (0.614), respectively. Therefore, the results show that *H4b* is supported when the relationship between health knowledge and public awareness about COVID-19 was studied independently from the complete model. Moreover, these results add more support for *H5b*.

The magnitude and strength of public attitude (*H4c*) and preventive behavior (*H5c*) as mediators between the source of information and public awareness regarding COVID-19 are provided in [Figure 6](#). The value of VAF (0.161) was less than 0.2 for public attitude as a mediator on the relationship between the source of information and public awareness regarding COVID-19 indicating no mediation exists. Thus, *H4c* is not supported. However, the results indicate that the relationship between the source of information and public awareness pertinent to COVID-19 partially mediated by preventive behavior as AVF (0.623) is higher than 0.2. Therefore, support *H5c*. The VAF values for all mediated relationship were above 0.2 expect *H4c*, which demonstrate the support for multi-mediation model proposition.

6. Conclusions and recommendations

Public COVID-19–related awareness of dealing with the pandemic increasingly grasps central attention worldwide. From the onset to early December 2020, the mortality rate dramatically increases in most countries, with a decrease in some of them. In Oman, the infection rate reached 126,240 cases, with 1,471 confirmed deaths by mid-December 2020 (WHO, 2020a). This disease is alarming for public health. Hence, it is well known that pandemic prevalence is directly pertinent to people's awareness, behavior, knowledge and attitude toward virus spread (Afzal *et al.*, 2020; Hamza *et al.*, 2020). This study explored key factors influencing the COVID-19 pandemic outbreak through an investigation of factors affecting public awareness during disease propagation in the Sultanate of Oman. This study explored the multi-mediation effects of public attitude and preventive behavior between risk perception, health related-knowledge, source of information and public health awareness pertinent to the COVID-19 epidemic. To accomplish the purpose of our study, we used an online survey and proposed a dual-mediation model.

The study results show that the public in Oman has proper health-related knowledge and modalities of the transmission of COVID-19, which affects their whole attitude and behavior during a pandemic outbreak. Our results demonstrate that health-related knowledge has an intense direct and indirect impact on public awareness about the COVID-19 epidemic. The results of our study also reveal that preventive behavior notably mediates the effect between risk perception and public awareness during the spread-of-viral-infection period.

Additionally, our findings are in line with Del Brutto *et al.* (2020), who concluded that the paradigms of COVID-19 pandemic prevention are heavily dependent on accurate public understanding of viral infection modes, symptoms and treatment, as well as that people's preventive behaviors are primarily and directly associated with their awareness level. Contrary to Reuben *et al.* (2020), our findings show that public attitude during the pandemic shows a powerful mediation effect between risk perception and health knowledge association with public awareness. Preventive behavior, represented by hand washing, mask-wearing and social distancing, shows public adherence toward official sources' guidance; similar results were also attained by Aker and Midik (2020).

Moreover, concerning the impact of public awareness on curbing the COVID-19 outbreak, our results are in line with Aslan and Bakan (2020), Louis-Jean *et al.* (2020), Singh *et al.* (2020), who found that risk perception, knowledge and information source, as well as the mediating effect of attitude and preventive behavior, have a significant association with public awareness about the COVID-19 epidemic. Our study findings consistently show a significant effect of these constructs on public awareness regarding the COVID-19 pandemic outbreak, whereas inconsistent findings were found in risk perception and public attitude insignificance having a direct association with public awareness regarding the COVID-19 epidemic. Additionally, it was found that there is an insignificant mediating effect of public attitude in the relationship between the source of information and public awareness regarding COVID-19.

COVID-19 pandemic containment needs strict procedures to overcome the epidemic spread. This study examines health awareness, knowledge, attitude and behavior regarding the COVID-19 pandemic in public perception. The key findings indicate that people overall gained knowledge about how to deal with the COVID-19 pandemic and that the accuracy of information significantly impacts public awareness. Likewise, public perception of COVID-19 risks ought to have a positive impact on their attitude, behaviors and their awareness when dealing with the disease.

Nonetheless, during such pandemics, the state health services should heavily invest in organizing online-focused sessions, leaflets and the use of social media platforms to ensure that citizens do have enough knowledge to deal with pandemics and act responsibly.

Responsible and well-behaved citizens are the front line in countering the negative impact of COVID-19 and do reduce the financial burden on health services resources. Countries that did not invest in increasing the awareness of their citizens paid a massive price in terms of the number of dead and infected people, which affect the entire country's economy. Well-managed health organizations that proactively plan their business and develop policies and implement strategies beforehand are well-positioned to steer the public during the sudden emergence of a disease outbreak.

Considering the study results, it has suggested for governmental health authorities to establish more efficient pandemic containment strategies to better control public behavior toward the COVID-19 pandemic and curb viral prevalence. Official sources of information must urgently adopt more trended social media platforms to publish COVID-19-related news and information. People's willingness to collaborate with containment plans for the current disease outbreak need to be better evaluated to reach higher levels of motivation (Abdelfattah *et al.*, 2015). Health organizations are also advised to develop and use sophisticated health information systems for tracking cases and improving patients' outcomes (Dahleez and Al Gharbawi, 2020; Dahleez *et al.*, 2020).

7. Limitations and suggestion for future research

This study is restricted by unavoidable limitations. During quarantine, we were unable to collect data from all infected states in the Sultanate of Oman. The questionnaire was distributed electronically, avoiding face-to-face meetings and personal interviews and following a convenience sampling process. Future research may use purposive sampling focusing on infected cases or their relatives. Future research may also target employees in the health sector. As several studies have focused on issues of coronavirus pandemic (COVID-19) status, little exploration has been undertaken regarding the knowledge, attitude and behavior of the public on health risks during the coronavirus pandemic (COVID-19) in the Sultanate of Oman, where the current research will add value. However, the findings of this research are expected to be developed in future research that emphasizes the in-depth study of public awareness regarding COVID-19. Further research can focus on patients as a targeted sample. Additionally, the proposed model can be further used to conduct studies in other countries infected by the COVID-19 epidemic.

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Corresponding author

Fadi Abdel Muniem Abdel Fattah can be contacted at: fadi.fattah@asu.edu.om

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