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Research Article

A cross-sectional study of perceptions of COVID-19 and adherence to preventive measures among Saudi college students using the health belief model

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ABSTRACT

This study utilized the health belief model (HBM) to investigate the association between the perceptions of COVID-19, adherence to healthy behaviors, and the credibility of COVID-19 information. This cross-sectional study utilized an online survey distributed to a random sample of graduate and undergraduate college students (N = 408) at a large public university in Riyadh, Saudi Arabia, during the COVID-19 pandemic. The study utilized two validated and reliable 5-point Likert scales to assess individuals' perceptions of COVID-19 and the credibility of health messages promoted via various communication channels. Various statistical analyses, including Kruskal-Wallis H and Pearson correlation coefficient (r) tests, suggested a positive association between the credibility of COVID-19 information and the HBM and a positive association between the HBM and adopting COVID-19 preventive measures. Individuals perceived public health authorities as more credible sources of COVID-19 information than traditional and social media platforms. The study recommends that public health authorities convey tailored, effective, consistent, and transparent health messages via proper communication channels to persuade and motivate individuals to adopt healthy behaviors during future pandemics.

Keywords: COVID-19, health belief model, information-seeking behavior, credibility, Saudi Arabia

INTRODUCTION

It is crystal clear that the COVID-19 pandemic has tremendously impacted different aspects of all societies, including health, economy, education, food, transportation, and social systems (World Health Organization [WHO], 2020a). Globally, more than 700 million people have been infected with the virus, with nearly seven million deaths (WHO, 2023a). Saudi Arabia is no exception, with more than 840,000 COVID-19 cases and 9,645 deaths reported by the Ministry of Health (MOH) (MOH, 2023a; WHO, 2023a). The WHO and the Centers for Disease Control and Prevention (CDC) have made massive efforts to combat and mitigate the risks of the COVID-19 pandemic by implementing new health policies, crafting tailored health messages, and launching educational health campaigns via various communication channels to raise awareness and educate individuals and communities about the healthy behaviors and preventive measures to prevent the spread of COVID-19 (CDC, 2022, 2023; WHO, 2023b).

Media plays a vital role during health crises (Coombs, 2007; Dry & Leach, 2010; Klemm et al., 2016; Laing, 2011; Pieri, 2019), bringing the scientific community, policymakers, and the public into one platform (Hoffman & Justicz, 2016; Pearman et al., 2021). As a result, individuals' attitudes, perceptions, beliefs, and behaviors are shaped (Gallagher & Updegraff, 2012; Laing, 2011; Pearman et al., 2021; Pieri, 2019). Studies suggested that mass media campaigns related to health and risk behaviors significantly increase positive behavioral changes and reduce negative changes among large populations (Wakefield et al., 2010). Social media is also indelible

in disseminating health messages, specifically during the COVID-19 pandemic (Chen & Wang, 2021; Chou et al., 2009; McNab, 2009; Salathé & Khandelwal, 2011). Multiple studies found social media to be the primary information source of COVID-19 (Silva et al., 2021; Zhong et al., 2021). Although extensive research has been conducted about the COVID-19 pandemic worldwide, to our knowledge, only a few studies have examined the phenomenon of health information-seeking behaviors, the credibility of health messages disseminated via various venues, and its relations to individuals' perceptions and adherence to the COVID-19 recommended measures through the lens of the health belief model (HBM) (Champion & Skinner, 2008; Hochbaum et al., 1952; Janz & Becker, 1984). This is indispensable, especially during health outbreaks, where health messages conveyed via various communication channels cannot be dissociated from individuals' perceptions, beliefs, and behaviors (Coombs, 2007; Dry & Leach, 2010; Gallagher & Updegraff, 2012; Hoffman & Justicz, 2016; Klemm et al., 2016; Laing, 2011; Pearman et al., 2021; Pieri, 2019).

Therefore, this study aimed to explore relationships between the credibility of health messages disseminated via different communication channels, the perceptions of COVID-19, and the adherence of college students to COVID-19 preventive measures in Saudi Arabia. This is vitally crucial because it helps public health authorities determine the roles and relationships between credible health messages, perceptions, and behaviors and how to convey tailored, effective, and credible messages that shape attitudes, perceptions, and behaviors during future health outbreaks.

LITERATURE OF REVIEW

COVID-19

According to the WHO, COVID-19 is caused by the SARS-CoV-2 virus and transmitted through large droplets or small aerosols from an individual's mouth or nose when breathing, speaking, singing, coughing, or sneezing (WHO, 2023c). Most COVID-19 infections are mild to moderate, and symptoms usually develop within two weeks. Symptoms may include a common cold, tiredness, fever, loss of smell or taste, headache, diarrhea, nausea or vomiting, and sore throat. Some individuals may develop other serious symptoms such as difficulty breathing, chest pain, aphasia, or paralysis. Older people and people with chronic medical conditions such as cancer, diabetes, and respiratory diseases are more susceptible to developing severe illnesses (CDC, 2022, 2023; WHO, 2023c, 2023d). However, all individuals from different age groups are susceptible to being infected or dying from COVID-19. To prevent virus infection, individuals should stay informed and aware of how the virus spreads and adopt the recommended preventive measures. Individuals, therefore, should seek new COVID-19 information and follow local health guidelines and recommendations to protect themselves and help public health authorities contain the virus (CDC, 2022, 2023; WHO, 2023d).

The MOH (2023a, 2023b) in Saudi Arabia swiftly adopted WHO's COVID-19 guidelines to educate the public and monitor, track, and report COVID-19 cases. The WHO and the CDC recommended that the public should follow hand and respiratory hygiene, such as proper handwashing, using tissues when coughing or sneezing, cleaning and disinfecting touched surfaces, wearing a mask to protect from getting infected, social distancing, and getting vaccinated and boosted against the COVID-19 (CDC, 2022, 2023; WHO, 2023c). As part of WHO's efforts to eradicate COVID-19, the #HealthAtHome campaign was launched to encourage the public to follow a healthy lifestyle during the pandemic, such as eating a healthy diet, exercising, and discouraging unhealthy behaviors such as smoking (WHO, 2023d). The National Health Emergency Operations Center (NHEOC) at the MOH strictly embraced such health messages and other guidelines to combat the COVID-19 pandemic (Khan et al., 2021; MOH, 2023a). As the WHO (2023b) stated, using integrated and effective communication is paramount to ensuring a healthy community and the safety of vulnerable people.

Health Belief Model

The HBM was established in 1950 to better understand why accessible and free tuberculosis TB screening campaigns were unsuccessful (Hochbaum, 1958; Janz & Becker, 1984). The model is considered the most extensively utilized health behavior model that attempts to understand and predict why certain individuals take or abstain from adopting healthy behaviors during health campaigns (Champion & Skinner, 2008; Hochbaum, 1958; Hochbaum et al., 1952; Janz & Becker, 1984; Rosenstock, 1974). The HBM has six dimensions:

(1) perceived susceptibility, which is concerned with individuals' risk perceptions of a particular disease,

(2) perceived severity, which is concerned with individuals' perceptions of the seriousness of a disease,

(3) perceived benefits, which is concerned with an individual's perceptions of the benefits and effectiveness of certain healthy behaviors,

(4) perceived barriers refer to the impediments that avert individuals from embracing healthy behaviors,

(5) cues to action, refers to internal and external cues that motivate an individual to follow healthy behaviors, and

(6) self-efficacy, which refers to individuals' capabilities and confidence to perform healthy behaviors (Champion & Skinner, 2008; Janz & Becker, 1984; Rosenstock, 1974).

Scholars have broadly utilized the HBM to explain and predict various health behaviors, including breast cancer (Champion, 1984; Guilford et al., 2017), wearing a helmet when riding a bike (Ross et al., 2010), receiving H1N1 immunization (Yang, 2015), following healthy sexual behaviors (Fehr et al., 2017), following preventive measures of Middle East respiratory syndrome coronavirus (Alsulaiman & Rentner, 2018), and intentions to receive the COVID-19 vaccine (Wong et al., 2020). Thus, the HBM was utilized as a theoretical framework to understand the perceptions of the COVID-19 pandemic among college students in Saudi Arabia.

Media Credibility

Crises create demands for information from various publics (Coombs, 2007, 2010). Scholars emphasized the importance of following best practices in crisis communication, including being honest, candid, and open. These elements form and build credibility (McCroskey et al., 1999). Because credibility is vital to an organization when managing a crisis (Ledingham & Bruning, 2000; Sellnow et al., 2010), providing accurate and consistent information helps it build and maintain credibility (Coombs, 2010; Curtin & Gaither, 2007). During a crisis, quick and early response can foster organizations to be perceived as more credible among stakeholders (Cooley & Cooley, 2011). Scholars suggested various elements that form message credibility, including the trustworthiness and expertise of a particular source (Hovland & Weiss, 1951), goodwill and competence (McCroskey et al., 1999), and believability and depth (Johnson & Kaye, 2009).

Studies found that messages credited to high-prestige sources were more effective in persuading the public to embrace a particular opinion than messages attributed to low-prestige sources (Hovland & Weiss, 1951). Factors like individuals' prior knowledge, type of message, and source significantly impact how individuals perceive a particular message (Eastin, 2001; Hovalnd & Weiss, 1951).

Scholars stated that media credibility comprises various constructs, including accuracy, trustworthiness, fairness, bias, and completeness (Austin & Dong, 1994; Meyer, 1988). However, believability, accuracy, completeness, biasness, and trustworthiness are considered to be the most comprehensive and consistent constructs of media credibility (Austin & Dong, 1994; Metzger et al., 2003; Meyer, 1988; Rimmer & Weaver, 1987; West, 1994). Both source credibility and type of message and source are associated with the pervasiveness and acceptance of a particular message (Callison, 2001; Hovland & Weiss, 1951; Pornpitakpan, 2004). For instance, a study conducted a systematic analysis of vaccine hesitancy during the H1N1 and Ebola pandemics found that trust in health authorities and accessibility to information about vaccines were some of the significant factors that influenced vaccine unwillingness and acceptability (Truong et al., 2022). That is why during global pandemics such as COVID-19, it is vital to learn and derive a comprehensive strategic risk communication plan from the efforts taken by scientific institutions, governments, and media to tackle a health crisis more effectively with a transparent and scientific approach (Valenti et al., 2023). It is also essential to ensure that the credibility and accuracy of health information disseminated to the public during a crisis are attained (Ledingham & Bruning, 2000; McCroskey & Teven, 1999; Sellnow et al., 2010; Valenti et al., 2023).

The type of message and channel selected to convey a particular message can profoundly impact the effectiveness of the message (Atkin & Hornik, 2002; Eastin, 2001; Johnson & Kaye, 2009; Nan et al., 2022). Thus, crafting tailored and effective health messages and targeting individuals' outcomes or efficacy beliefs is crucial to spur the embracing of healthy behaviors (Atkin & Hornik, 2002; Nan et al., 2022; Wakefield et al., 2010). Using a proper communication channel to convey risk messages to a specific group also becomes more critical in a global pandemic like COVID-19, where risk communication messages must be tailored to locals'

needs, traits, and contexts (Seeger et al., 2010; Valenti et al., 2023). For instance, Wong and Sam (2010) suggested that individuals with low education mainly rely on television and newspapers to obtain more health messages related to the H1N1 pandemic than those with higher education. The study also found that family and friends played crucial roles in disseminating and educating family members about H1N1 (Wong & Sam, 2010). A study of Hispanics/ Latinx from 16 countries also found that friends and family, television, and social media platforms were the main communication sources for the COVID-19 vaccine (Scheiber et al., 2023).

A recent study concluded that college students in the US were more likely to use the Internet, CDC's and WHO's communication channels, healthcare providers, and government officials to procure information about COVID-19 than social media influencers, radio, blogs, and Facebook. The study also indicated that the WHO and the CDC were viewed as more credible sources of health information than Twitter (X), Facebook, family and friends, and social media influencers (Alsulaiman & Rentner, 2022). Hence, health communicators must craft tailored health messages conveyed via proper channels to achieve effective outcomes (Atkin & Hornik, 2002; Nan et al., 2022; Seeger et al., 2010; Valenti et al., 2023; Wakefield et al., 2010).

Based on the literature, the following questions were posed:

RQ1. Where do Saudi college students first go to obtain information about COVID-19?

RQ2. What communication channels do Saudi college students use to get information about COVID-19?

RQ3. Which COVID-19 information sources are considered credible among Saudi college students?

RQ4. Do Saudi college students adhere to the recommended COVID-19 measures?

Similarly, the following hypotheses were posed:

H1. Individuals with a higher HBM mean score are more likely to follow COVID-19 health measures than those with a lower mean score.

H2. Perceiving the COVID-19 information sources to be highly credible is associated with higher adherence to recommended COVID-19 measures.

H3. Perceiving the COVID-19 information sources to be highly credible is associated with a higher HBM mean score.

METHOD

This is a cross-sectional study with a simple random sample of college students from a large university in Riyadh, Saudi Arabia. The institution was selected because it has a diverse population of students from different regions. The study adopted a validated HBM scale of 46 items measuring COVID-19 perceptions with a 5-point Likert scale (strongly agree = 5 to strongly disagree = 1) among college students in the United States. The scale showed high validity and reliability (Alsulaiman & Rentner, 2022). Three experts in health communication and epidemiology thoroughly reviewed the questionnaire and revised it based on the aim of the study. Two experts with PhDs in linguistics translated the instrument into Arabic. The WHO (2020b) translation process was followed to ensure the instrument's accuracy. A pilot study was conducted among several individuals of different statuses to test the instrument's language, accuracy, and simplicity. A few changes were made based on their feedback.

Furthermore, we conducted an exploratory factor analysis (EFA) by utilizing the principal component along with direct oblimin rotation as recommended by researchers (Costello & Osborne, 2005). The EFA explained 69.5% of the HBM variance, and all extracted factors were above the eigenvalue of one. Variables were loading above .5 and above .5 extracted commonalities. Cross-loaded items with .4 were dropped. Kaiser-Meyer-Olkin of sampling adequacy for the overall HBM constructs was above .87, and Bartlett's test of sphericity was significant ($p < .001$). Four items were dropped based on the EFA and Cronbach's alpha tests, bringing the HBM total to 42 items (mean [*M*] = 3.56, standard deviation [*SD*] = 0.48). The perceived susceptibility had five items ($M = 2.82$, $SD = 0.80$); perceived severity had six items ($M = 1.98$, $SD = 0.94$); perceived barriers had 11 items ($M = 1.20$, $SD = 0.74$); perceived benefits had seven items ($M = 3.91$, $SD = 1.08$); cues to action had seven items ($M = 4.18$, $SD = 0.56$); and self-efficacy had six items ($M = 4.17$, $SD = 0.71$). The overall HBM instrument showed a Cronbach's alpha test score of 0.91. The study applied the HBM to measure individuals' beliefs, and a higher mean score in the perceived benefits, severity, susceptibility, self-efficacy, and cues to action means

a higher HBM mean score. The coding of the perceived barriers was reversed for accurate analyses (strongly agree = 1 and strongly disagree = 5).

Participants had 20 minutes to complete the questionnaire. The questionnaire included demographic questions and other questions about the adherence to the COVID-19 preventive behaviors recommended by the WHO and the CDC (CDC, 2022, 2023; WHO, 2023b, 2023c), such as do you wear a mask in public? (yes = 3, sometimes = 2, no = 3); do you wear a mask when visiting ill people? (yes = 4 to no = 1); how often do you wash your hands daily? (I do not wash my hands = 1 to 9 or more times a day = 4); do you follow a healthy diet? (yes = 3, sometimes = 2, no = 1); do you stay away from animals? (yes = 3, sometimes = 2, no = 1); how often do you follow proper respiratory hygiene? (always = 5 to never = 1); how long do you exercise weekly? (4 = 150 minutes or more to 1 = I do not exercise); and how long do you sleep at night? (seven hours or more = 5 to less than four hours = 1). Other questions also included do you stay six feet away from other people? (no = 1 to yes = 3); have you been infected with COVID-19? (no = 1 to yes = 3); and have you received a COVID-19 vaccination? (no = 1 to yes, both shots plus booster shot = 4). The instrument also included the media credibility scale, which is considered the most consistent and comprehensive scale to assess media credibility on a particular topic (Austin & Dong, 1994; Gaziano, 1988; Metzger et al., 2003; Meyer, 1988; Rimmer & Weaver, 1987; West, 1994). The 5-point Likert scale assessed five dimensions of COVID-19 information, including believability, accuracy, trustworthiness, biasness, and completeness (e.g., extremely believable = 5 to not at all believable = 1), and a higher mean score means higher information credibility. We asked participants to assess the credibility of COVID-19 information in multiple communication channels. The credibility scale showed high reliability (Alsulaiman & Rentner, 2022). The scale was retested in this study using Cronbach's alpha test, yielding a score of 0.84. Also, we used a 5-point Likert scale (extremely likely = 5 to extremely unlikely = 1) to assess the likelihood of using various communication channels to get information about COVID-19. A higher mean score indicates a high likelihood of using a certain communication channel.

Procedures

The institution sent the online survey two times to a random sample of graduate and undergraduate students. The first invitation was sent in the fall of 2021, and the second was sent in the spring of 2022. Qualtrics was utilized to collect the data. The number of participants was 408, with a 40% completion rate. Participants were given the option of taking the survey in either English or Arabic.

Data Collection & Statistical Analyses

SPSS version 21 (IBM, Armonk, NY, US), was utilized to run the statistical analyses, such as the EFA, Kruskal-Wallis H, and Pearson correlation coefficient (r) tests. Missing data were removed, and only significant data ($p < .05$) were reported.

RESULTS

The number of participants who started the study was (N = 408) of which 58.8% (n = 240) were females and 41.2% (n = 168) were males. More than half of the participants were between 18 and 24 years old (n = 206); 38% were between 25 and 34 years old (n = 136); 9% were between 35 and 44 years old (n = 49); and less than 5% were above the age of 45 years (n = 17).

Results of **RQ1** showed that 47% of participants went first to MOH's channels, such as the website, Twitter (X), Instagram, Facebook, and YouTube, to procure COVID-19 information, followed by 33% who went first to the internet. Only 6% of participants went first to social media to obtain COVID-19 information, while 5% went first to WHO's communication channels, like its website, Twitter (X), Facebook, Snapchat, and YouTube. Less than 2% went first to healthcare providers, and less than 1.5% of participants went first to CDC's communication channels. Also, less than 1.5% of participants went to family and friends first to get COVID-19 information. None of the participants reported going first to traditional media, like TV, radio, and newspapers.

Results of **RQ2** suggested that Saudi college students were more likely to use MOH's communication channels, such as its website, Twitter (X), YouTube, Instagram, Snapchat, and LinkedIn (M = 4.42, SD = 1.03) to obtain COVID-19 information, followed by Twitter (X) (M = 4.26, SD = 1.03), healthcare providers (M = 4.11, SD

= 0.96), the internet (*M* = 3.96, *SD* = 1.17), and WHO's communication channels, like its website, Twitter (X), Facebook, Instagram, YouTube (*M* = 3.53, *SD* = 1.36).

However, college students in Saudi Arabia were less likely to procure information about COVID-19 through Facebook (*M* = 1.39, *SD* = 0.83), followed by newspapers (*M* = 1.87, *SD* = 1.12), radio (*M* = 1.91, *SD* = 1.11), blogs (*M* = 2.18, *SD* = 1.25), and social media influencers (*M* = 2.19, *SD* = 1.28) (**Table 1**).

Table 1. Communication channels mostly used to obtain COVID-19 information

S/N	Communication channels	Mean (standard deviation)
1	MOH's communication channels	4.42 (1.03)
2	Twitter (X)	4.26 (1.03)
3	Healthcare providers	4.11 (0.96)
4	The Internet	3.96 (1.17)
5	WHO's communication channels	3.53 (1.36)
6	Friends & family	3.20 (1.24)
7	CDC's communication channels	3.18 (1.83)
8	Television	3.08 (1.34)
9	University's communication channels	2.95 (1.43)
10	YouTube	2.95 (1.44)
11	Instagram	2.53 (1.44)
12	Social media influencers	2.19 (1.28)
13	Blogs	2.18 (1.25)
14	Radio	1.91 (1.11)
15	Newspapers	1.87 (1.12)
16	Facebook	1.39 (0.83)

Results of **RQ3** suggested that the participants perceived official and recognizable health agencies, such as the MOH, WHO, CDC, and healthcare providers, as more credible sources to obtain COVID-19 information than social media platforms and social media influencers (**Table 2**).

Table 2. Source credibility

S/N	Communication channels	Mean (standard deviation)
1	MOH's communication channels	4.26 (0.91)
2	CDC's communication channels	3.93 (0.91)
3	WHO's communication channels	3.92 (0.99)
4	Healthcare providers	3.90 (0.80)
5	University's communication channels	3.81 (0.83)
6	Television	3.11 (0.87)
7	Newspaper	2.97 (0.83)
8	Radio	2.93 (0.77)
9	The Internet	2.92 (0.80)
10	Twitter (X)	2.80 (0.82)
11	Friends & family	2.63 (0.77)
12	Blogs	2.58 (0.76)
13	YouTube	2.52 (0.81)
14	Instagram	2.42 (0.79)
15	Facebook	2.35 (0.74)
16	Social media influencers	1.98 (0.80)

Results of **RQ4** showed that most of the individuals firmly adhered to most recommended COVID-19 behaviors. More than 57% of individuals reported wearing a mask when visiting ill people, 67% stated they always wear a mask in public, and more than 66% followed proper respiratory hygiene (**Table 3**).

Table 3. Adherence to COVID-19 preventive behaviors

S/N	Preventive behaviors	*n*	%
1	Do you wear a face mask when visiting ill people?	Yes = 93	57.06
		No = 3	1.84
		Sometimes = 10	6.10
		I do not visit ill people = 57	34.57
2	Do you stay six feet/at least one meter away from people?	Yes = 76	46.91
		No = 20	12.35
		Sometimes = 66	40.74

Table 3 (Continued). Adherence to COVID-19 preventive behaviors

S/N	Preventive behaviors	*n*	%
3	How often do you wear a mask in public?	Always = 110	67.48
		Most of the time = 26	15.95
		Sometimes = 14	8.59
		Rarely = 7	4.29
		Never = 6	3.68
4	Do you stay away from animals?	Yes = 106	63.19
		No = 38	23.31
		Sometimes = 22	13.50
5	I ..... follow proper respiratory hygiene.	Always = 109	66.87
		Most of the time = 39	23.93
		Sometimes = 9	5.52
		Rarely = 3	1.84
		Never = 3	1.84
6	How long do you exercise weekly?	150 minutes or more = 18	11.04
		Between 75-140 minutes = 26	15.95
		Less than 75 minutes = 58	35.58
		I do not exercise = 61	37.42
7	How long do you sleep at night?	Seven hours or more = 62	38.04
		Six hours = 55	33.74
		Five hours = 31	19.02
		Four hours = 9	5.52
		Fewer than four hours = 6	3.68
8	How often do you follow a healthy diet?	Always = 18	11.04
		Most of the time = 45	27.61
		Sometimes = 46	28.22
		Rarely = 31	19.02
		Never = 23	14.11
9	Have you received a COVID-19 vaccination?	Yes, both vaccine shots, plus booster shots = 43	26.38
		Yes, both vaccine shots = 108	66.26
		Yes, one vaccine shot = 4	2.45
		No = 8	4.91
10	Have you been infected with the coronavirus (COVID-19)?	Yes = 44	26.99
		No = 108	66.26
		I do not know = 11	6.75
11	How often do you wash your hands daily?	Nine or more times = 27	16.56
		Five-eight times = 50	30.68
		One-four times = 83	50.92
		I do not wash my hands = 3	1.83

Moreover, Kruskal-Wallis H tests found significant differences in individuals with higher and lower HBM mean scores regarding following COVID-19 preventive behaviors. Individuals who had a higher HBM mean score were more prone to stay six feet away from others and use a mask when visiting ill people (**Table 4**).

Table 4. Reports of association between HBM, COVID-19 preventive behaviors, credibility, and vaccination

COVID-19 preventive behaviors	Median	Kruskal-Wallis X^2 (SD)	*p*
HBM & COVID-19 preventive behaviors:			
Do you wear a mask when visiting ill people?	Yes = 3.61	X^2 (3) = 10.122	< .05
	No = 2.88		
	Sometimes = 3.33		
	I do not visit sick people = 3.71		
Do you stay six feet away from people?	Yes = 3.72	X^2 (2) = 25.851	< .001
	No = 2.88		
	Sometimes = 3.64		
Credibility & COVID-19 vaccination:			
Have you received COVID-19 vaccination?	No = 2.87	X^2 (3) = 7.890	< .05
	Yes, one vaccine = 3.03		
	Yes, both vaccine shots = 3.3		
	Yes, both shots, plus booster shots = 3.4		

Pearson correlation coefficient (r) also found a positive correlation between the HBM and following COVID-19 preventive behaviors. Individuals with a higher HBM mean score reported washing hands more frequently,

were more likely to wear a mask in public, and were more likely to follow proper respiratory hygiene (**Table 5**). Hence, **H1** was supported.

Table 5. Pearson's r correlations of HBM, COVID-19 preventive measures, and information credibility

Variables	r	*P*
Relationship between HBM & preventive measures:		
Frequency of washing hands daily.	0.306	< .001
Frequency of wearing a mask in public.	0.435	< .001
Frequency of following proper respiratory hygiene.	0.398	< .001
Relationship between HBM & credibility of COVID-19 health messages:	0.310	< .001

Furthermore, the Kruskal-Wallis H test reported significant differences between those who perceived COVID-19 messages as more or less credible when taking COVID-19 vaccination. Individuals were more likely to get COVID-19 vaccines when they perceived COVID-19 information to be more credible (**Table 4**). Thus, **H2** was supported.

The Pearson correlation coefficient (r) also found a positive correlation between the HBM and the credibility of COVID-19 messages (**Table 5**). Therefore, the credibility of COVID-19 messages influenced individuals' perceptions of COVID-19, and participants with higher HBM were more likely to adhere to COVID-19 preventive behaviors. Hence, **H3** was supported.

DISCUSSION

This study has shown that Saudi college students who reported an overall high HBM mean score tended to follow respiratory hygiene and COVID-19 preventive behaviors closely. Such findings are consistent with a recent study conducted among US college students, which found that individuals with high HBM were more prone to apply respiratory hygiene and COVID-19 preventive behaviors (Alsulaiman & Rentner, 2021). It is also consistent with another previous study that concluded that individuals who reported higher perceived benefits found to be more likely to apply stress management techniques such as running or exercising, listening to music, and venting to a friend or family member than those with low perceived benefits (King et al., 2012). The findings are compatible with another study that found individuals with high HBM were more willing to adopt healthy behaviors like wearing a helmet when biking than those with low HBM (Ross et al., 2010). It is also similar to another study that found that perceived benefits predicted individuals' willingness to receive the COVID-19 vaccine (Wong et al., 2020).

Furthermore, a systematic analysis study suggested that both perceived benefits and barriers had a significant relationship with vaccine hesitancy (Limbu et al., 2022). A recent study also showed that HBM is associated with accepting COVID-19 booster (Ghazy et al., 2022). Another study applied the HBM to examine healthcare workers' acceptance of the COVID-19 vaccine has found that those with higher HBM were more likely to receive COVID-19 vaccination. The same study concluded that more than 82% of participants with high HBM showed a willingness to get vaccinated. Meanwhile, individuals with high perceived barriers were less prone to get the COVID-19 vaccine (Wang et al., 2022). These results signify that using the HBM to assess individuals' perceptions and predict the adoption of healthy behaviors during public health programs is crucial (Champion, 1984; Champion & Skinner, 2008; Guilford et al., 2017; Hochbaum, 1958; Hochbaum et al., 1952; Janz & Becker, 1984; Maiman & Becker, 1974; Rosenstock, 1974).

While the current study has found that college students who had higher HBM were more prone to follow respiratory hygiene and COVID-19 preventive behaviors, the findings are quietly different regarding vaccination. The study has demonstrated that the credibility of COVID-19 health messages has chiefly played a significant role in predicting and influencing COVID-19 vaccine acceptance. In particular, individuals who have received more COVID-19 series shots were found to believe and trust COVID-19 health messages compared to individuals who received fewer COVID-19 shots. This finding is compatible with a longitudinal study that found credibility and trust in public health authorities were the main predictors of individuals' vaccination status against H1N1 in Switzerland (Gilles et al., 2011). It is also compatible with another recent research conducted in Germany that suggested higher trust and credibility of COVID-19 information were associated with higher COVID-19 vaccine intentions and uptakes (Gehrau et al., 2021). Also, a study among

357 parents from minority communities in the US found a relationship between lack of trust in health messages and human papillomavirus vaccine (HPV) acceptance (Tsui et al., 2023).

Nevertheless, other important factors, like race, gender, confidence and trust, complacency, collective responsibility, poor communication, and inadequate policy, should not be underestimated as they play significant roles in vaccine hesitancy and acceptance (Baldwin et al., 2023; McRee et al., 2023).

Furthermore, this study emphasizes the importance of utilizing integrative, effective, consistent, and credible information when communicating with the public. The study suggests that the credibility of COVID-19 health messages is positively associated with a higher HBM mean score, thus triggering individuals to embrace healthy behaviors. This is consistent with previous research that investigated the role of messages and source credibility in shaping and changing individual beliefs (Pornpitakpan, 2004; Simons et al., 1970; Slater & Rouner, 1996).

Additionally, the current study has suggested that most Saudi college students first visited the communication channels of the MOH and used the internet to get information about COVID-19. Saudi college students reported they were more prone to use MOH's communication channels, Twitter (X), healthcare providers, the internet, and WHO's communication channels to procure COVID-19 health messages, and they were unlikely to get them from radio, newspapers, blogs, social media influencers, Facebook, and Instagram. These findings are similar to a US study that found that the internet was among the first sources used to obtain information on COVID-19. The same study suggested that college students were more likely to use the internet, WHO, and CDC than blogs, newspapers, radio, social media influencers, and Facebook to obtain COVID-19 health messages (Alsulaiman & Rentner, 2022). The same study suggested that college students were more likely to use the internet, WHO, and CDC than blogs, newspapers, radio, social media influencers, and Facebook to obtain COVID-19 health messages.

Furthermore, this study has also found that individuals viewed official health agencies like the MOH, WHO, CDC, and healthcare providers as highly credible sources of COVID-19 health messages compared to social media, traditional media, friends and family, and social media influencers. This finding is comparable to Alsulaiman and Rentner's (2022) study that suggested US college students perceived public health authorities' messages on COVID-19 as more credible than social and traditional media.

Interestingly, despite having average credibility, Twitter (X) was among the top communication sources Saudi college students were most prone to use to obtain COVID-19 health messages. This finding can be explained by recent research that found social media networking sites were the most used and desired communication sources to get news and information among college students in Saudi Arabia. The same study stated that Saudi college students sometimes trust the information and news they get from social media and perceive it to be inaccurate compared to other sources (Alsulaiman, 2022). Another explanation is called credibility experience in which a user assesses the credibility of something based on their own experience (Tseng & Fogg, 1999).

Although the credibility of health messages is central to gaining public trust during pandemics, public health authorities should always prepare for future health crises. A recent report by the Pew Research Center stated that around 49% of Americans viewed health agencies as unprepared for the COVID-19 pandemic, that the efforts of health agencies to contain the outbreak had been impeded by government officials, and got the facts wrong about COVID-19 (Nadeem, 2022). Another recent study indicated that media trust has declined during the pandemic in Switzerland (Adam et al., 2023). Thus, pandemics provide tremendous challenges, opportunities, and great lessons for health campaigners and policymakers to learn and prosper, yet conveying credible and consistent messages through official platforms is always imperative to gain public trust and achieve the desired behavioral changes (Truong et al., 2022).

Limitations

There are two limitations of this study. First, while the study used an online survey of college students in one of the universities in Saudi Arabia, the results cannot be representative or generalized over the whole population. Second, the study relied on the survey method in which more in-depth insights could be obtained using other research methods, like interviews or mixed methods.

CONCLUSIONS

This unique study illustrates that the HBM, and the credibility of health messages play indispensable roles during health outbreaks such as the recent COVID-19 pandemic. Credible health messages influenced the HBM and triggered individuals to embrace healthy behavior during the COVID-19 pandemic. Health agencies should always craft tailored, consistent, and credible health messages when communicating with various audiences during pandemics to ensure public adherence to healthy behavior. Using different official communication channels to convey effective health messages during pandemics is also crucial. Credible messages influence perceptions and ultimately lead to behavioral changes.

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Ethics declaration: The author declared that the study involving human participants was reviewed and approved by the Standing Committee for Scientific Research Ethics at King Saud University, Riyadh, Saudi Arabia (Ref No: KSU-HE-21-449). All relevant ethical guidelines and regulations regarding human research per the Helsinki Declaration were strictly followed. The author obtained informed consent from participants before conducting the study. Participation in the study was voluntary, and participants were free to withdraw or discontinue from study at any time without any penalty.

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