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ORIGINAL RESEARCH

Risk Communication Effectiveness During COVID-19 Pandemic Among General Population in Saudi Arabia

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Yasir Almuzaini[1]
Abdulaziz Mushi[1]
Alhanouf Aburas[1]
Yara Yassin[1]
Fahad Alamri[1]
Ahmed Alahmari[1]
Saber Yezli[1]
Anas A Khan[1,2]
Hani A Jokhdar[3]

[1]Global Center for Mass Gatherings Medicine, Ministry of Health, Riyadh, 12341, Saudi Arabia; [2]Department of Emergency Medicine, College of Medicine, King Saud University, Riyadh, 12372, Saudi Arabia; [3]Deputyship of Public Health, Ministry of Health, Riyadh, 11461, Saudi Arabia

Purpose: The novel coronavirus (COVID-19), declared a pandemic by WHO in March 2020, is an unprecedented occurrence in our recent history. Effective risk communication by health authorities, through relaying reliable and authoritative information, is imperative in combating the spread of the outbreak. We aimed to measure the effectiveness of risk communication campaign and overall awareness during COVID-19 pandemic among the general population in Saudi Arabia.

Patients and Methods: A cross-sectional survey of 5472 individuals in Saudi Arabia was conducted to assess several factors regarding the risk communication messages during the COVID-19 pandemic, including the knowledge and response of the general population toward COVID-19 and MoH efforts. The questionnaire was divided into five main sections: general knowledge of COVID-19, channels and social media platforms used perceived risk and stress or panic toward COVID-19, satisfaction and community perception, most trusted source of information, and type of information received.

Results: A total of 5472 individuals participated in the study residing in Saudi Arabia. Overall knowledge of COVID-19 was determined to be above average (0.58 + 0.159). Of the general population, 57.1% perceived that the risk of getting sick with COVID-19 is low, while nearly half of the respondents (45.7%) have a high level of stress and panic toward COVID-19. The majority of responders to the questionnaire reinforced that MoH was their most trusted source of information for the COVID-19 pandemic (91.7%).

Conclusion: This study showed that the risk communication campaign by healthcare authorities during the COVID-19 pandemic has improved the awareness among the general population in Saudi Arabia, where the overwhelming majority placed high trust in the MoH as its main reference for COVID-19 information.

Keywords: COVID-19, risk communication, awareness, Saudi Arabia

Introduction

The novel coronavirus disease 2019 (COVID-19), associated with the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), drew the attention of the world in early January 2020.[1] The World Health Organization (WHO) officially declared it a pandemic on March 11, 2020.[2] As of January 19, 2021, there were over 93 million confirmed cases and over two million deaths globally.[3] As numbers are expected to grow, the COVID-19 pandemic is an unprecedented occurrence in our recent history.[4,5]

COVID-19 has quickly become the topic dominating the media globally and even at the micro-community level, causing panic, psychological distress,[6] fear, and

Correspondence: Yasir Almuzaini
Global Center for Mass Gatherings Medicine, Ministry of Health, Riyadh, Saudi Arabia
Tel +966567761011
Email Almuzaini.Yasir1@gmail.com

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the spread of rumors and disinformation.[7–10] The consequences have been massive, distressing every country, industry, and individual, changing daily life as we know it.[5]

Granted that there remains much to learn as the COVID-19 outbreak is still ongoing, clinical trials for multiple vaccines are underway globally.[11] Additionally, measures have been implemented to limit the spread of COVID-19. In tandem with the WHO recommendations, countries have intensively ramped up their response to the pandemic through various initiatives to limit the spread of COVID-19.[12–14] Even countries that curbed the spread in their communities set up additional measures to keep reported cases down.[13,14]

Risk perception represents a main driving factor in how people react and adhere to public health measures during pandemics. Previous reports showed that adequate perception of exposure risk was a determinant for risk-averse behaviors and adherence to safety guidelines.[15] Exaggerated risk perception was significantly associated with misuse of precautionary measures, reflecting that inadequately high-risk perception can lead to panic reactions and misuse of health measures.[16] Risk perception can be affected by many factors, especially risk communication messages.[15] A recent survey that gathered data from 58 countries during the early phase of the COVID-19 pandemic demonstrated that cultural values and behavior play a crucial role in risk perception among the general population. Notably, this survey also found that a high level of uncertainties due to ineffective risk communication was positively correlated with limited adherence to social distancing measures.[17] In another recent survey from Vietnam, ineffective or overwhelming risk messages were associated with either exaggerated or underestimated risk perception during the COVID-19 pandemic.[18] Such findings highlighted the impact of effective communications on population behavior during the COVID-19 pandemic.

Alongside the direct efforts of the government and healthcare professionals against the COVID-19 pandemic, spreading risk awareness through effective communication channels is a key driver in empowering the general population with the knowledge needed to do their part in alleviating the quick spread of COVID-19. Nevertheless, with traditional media outlets and the widespread use of social media, it is difficult to regulate what information is accepted by the general public and how information can affect the community's awareness about COVID-19, risk perception, and response. During a pandemic, it is essential that any communicated information is accurate, authoritative, reliable, easy to understand, accessible, leaves little to interpretation, and quickly shuts down any misinformation that can be potentially spread amongst the community.[9,10,12,19,20]

In an effort to alleviate the spread of COVID-19 in Saudi Arabia, which reported 365,775 cases and 6342 deaths as of January 2021,[21] the Ministry of Health (MoH) has been especially active in disseminating information to the general public to raise awareness of COVID-19 in terms of general knowledge, community updates, risk factors, and preventive measures. To ensure the effectiveness of the COVID-19 risk communication, a questionnaire survey was conducted with responders from all over the country, spanning different age groups, socioeconomic classes, and education levels.

This study aimed to measure the risk communication effectiveness among the general population in Saudi Arabia in terms of awareness, knowledge accuracy, perceived trust in different channels of communication, and overall satisfaction with the MoH's efforts in raising awareness.

Methodology

The study's protocol was approved by the Central Institutional Review Board of the MoH-KSA (Central IRB log No. 20–77M) prior to the initiation of the data collection process. We confirm that all study procedures were in line with the principles of the latest version of the Declaration of Helsinki[22] and applicable local laws. As the present study was an online survey-based report, participants were not required to provide written informed consent. The cover page of the online survey stated the main objectives of the study and informed the participants that their answers to the survey's questions will be used to assess the study's objectives. Thus, participants, who filled the survey, implied their consent to participate in the study. All personal data of the participants were anonymized or maintained with confidentiality. As the survey was sent to the registered individuals within the "Mawid" E-service, which contains a database of adult individuals only, we confirm that all participants under the age of 18 had a parent or legal guardian supervision during the survey, as required by the Central Institutional Review Board of the MoH-KSA.

Study Design and Target Population

A cross-sectional study was conducted among the residents of Saudi Arabia. This study targeted all Saudi general population, citizens or residents of both genders and all age groups. The online survey was randomly distributed to all KSA regions through "Mawid" E-service databases. The "Mawid" E-service is a platform, provided by the MoH, to enable patients to book, cancel or reschedule their appointments at primary health care centers, as well as managing their referral appointments.[23] All data were collected through an online survey from May 15 to June 15, 2020.

Study Instrument

The study tool is adapted from the WHO-RCCE questionnaire (Risk Communication and Community Engagement Tool).[24] The questionnaire was translated into Arabic, tested, and validated by public health emergency experts. The questionnaire was distributed as an online survey using text messages and social media platforms such as Whatsapp and Twitter, in two languages (Arabic and English). This tool was used for collecting information from participants regarding their demographic characteristics, including age, gender, location, level of education, employment status, as well as exploring the participants' knowledge and trust regarding risk communication messages related to COVID-19.

Sample Size

We utilized the Raosoft® software for sample size calculation. Using a 95% confidence interval, a response distribution of 50%, and a 2.5% margin of error, the targeted sample size was estimated to be 1067 participants. Adjusting for the projected 10% attrition, the final sample size estimated for this general population survey was at least 1200 participants. By the end of the study, 5407 participants were enrolled in accounting for potential errors or non-respondents.

Statistical Analysis

A descriptive statistical analysis was conducted for all variables using percentages and frequencies for categorical variables to describe participants' demographics, knowledge, and response regarding the risk communication messages. For the overall knowledge score, all affirmative answers were given a score of 1, whereas negative answers were given 0. For multiple-choice questions with more than one correct answer, 1 score was given for choosing the correct/appropriate response and 0 score for not choosing the incorrect/inappropriate responses. The question's score was then divided by the total number of multiple choices in the question to standardize the scores to be between 0 and 1. Additionally, the overall mean scores ranged from 0 to 1. The difference in knowledge scores concerning demographics variables was evaluated by the Mann–Whitney *U*-test or Kruskal–Wallis test, as appropriate. A p-value of ≤ 0.05 was considered statistically significant. All analyses were performed using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA).

Results

Study Population and Demographics

A total of 5472 individuals willingly responded to the questionnaire survey (Table 1), a little over half of them were females (57.6%). Most respondents were of Saudi nationality (95.4%), with almost 39.7% and 30.4% residing in the Central and Western regions of Saudi Arabia, respectively. The most common responses came from the age group between 19 and 34 years (52.5%), followed by 35 to 50 years (38.2%). University degree represented the most common education level among the study population (68.1%). Almost two-thirds of the responders (37.2%) worked in the Saudi governmental sector.

Variable Assessments of Saudi Arabia General Population

The questionnaire survey focused on five main aspects concerning COVID-19: knowledge, source of information, channels including social media, level of trust and the most trusted source of information, level of stress and panic, and satisfaction (Table 2). These sections were designed as multiple-choice questions, with "Yes" answering in the affirmative.

General Knowledge of COVID-19-Related Information

Around half of the respondents (50.9%) believed that all ages are at risk of getting COVID-19 (Table 2). However, only one-third (30.8%) confirmed that the elderly (65 or above) are at the highest risk. When asked about virus transmission methods, 49.2% of the responders answered that COVID-19 spreads through droplets from an infected person, and 43.6% answered that COVID-19 spreads through direct contact with an infected person (43.6%).

Table 1 Demographics Characteristics of Respondents

Variables	Number	Percentage (%)
Gender	**5463**	
Female	3144	57.6
Male	2319	42.4
Age groups	**5449**	
≤18	33	0.6
19–34	2860	52.5
35–50	2081	38.2
51–65	444	8.1
>65	31	0.6
Nationality	**5463**	
Saudi	5214	95.4
Non-Saudi	249	4.6
Place of Residence	**5460**	
Eastern Region	991	18.2
Central Region	2165	39.7
Northern Region	236	4.3
Southern Region	407	7.5
Western Region	1661	30.4
Highest Level of Education	**5462**	
No Formal Education	10	0.2
Primary Education	42	0.8
Elementary Education	140	2.6
Secondary Education	1087	19.9
University	3719	68.1
Higher Education	464	8.5
Occupational Status	**5461**	
Governmental Employed	2032	37.2
Private Sector Employed	912	16.7
Private Business/Freelancer	112	2.1
Retired	336	6.2
Unemployed	1556	28.5
Student	513	9.4

Note: Bold numbers indicated the total number of the participants answered to the survey's question.

Seventy-six percent of the participants believed that COVID-19 is mainly associated with cough, fever, shortness of breath, and breathing difficulties as the main symptoms. In response to how to respond if COVID-19 symptoms appear, 89.3% stated that they would call the MoH Service Center and would stay in home quarantine, and 8.8% of the participants confirmed that they would go to the hospital/primary healthcare directly.

Furthermore, respondents understand that social distancing (57.1%), avoiding close contact with anyone who has

Table 2 Frequency of All Variables According to Questionnaire Themes

Variable	n	Yes	Percentage %
General knowledge			
Who do you think is at the highest risk to get the new coronavirus disease (COVID-19)?			
Adolescents (10–19 years)	5459	30	0.5
Adults (19–64 years)	5459	905	16.6
All Age Category	5459	2780	50.9
Children (1–9 years)	5459	36	0.7
Elderly (65 or above)	5459	1683	30.8
Infants (12 months or less)	5459	25	0.5
How does the new coronavirus disease (COVID-19) spread?			
Blood Transfusion	4879	275	5.6
Droplet from infected person	4879	2400	49.2
Direct contact with infected person	4879	2128	43.6
Touching contaminated objects/ surfaces with the new coronavirus	4879	953	19.5
Sexual intercourse contact	4879	218	4.5
Mosquito bites	4879	22	0.5
I do not know	4879	32	0.7
What are the main symptoms of the new coronavirus disease (COVID-19)?			
Cough, Fever, Shortness of breath and breathing difficulties	5461	4148	76
Fever, Muscle Pain, Headache	5461	738	13.5
No symptoms	5461	8	0.1
Shortness of breath and breathing difficulties, Fever, Diarrhea	5461	502	9.2
I do not know	5461	65	1.2
What to do if you have symptoms of the new coronavirus disease (COVID-19)?			
I will buy medicines by my self	5461	20	0.4
I will call 937 and I would stay in home quarantine	5461	4875	89.3
I will go to the hospital/Primary healthcare	5461	482	8.8
I will look for a more experienced relative to advise me on what to do	5461	48	0.9
I would search in the internet about the symptoms	5461	4	0.1
Other	5461	6	0.1
I do not know	5461	26	0.5
Do you know how to protect yourself from the new coronavirus disease (COVID-19)?			

(*Continued*)

Table 2 (Continued).

Variable	n	Yes	Percentage %
Wash your hands regularly using alcohol or soap and water	5337	1170	21.9
Cover your mouth and nose when coughing or sneezing	5337	848	15.9
Avoid close contact with anyone who has a fever and cough	5337	2367	44.4
Cook meat and eggs well	5337	1219	22.8
Avoid contact with animals	5337	664	12.4
Social distancing	5337	3045	57.1
I do not know	5337	7	0.1
Perceived risk and stress/panic toward COVID-19			
How likely do you think it is that you will become sick with the new coronavirus (COVID-19)?			
Low	5462	3120	57.1
Moderate	5462	1543	28.2
High	5462	799	14.6
Describe your feelings in term of stress and panic toward the new coronavirus (COVID-19)			
Low	5462	1161	21.2
Moderate	5462	1805	33
High	5462	2496	45.7
Do you consider it important to take actions to prevent the spread of coronavirus in your community?			
Strongly agree	5462	4660	85.3
Agree	5462	598	10.9
Neutral	5462	162	3
Disagree	5462	19	0.3
Strongly Disagree	5462	23	0.4
Satisfaction and community perception toward MoH			
How satisfied are you about MoH efforts in raising the health awareness of the new coronavirus (COVID-19)?			
Very satisfied	5462	4450	81.5
Satisfied	5462	826	15.1
Neutral	5462	117	2.1
Unsatisfied	5462	44	0.8
Very Unsatisfied	5462	25	0.5
What do you think about the MoH response against any rumours related to the new coronavirus (COVID-19)?			
Fast	5462	4478	82
Moderate	5462	818	15
Slow	5462	114	2.1
No response	5462	52	1

(*Continued*)

Table 2 (Continued).

Variable	n	Yes	Percentage %
Most trusted source of information			
From where or whom do you trust the most to receive information related to the new Coronavirus (COVID-19)?			
MoH (Official Accounts and Website)	5462	5006	91.7
World Health Organization	5462	144	2.6
Saudi FDA	5462	23	0.4
Family/Friends	5462	2	0
Healthcare Workers	5462	50	0.9
Other International Websites (eg USCDC website)	5462	41	0.8
Scientific Publications	5462	26	0.5
Social Media	5462	58	1.1
Social Media Influencers	5462	7	0.1
Other	5462	6	0.1
I do not have specific sources	5462	84	1.5
None of the above	5462	15	0.3
Type of received information			
What kind of information have you received about the new coronavirus disease (COVID-19)?			
How to protect yourself from new coronavirus disease (COVID-19)	5191	375	7.2
Symptoms of the new coronavirus disease (COVID-19)	5191	591	11.4
How is the new coronavirus disease (COVID-19) transmitted	5191	3158	60.8
What to do if you have the new coronavirus disease (COVID-19) symptoms	5191	1915	36.9
About Risks and complications of the new coronavirus disease (COVID-19)	5191	1966	37.9
None of the above	5191	26	0.5

a fever and cough (44.4%), and regular hand washing using alcohol or soap and water (21.9%) are important preventive measures against COVID-19. Very few respondents answered that they do not know how to protect themselves from COVID-19.

The overall mean knowledge score of COVID-19 among the general population was 0.58 (± 0.159) out of 1 (Table 3). The general population scored the highest in response measures taken to COVID-19 symptoms with a mean score of 0.89 (± 0.31) and in identifying

Table 3 COVID-19 Knowledge and Awareness in General Population in Saudi Arabia Based on Questionnaire

Knowledge Areas Related to COVID-19	n	Min	Max	Mean	SD
Population at higher risk of SARS-CoV-2 infection	5459	0	1	0.51	0.5
Main symptoms of COVID-19	5461	0	1	0.76	0.429
Protective measures against COVID-19	5337	0	0.85	0.24	0.129
COVID-19 Transmission	4879	0	0.75	0.52	0.2
Response measures taken to COVID-19 symptoms	5461	0	1	0.89	0.31
Overall knowledge of COVID-19	5481	0	0.86	0.58	0.159

Abbreviations: n, number of observations; Min, minimum number of observations; max, maximum number of observations; SD, standard deviation.

the main symptoms of COVID-19 with a mean score of 0.76 (± 0.429), but poorly in the knowledge of protective measures against COVID-19 (0.24 ± 0.129).

In relation to the COVID-19 pandemic knowledge areas (Table 4), all age groups (p=0.002) scored a mean knowledge score above 0.5 out of 1, except for the population above 65 years of age (0.49 ± 0.17). The highest knowledge scores were seen in the age groups of 19–34 years (n=2860; mean ± SD, 0.59 ± 0.15) and 35–50 years (n=2081; mean ± SD, 0.58 ± 0.16). The lowest score was found in the oldest age group of >65 years (n=31; mean ± SD, 0.49 ± 0.17).

Knowledge scores between both genders were observed in females with a mean score of 0.59 (± 0.15), scoring slightly higher than males with a mean score of 0.57 (± 0.15). Expectedly, population educational levels were significantly proportional to the COVID-19 knowledge scores (higher education level responders had a mean score of 0.85 (± 0.16), followed by university degree holders who scored 0.59 out of 1 (± 0.15).

There was no significant difference between knowledge scores of participants with different stress levels (p = 0.768). However, participants with moderate stress levels had a slightly higher knowledge score of 0.59 out of 1 (± 0.15). Similarly, there were no notable differences in knowledge scores in relation to perceived risks of COVID-19 (p = 0.032).

Table 4 Demographics Variables and Knowledge Score

Variable	Knowledge Score			
	n	Mean	SD	P-value
Age	**5449**			0.002
≤18	33	0.52	0.14	
19–34	2860	0.59	0.15	
35–50	2081	0.58	0.16	
51–65	444	0.57	0.16	
>65	31	0.49	0.17	
Gender	**5463**			0.001
Female	3144	0.59	0.15	
Male	2319	0.57	0.15	
Education	**5462**			0.001
No Formal Education	10	0.49	0.24	
Primary	42	0.56	0.16	
Elementary	140	0.56	0.16	
Secondary	1087	0.57	0.16	
University	3719	0.59	0.15	
Higher	464	0.85	0.16	
Stress level	**5462**			0.768
Low	1161	0.58	0.16	
Moderate	1805	0.59	0.15	
High	2496	0.58	0.16	
Perceived risk	**5462**			0.032
Low	3120	0.58	0.16	
Moderate	1543	0.59	0.15	
High	799	0.59	0.15	

Notes: Bold numbers indicated the total number of the participants answered to the survey's question. p-value for the Mann–Whitney U or Kruskal–Wallis Test.
Abbreviations: n, number of observations; SD, standard deviation.

Perceived Risk and Stress/Panic Toward COVID-19

Although 57.1% of the general population perceived that the risk of them getting sick with COVID-19 is low, nearly half of the respondents (45.7%) have a high level of stress and panic toward COVID-19. However, 85.2% of the participants strongly agreed on the importance of taking actions to prevent the spread of COVID-19 within the community (Table 2).

The association of perceived risk and stress levels, according to demographics, provided an in-depth look at the general population's view of COVID-19 (Table 5). All age groups (n=5441) were similar in that the majority (>80%) reported a neutral or low perceived risk. The elderly made up most of those who reported a high perceived risk (17.4% in 51–65 years old and 16.1% in >65 years old) of

Table 5 Association Between Demographics versus Perceived Risk and Stress Levels During COVID-19 Pandemic*

Variable	Perceived Risk (n)	Neutral or Low Perceived Risk	High Perceived Risk	P-value	Stress Level (n)	Low-Stress Level	High and Neutral Stress Level	P-value
Age	**(n=5441)**			0.285	**(n=5438)**			0.001
≤18		83.90%	6.10%			42.40%	57.60%	
19–34		85.70%	14.30%			20%	80%	
35–50		85.20%	14.80%			20.50%	79.50%	
51–65		82.60%	17.40%			30.30%	69.70%	
>65		83.90%	16.10%			25.80%	74.20%	
Gender	**(n=5457)**			0.001	**(n=5454)**			0.001
Female		87%	13%			16.70%	83.30%	
Male		83.20%	16.80%			27.40%	72.60%	
Educational level	**(n=5457)**			0.086	**(n=5457)**			0.206
Elementary		87.90%	12.10%			27.10%	72.90%	
Higher Education		82.50%	17.50%			23.10%	76.90%	
No Formal Education		80%	20%			30%	70%	
Primary		78.60%	21.40%			19%	81%	
Secondary Education		87.60%	12.40%			22.50%	77.50%	
University		85.40%	15%			20.40%	79.60%	
Occupational Status	**(n=5457)**			0.001	**(n=5454)**			0.001
Governmental		81.80%	18.20%			21.70%	78.30%	
Employed								
Private Business		87.50%	12.50%			27.70%	72.30%	
Private sector		83.80%	16.20%			22.30%	77.70%	
Retired		81.30%	18.80%			28.30%	71.70%	
Students		93.20%	6.80%			24.20%	75.80%	
Unemployed		89.10%	10.90%			16.90%	83.10%	

Notes: Bold numbers indicated the total number of the participants answered to the survey's question. *Calculated using Chi-Square.

COVID-19. The general population across all age groups gravitate more toward high and neutral stress levels, with the majority between the ages of 19–50 reporting the highest stress levels (80% in 19–34 years old, 79.5% in 35–50 years old).

Gender did not affect the perception of the risk associated with COVID-19 (females 87% versus males 83.2%, p=0.001). Both female and male genders reported high and neutral stress levels being 83.3% and 72.6%, respectively. The majority of educational levels reported a low perceived risk of COVID-19 (>78%). The educational level that showed the highest perceived risk was those who have completed primary education (21.4%), followed by those with no formal education (20%). Similarly, the characteristic response across different levels of education was neutral or high-stress levels.

The occupational status had an impact on the perceived risk of the participants (p=0.001). Students (93.2%) and private business (87.5%) had a neutral or low perceived risk of COVID-19 infection. However, neutral or high-stress levels were commonly reported in the unemployed participants (83.1%) and governmental employees (78.3%).

Main Channels Used for Knowledge of COVID-19

The four main channels, reported by the study population as sources for COVID-19 information, were text messages (n=1570), followed by social media (n=1013), television (TV) (n=597), and the 937 Call Center (Official Saudi MoH service center for health inquiries including COVID-19) (n=585) (Table 6). However, there were slight variations within each age group. In the bulk of the study

Table 6 Frequency of Channel Use for COVID-19 Risk Communication Messages According to Age

Channel	Where Did You Hear About the New Coronavirus Disease (COVID-19)?					
	Age Group (Years)					
	All (n=5409)	<18 (n=23)	19–34 (n=2818)	35–50 (n=2070)	51–65 (n=466)	>65 (n=32)
	n%	n%	n%	n%	n%	n%
Radio	71 (1.3%)	0.0%	32 (1.3%)	39 (2.2%)	0.0%	0.0%
TV	597 (11.0%)	3 (12.5%)	275 (11.2%)	260 (14.4%)	58 (14.6%)	1 (3.6%)
Social Media	1013 (18.7%)	7 (31.8%)	506 (21.1%)	406 (23.0%)	88 (22.3%)	6 (21.4%)
Other Internet Websites	365 (6.7%)	3 (13.6%)	175 (7.3%)	155 (8.8%)	30 (7.6%)	2 (7.1%)
Text Messages*	1570 (29.0%)	1 (4.5%)	820 (34.1%)	601 (34.0%)	138 (35.0%)	10 (35.7%)
937 Call Center†	585 (10.8%)	4 (18.2%)	301 (12.5%)	218 (12.3%)	55 (14.0%)	7 (25.0%)
Health Facilities/Healthcare workers	350 (6.5%)	1 (4.5%)	210 (8.7%)	112 (6.3%)	26 (6.6%)	1 (3.6%)
Family/Friends	288 (5.3%)	2 (9.1%)	193 (8.0%)	73 (4.1%)	20 (5.1%)	0.0%
Newspapers (Paper/Electronic)	133 (2.5%)	1 (4.5%)	73 (3.0%)	46 (2.6%)	12 (3.0%)	1 (3.6%)
Street Banners	437 (8.1%)	1 (4.5%)	233 (9.7%)	160 (9.1%)	39 (9.9%)	4 (14.3%)

Notes: *Sender: MoH and other governmental agencies (Ministry of Interior, Civil Defense, Municipality, Saudi FDA. †Official Saudi MoH service center for inquiries about COVID-19.

population (age 19 to 65 years old), the majority reported they first heard about COVID-19 from text messages (34.1% of the 19–34 years age group, 34% of the 35–50 age group, and 35% of the 51–65 age group). Considering that the sample size for the youngest (<18 years) and oldest age groups (>65 years) was very small, the potential bias of the result could have skewed results in these respective groups. Although text messages were identified per the questionnaire as the main channel, social media and 937 Call Center were prominent main channels in common in all age groups.

Those who responded to social media as a primary channel were also asked to elaborate on the platform used (Figure 1).

Twitter, by far (n=2436), was the highest reported social media platform used for COVID-19 information in the total study population, which was most eminent in the 19–50 age group (59.9% in 19–34 years and 56.9% in 35–50 years). WhatsApp (n=1740) represented the second most frequently used platform, and Snapchat (n=1699) closely followed in third. Facebook (n=210) was the least commonly reported, owing to the fact that Saudi nationals, who make up the majority of the study population, rarely use Facebook as opposed to Non-Saudis, who use it more frequently.

Most Trusted Source of Information

The overwhelming majority of responders to the questionnaire positively reinforced that MoH was their most

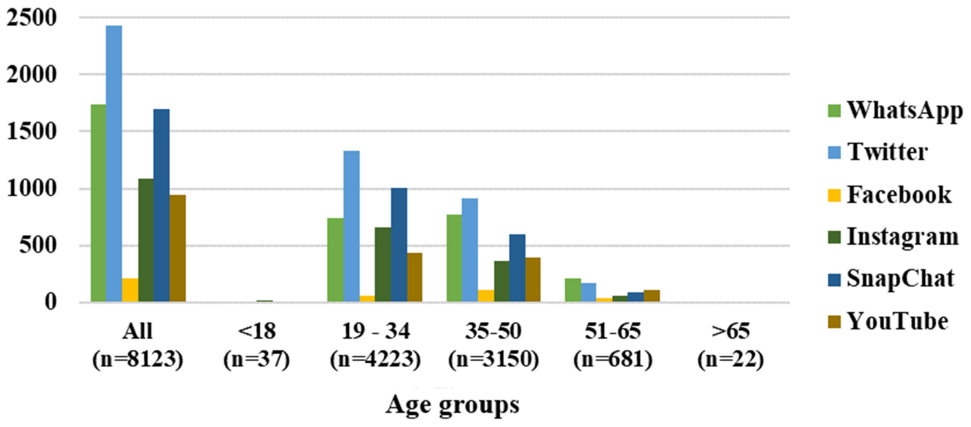

Figure 1 Social media platform use for COVID-19 information in Saudi Arabia according to age.

trusted source of information for the COVID-19 pandemic (91.7%), followed by the WHO (2.6%) (Table 2). Although different social media platforms were one of the most frequently used channels as sources of information for the COVID-19 pandemic, social media scored relatively low (1.1%) in trust value.

Type of Received Information

The majority of respondents conveyed that the type of information they received in relation to COVID-19 included mainly viral transmission methods (60.8%), risks and complications (37.9%), response to COVID-19 symptoms (36.9%). About 0.5% of responders reported not receiving any information.

Discussion

The WHO defined risk communication as the "exchange of real-time information, advice, and opinions between experts and people facing threats to their health, economic or social well-being".[25] Misinformation is expected with the presence of multiple uncontrolled platforms of information.[26] The worldwide panic from the COVID-19 pandemic caused a surge of information reflecting health, financial, social, and psychological concerns.[27] The emergence and spread of rumors related to COVID-19 divert the fear and perception of populations from the original threat to factitious risks created from false perceptions.[28] One of the most crucial roles of governments in the current pandemic is effectively and proactively engaging their communities to properly understand their concerns, needs, and beliefs.[28]

In 2017, the Saudi Vision 2030 set the fundamentals of digital transformation in the Kingdom. The Saudi government utilized all resources to ensure proper risk communication during the COVID-19 pandemic.[26] The MoH communicated and educated the Saudi population through its website and social media platforms, including; Facebook, Twitter, Instagram, YouTube, and Snapchat. Almost 19 applications and platforms were created to reach more than 89% of the Saudi population, who were estimated to use the internet.[26] The general aim of this study was to measure the effectiveness of the risk communication messages from MoH.

Knowledge scores suggest that the general population has a more reactive rather than proactive approach in the understanding of the COVID-19 pandemic and relies on more than one channel (social media such as Twitter and WhatsApp, and MoH) to gain information. The most trusted source of information was found to be the MoH based on the responses. A Chinese survey reported that the majority of the Wuhan population viewed their healthcare professionals, including physicians (90%) and nurses (88%), as the most trusted source of information. While 75% of the participants trusted COVID-19 information from Chinese television, only 32% trusted the internet as a credible source of information.[29] Another survey on Jordanian pharmacists revealed that moderate trust in social media as a source of information, believing that it is rather a source of fear and anxiety to the community.[30]

The knowledge scores in this study also conveyed that the Saudi population is generally well-informed through the efforts of the Saudi MoH in its risk communication campaign in creating the desired knowledge and awareness among the general public regarding COVID-19. MoH followed a comprehensive method of disseminating information to the general public, following technology-friendly methods,[19] and effectively minimizing misinformation.[9,10,12,14,19,20,31–33] Similarly, a Vietnamese survey reflected the proper risk communication related to the COVID-19 pandemic. Of 467 participants, the majority had a clear understanding of COVID-19 and proper perceptions of its risk on public health and economic status.[34]

The "infodemic",[7,10,31,32,35] a term devised to describe which has been largely seen as a result of massive amounts of indiscriminate information and rumors being readily available on social media, is another fight that must be combatted alongside the actual COVID-19 pandemic. A great deal of inaccurate information, rumors, and conspiracy theories in relation to COVID-19 are widely available on social media and thus shared easily, quickly, and unfiltered. Thus, it is imperative that there are measures taken to ensure that misinformation is discredited by trusted health authorities and professionals on a national level and replaced with authoritative and reliable information.[12,19,31,32,35] In line with this recommendation, the results from this study showed that although social media is quite pivotal in creating awareness of COVID-19, the overwhelming majority's most trusted and relied upon source is indeed the MoH, showing the effectiveness of the risk communication campaign in discrediting any false information. It also showed the general population's initiative to seek information from reliable and authoritative sources rather than only rely on social media. Our findings are in line with a national survey on 5039 Chinese

participants from 31 provinces that showed high coverage of risk communication messages and high impact of exposure to preventive information on population behavior. However, 407 respondents believed that at least one piece of misinformation could be true.[36] Similar findings concerning the impact of risk communication messages on college students' behavior from China were reported.[37] This study also finds that the general Saudi population has an adequate understanding of knowledge areas about COVID-19. The responders correctly identified the main symptoms of COVID-19[38,39] and high-risk populations.[38] The importance of home quarantine, social distancing, and notifying a health authority or healthcare professional in case of the onset of COVID-19 symptoms is also well-understood among the general population, most of whom identified social distancing as an important preventive measure.[40–43] Higher education levels and majority age groups (19–50 years of age) expectedly showed the highest level of knowledge. Although an overall above-average knowledge level is evident, knowledge in preventive measures was below average. It is apparent that the Saudi MoH has effectively conveyed the general aspects of knowledge effectively through risk communication messages to the general population but must continue to sustain and elaborate on the methods of prevention to ensure better cooperation from the public. The Chinese national survey observed similar results, where participants with high education levels and incomes had higher exposures to preventive information and had lower levels in believing misinformation compared to lower education levels and incomes ($p<0.05$).[36]

In the present study, the general population inclined more towards lower perceived risk and stress in spite of an above-average knowledge level. Our findings are in line with previous surveys from Nigeria[44] and Italy.[45] However, a recent survey that covered ten countries from Europe, America, and Asia reported that the risk perception among the general population was high.[46] Stress levels, however, were inclined to be high in varying degrees among the population regardless of age, occupation, and education level. Generally, females showed a slightly higher stress level than males. This could owe to a number of reasons, including the fear of the unknown, the increasing impact on everyday life, socioeconomic factors such as occupation, education level, and to COVID-19 dominating the world social media platform. Furthermore, social isolation and indeterminate durations of separation can cause loneliness, stress, and a disconnect from the outside world.[47] This has been seen on a global level[46,48] and specifically in Saudi Arabia,[48] as evident in the results of this study. An Indian survey showed increased levels of stress among the participating population. About 78.7% of the participants had stress related to fear from financial instability due to the pandemic.[49]

It is imperative that awareness of the risk of COVID-19 spread be created, yet steps should be taken by health and government authorities to alleviate stress and panic among the general population through a carefully balanced information campaign with the necessary guidance on return to life with protective measures.[46,48,50–53] Assessing risk communication is expected to aid the interaction between the community and the responsible authorities, health workers, and media. Taking corrective actions could direct the population towards proper behavioural and belief perception, crisis awareness and management, and public trust.[54]

While the present study has the strength of large sample size and comprehensive coverage of various Saudi Arabia regions, we acknowledge the existence of some limitations in this survey. Our survey was based on a self-reported, online-based survey that might suffer from selective participation, difficulties in measuring attrition rates, and liability to participants' feelings during survey filling.[55,56]

Conclusion

This study showed that the risk communication campaign by healthcare authorities during the COVID-19 pandemic has improved awareness among the general population in Saudi Arabia. The present survey demonstrated that the Saudi population had a fair level of knowledge regarding the transmission and protection against COVID-19. Nonetheless, the Saudi population demonstrated a low perceived risk of infection and high stress levels, despite this good knowledge. Overall, our results highlighted that the majority of the Saudi population placed high trust in the MoH and relied on all aspects related to COVID-19 information and updates.

Our findings highlight the instrumental role that healthcare authorities can play to correct misinformation, embed a satisfactory awareness among the general population about general knowledge of COVID-19, and count on trusted and authoritative sources for information. Furthermore, the study also presented the use of different social media platforms and their frequency of use among the population, wherein it conveyed a vital venue to be

utilized to help direct risk communication messages to each age group. The encouraging results associated with the above-average knowledge scores resulting from this risk communication messages campaign could be the foundation for even more effective campaigns and efforts by healthcare authorities. Hence, it will ensure that the population remains well-informed, manage misinformation, reduce stress levels, and consequently, reduce the spread of COVID-19 and ultimately, overcome the outbreak.

Nonetheless, there remained an overall perception of low risk associated with higher stress levels. Therefore, future research should be directed towards evaluating the main determinants of adequate risk perception amongst the general population.

Disclosure

The authors report no conflicts of interest in this work.

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