Assessment of Knowledge, Attitude, and Perception towards COVID-19 Vaccine among the General Population in the Hail Province, KSA

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Authors’ contributions

This work was carried out in collaboration among all authors. Authors ASSK, MZ and MS conceptualized and investigated the study, author ASSK performed the methodology, wrote the protocol, authors ASSK and MS maintained the project administration. Authors MAS, KAS, AAR, AAT, AAJ, AAH, AAN, LAS, SAE, YAR, ZAS and AA managed the resources of the study. Authors MZ and ASSK performed the software analysis of the study. Authors ASSK and MZ have done the review writing and editing of the final copy of the manuscript. All authors read and approved the final manuscript.

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# ABSTRACT

**Aim:** Coronavirus infection has caused disease at the pandemic level with several deaths worldwide and affected all aspects of human life. One way to minimize virus transmission and its effects is to perform mass vaccination within the general population so that herd immunity is developed against the SARS-CoV-2 virus. However, low health literacy and vaccine hesitancy are potential threats in achieving this. The present study is designed to measure the Knowledge, Attitude, and Perception levels towards COVID-19 and assess public perception and acceptance levels of the vaccine among the general population in the Hail province of Saudi Arabia.

**Methods:** A bilingual, community-based questionnaire, consisting of the respondents’ socio-demographic profile, COVID-19 knowledge, and attitude & perception towards COVID-19 vaccination, was circulated using different social media platforms. The collected data was analyzed using SPSS software.

**Results:** Appropriate knowledge level was found in 74.8% of the respondents, whereas inappropriate knowledge levels were observed in females and participants with non-health-related occupations and were inversely related to willingness to the vaccine. More than 60% of the respondents had a negative attitude towards the COVID-19 vaccine, as only 51% were willing to get vaccinated. A negative attitude was significantly associated with female respondents.

**Conclusion:** Our study reports a high knowledge level among the respondents in the Hail province. However, there is also a decreased willingness to be vaccinated, suggesting that more vaccine and health literacy seminars should be conducted to generate awareness among the general population in the Hail province, KSA.

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**Keywords:** Knowledge; attitude; perception; Coronavirus; COVID-19 vaccine; vaccine hesitancy; health literacy.

## 1. INTRODUCTION

Since the emergence of the first reported incidence in Wuhan, China, in December 2019, the world is fighting a global war against a public health concern involving a newly discovered Coronavirus strain [1]. This new strain of coronavirus, named SARS-CoV-2, has genetic similarity to the SARS-CoV-1 virus, responsible for the severe acute respiratory syndrome (SARS) epidemic in 2002–2003. Coronavirus infection has caused disease at the pandemic level with several deaths worldwide and affected all aspects of human life. It has resulted in most governments in the world imposing curfews. Most of the events, such as sports, social, marriages, and other ceremonies, were also canceled. Almost every industry has been affected throughout the world, triggering a global economic crisis [2].

The SARS-CoV-2 virus is highly infectious; the reproduction number ($R_0$) is around 2-3 [3]. The virus has since rapidly spread across almost all the countries of the world. According to the World Health Organization (WHO) data, by the end of July 2021, there have been more than two hundred million confirmed cases of COVID-19, including more than four million deaths [4]. In the Kingdom of Saudi Arabia (KSA), the Ministry of Health (MoH) announced the first case of coronavirus infection in March 2020 [5]. Since then, there is a slow but steady increase in newly infected cases in the country. Within KSA, more than 500,000 individuals were infected with the virus, and nearly 8000 people lost their lives until the end of July 2021. One way to minimize virus transmission and its effects is to increase public health education programs, generate awareness regarding the virus, the disease it causes, and the possible ways of its spread. In addition, for fighting the current pandemic, restoring everyday life, and uplifting the global economies, developing an effective and safe vaccine is the best option.

For the same reason, there are several vaccine candidates that are either developed or under development. As of January 2021, several safe and effective possible vaccine candidates are identified with high efficacy rates [6]. It usually takes several years and massive funding to develop a safe and effective vaccine that involves extensive pre-clinical testing before the clinical trials. Nevertheless, the recent developments in science and technology helped accelerate the vaccine development against coronavirus [6,7], using innovative and modern methods [8]. However, the recent reports of blood clots (thrombocytopenia and
thrombocytosis) in individuals injected with ChAdOx1 nCov-19 (AstraZeneca; [9,10]), or BNT162b2 (Pfizer/BioNTech [11]) vaccines have created a sense of restlessness in the general public. However, investigations by European Medicines Agency and the U.K.’s Medicines and Healthcare Regulatory Agency did not establish a causal relationship between blood blots and vaccine administration [12]. Another report also suggested that the benefits of vaccination were higher than the risks.

For community acceptance and readiness for COVID-19 vaccination, governments and healthcare providers must ensure vaccine availability and that the general population is well educated and informed regarding different vaccines. It is also essential to understand the public perception regarding vaccination, as mass vaccination is a critical step in attaining herd immunity regarding any pandemic [13,14]. In contrast, vaccine hesitancy due to misinformation is one of the biggest hurdles in achieving community immunity [15,16]. With the supply of vaccines from Pfizer and AstraZeneca underway in KSA, it is essential to assess public perception and acceptance levels towards these vaccines. The present study is designed to investigate and measure the knowledge level regarding COVID-19 and attitude towards vaccination of the general population living in the Hail province, KSA. It is vital to know how anti-vaccine ideas and rumors affect the distribution and uptake rates of the COVID-19 vaccine. Based on these results, it is easier to formulate plans to improve the vaccine acceptance level and increase the administration rates of the new vaccine for the population in the Hail province.

2. MATERIALS AND METHODS

2.1 Study Design, Target Population

2.1.1 Study sampling technique and Sample Size

The participants were selected through a convenient sampling technique. For determining the sample size, Raosoft Inc software is used. (http://www.raosoft.com/samplesize.html) [17]. After the two-month period, more than 950 respondents participated in the study.

2.2 Data Collection

Data was collected through an online self-administered structured questionnaire. The questionnaire was designed using the Google survey tool (Google Forms), and the link was shared through social media channels, including WhatsApp of the personal contacts list. The questionnaire was prepared in both English and Arabic languages to make it easier for the non-English speaking respondents to answer.

The detailed and structured questionnaire consisted of respondents’ demographic profiles and focused on questions related to their knowledge regarding the COVID-19 pandemic and attitude toward COVID-19 vaccination.

2.3 Study Questionnaire

The questionnaire was divided into three sections: socio-demographic profile of the respondents, knowledge regarding COVID-19, and attitude and perception towards COVID-19 vaccination. In the demographic section, age, gender, marital status, occupation, and past medical history were included. The occupation variables were divided into two categories health-related and non-health-related. In the knowledge section total of 10 questions were included. The correct answer was coded 1 point, and the wrong answer was coded 0 points. The total score ranged from 0 to 10 points. A cut-off value of > 6 points was considered as appropriate knowledge. The attitude section consisted of a total of 17 questions. The correct answer as frequency was scored on a Likert scale of 1.0 (strongly agree), 2.0 (agree), 3.0 (neutral), 4.0 (disagree), and 5.0 (strongly disagree), and each individual score of individual questions was summed and then transformed into proportion to characterize the attitude score. The cut-off value >25 was considered as a positive attitude. The survey questions were developed from previously published literature [18,19].

2.4 Statistical Analysis

All the data obtained were first checked manually for repeated responses by the same respondent. Then, it was analyzed using Microsoft Excel (Microsoft, USA) and SPSS version 23 (SPSS, Inc., Chicago, IL, USA) software. Descriptive statistical analyses were calculated for mean scores and proportions. Inferential statistical analysis was used by logistic regression models to test an association of age group, gender, occupation, and past medical history with the knowledge and attitude scores, respectively. A p-value of <0.05 is considered statistically significant.
3. RESULTS AND DISCUSSION

3.1 Socio-Demographic Characteristics of Study Participants

A total of 955 respondents undertook the e-survey. The average age of study participants was 30.52±11.43 years, and a majority of them were male (58.5%) and unmarried (52.5%). More than 54% of the survey population belong to non-health-related occupation. The majority of the respondents (81.2%) identified themselves as smokers (either present or past). Nearly 70% did not have any past medical history (Table 1), including diabetes, hypertension, cardiovascular disorders, respiratory disorders, neurological disorders, musculoskeletal disorders, gastrointestinal disorders, or renal disorders.

3.2 Knowledge Regarding the COVID-19 Disease

We started the study by examining the participants’ Knowledge regarding the COVID-19 disease and its vaccine. The majority (56%) of participants knew that COVID-19 is caused by the SARS-CoV-2 virus, whereas 29.5% of respondents indicated that the SARS-CoV-1 virus caused the current pandemic (Fig. 1A, Table 2).

Almost all the respondents knew the transmission mode, as 98.4% chose that the disease spread through direct contact with infected persons and their droplets and indirect contact by touching surfaces or objects contaminated with the virus (Table 2). More than 60% knew that the common symptoms of COVID-19 infection are sore throat, diarrhea, and inflammation of the conjunctiva, and nearly 80% of the respondents were of the view that if treated appropriately and timely, the patients can be cured, and the virus can be removed from the body.

In our e-survey, 11% of respondents had previously been infected with COVID-19 (Fig. 1B), and 86% believed that it affected their daily living activities (Table 1). The majority (64.6%) of the respondents got COVID-19-related information from social media, and 81.4% were committed to preventive measures of COVID-19, including facemasks and social distancing. Appropriate knowledge level regarding COVID-19 was found among 74.8% of participants (Table 2). We further categorized respondents based on their past COVID-19 infection and their knowledge level, and their willingness to get

| Characteristics                  | Frequency (%) |
|----------------------------------|---------------|
| Age (Years) (Mean ±SD)           | 30.52±11.43   |
| Age Category (years)             |               |
| 18-30                            | 528 (55.3)    |
| 31-70                            | 427 (44.7)    |
| Gender                           |               |
| Male                             | 559 (58.5)    |
| Female                           | 396 (41.5)    |
| Marital Status                   |               |
| Single                           | 501 (52.5)    |
| Married                          | 454 (47.5)    |
| Occupation                       |               |
| Health-related                   | 474 (49.6)    |
| Non-Health-related               | 481 (50.4)    |
| Smoking                          |               |
| Ever                             | 775 (81.2)    |
| Never                            | 180 (18.8)    |
| Past Medical History             |               |
| Yes                              | 288 (30.2)    |
| No                               | 667 (69.8)    |

SD – Standard Deviation
Table 2. Knowledge about COVID-19 among study participants (n=955)

| Knowledge questions (Correctly Answered) | N (%) |
|------------------------------------------|-------|
| **Cause of COVID-19**                    |       |
| SARS-CoV-2                               | 536 (56) |
| SARS-CoV-1                               | 282 (29.5) |
| **Mode of transmission of COVID-19**     |       |
| Direct contact with COVID-19 infected people, animals, and their products; | 950 (98.4) |
| Direct contact with the droplets dispersed when a patient coughs or sneezes; | |
| Indirect contact by touching surfaces or objects contaminated with the virus and then touching the nose, eyes or mouth. | |
| **COVID-19 affect daily living activities** |       |
| Yes                                      | 816 (86.5) |
| **Covid-19 affected psychological status** |       |
| Yes                                      | 600 (62.82) |
| **Reliable source of COVID-19 infection** |       |
| TV                                       | 105 (11) |
| Doctor                                   | 188 (19.6) |
| Social media                             | 618 (64.6) |
| Family and friends                       | 44 (4.8) |
| **COVID-19 virus stays in the body forever** |       |
| No                                       | 758 (79.4) |
| **Common symptoms of COVID-19 infection are sore throat, diarrhea, and inflammation of the conjunctiva** |       |
| Yes                                      | 605 (63.4) |
| **Most people who have COVID-19 infection will recover completely** |       |
| Yes                                      | 752 (78.7) |
| **Commitment to preventive measures**    |       |
| Yes                                      | 777 (81.4) |
| **Interested to know more about the Covid-19** |       |
| Yes                                      | 610 (63.9) |
| **Knowledge Category**                   |       |
| Appropriate Knowledge                     | 714 (74.8) |
| In-Appropriate Knowledge                  | 241 (25.2) |

*Knowledge scale category, Inappropriate=1-6, Appropriate =>6

Table 3. Association between respondents with past COVID-19 infection and their knowledge level and willingness to get vaccinated

| Variables                  | Covid-19 Infection | p-Value |
|----------------------------|--------------------|---------|
| **Knowledge category**     | Yes                | No      |
| Appropriate                | 26 (24.5%)         | 215 (25.3%) | 0.374 |
| Inappropriate              | 80 (75.5%)         | 634 (74.7%) |
| **Willing to Vaccinate**   | Yes                | No      |
| Yes                        | 53 (50.5%)         | 431 (52%) | 0.864 |
| May be                     | 31 (29.5%)         | 237 (28.6%) |
| No                         | 21 (20%)           | 161 (19.4%) |

vaccinated, but there were no significant differences between the respondents infected with COVID-19 compared to non-infected participants (Table 3).

Furthermore, we examined an association of COVID-19 knowledge with socio-demographic characteristics of the study participants. In univariate analysis, statistically significant associations were observed between inappropriate knowledge and female respondents (p<0.049) and those with non-health-related occupations (p<0.050, Fig. 1C, Table 4). Moreover, inappropriate knowledge was also significantly associated with decreased vaccine willingness (p<0.000). We also found
that respondents with age categories between 31-70 years, unmarried persons, ever smokers, and those who had past medical history were all associated with inappropriate knowledge, but the association was not statistically significant (Table 4).

![Fig. 1. Knowledge level, attitude towards COVID-19 vaccine, and willingness to take the vaccine among study participants. Percentage of respondents with knowledge regarding cause of COVID-19 (A), past COVID-19 infection (B), appropriate knowledge level (C), positive attitude (D) of the respondents with health-related occupation, and willingness to vaccinate (E)](image)

**Table 4. Association of Knowledge about COVID-19 with Socio-demographic characteristics among study participants (n=955)**

| Characteristics                  | Inappropriate Knowledge | Inappropriate Knowledge |
|----------------------------------|-------------------------|-------------------------|
|                                  | Crude Odd Ratio COR [95% Confidence interval CI] (p-value) | Adjusted odd Ratio AOR [95% Confidence interval CI] |
| Age Category (years)             |                         |                         |
| 18-30                            | 1                       | 1                       |
| 31-70                            | 0.91 [0.685-1.234] (0.574) | 1.0 [0.66-1.51] (0.978) |
| Gender                           |                         |                         |
| Male                             | 1                       | 1                       |
| Female                           | 1.34 [1.00-1.80] (0.049) | 1.32 [0.97-1.78] (0.070) |
| Marital Status                   |                         |                         |
| Married                          | 1                       | 1                       |
| Single                           | 1.05 [0.79-1.41]         | 1.03 [0.69-1.54] (0.865) |
| Occupation                       |                         |                         |
| Health-related                   | 1                       | 1                       |
| Non-Health-related               | 1.32 [1.01-1.77] (0.050) | 0.76 [0.57-1.03] (0.083) |
| Smoking                          |                         |                         |
| Never                            | 1                       | 1                       |
| Ever                             | 0.94 [0.65-1.38] (0.786) | 1.03 [0.70-1.52] (0.854) |
| Past Medical History             |                         |                         |
| No                               | 1                       | 1                       |
| Yes                              | 0.90 [0.65-1.25] (0.551) | 0.93 [0.67-1.29] (0.684) |
| Vaccine willingness              |                         |                         |
| Yes                              | 1                       | 1                       |
| No                               | 2.12 [1.69-2.87] (0.000) | 2.03 [1.50-2.73] (0.000) |
3.3 Attitude and Perception towards COVID-19 Vaccine

Next, we examined the attitude and perception of the COVID-19 vaccine among our study subjects (Tables 5 & 6). More than 50% of the respondents disagreed with the common misinformation regarding the vaccine. They believed that it neither affected the fertility of the recipients nor altered genes. They also did not think that it contained any microchip or fetus cells. The respondents also knew that the vaccine was not safe for immune-compromised persons and did not cause paralysis (Table 5). They also believed that preventive measures, such as using facemasks and sanitizers and maintaining social distancing, should be followed even after vaccination. More than 60% of the respondents believed the vaccine was not only effective for infected people but would also be helpful for non-infected individuals. While more than 70% of the participants agreed that the vaccination should be prioritized for the elderly, nearly 60% of respondents believed that the mass vaccination could end the pandemic (Table 5). More than 50% of the participants were willing to take the vaccine, while nearly 30% were undecided (Fig. 1E).

However, more than 70% of respondents were of the opinion that the current vaccines have low efficacy, and more than 55% believed that the vaccine could cause the death of the recipients. While more than 70% of the participants agreed that the vaccines could cause allergic reactions, nearly 75% of the participants agreed that the vaccine is not safe for pregnant and breastfeeding ladies. A positive attitude towards the COVID-19 vaccine was found among only 37.6% of participants (Table-5), whereas a positive attitude was nearly similar in respondents with or without health-related occupations (Fig. 1D).

We also examined an association of attitude and perception towards the COVID-19 vaccine with the socio-demographic characteristics of the study participants (Table 6). In univariate analysis, there was a statistically significant association between negative attitude and female respondents (p=0.002). Furthermore, like knowledge level, the negative attitude was significantly associated with decreased vaccine willingness (p<0.000) of the respondents. We also found that respondents with age categories between 31-70 years, not married, non-health-related occupation (Fig. 1D), ever smokers, and those who had past medical history were all associated with a negative attitude, but the association was not statistically significant [Table 6].

Table 5. Attitude and perception toward COVID-19 vaccine among study participants (n=955)

| Attitude questions (Correctly Answered) | N (%) |
|-----------------------------------------|-------|
| Vaccine efficacy low (Disagree. Strongly Disagree) | 250 (26.2) |
| Vaccine causes fertility (Disagree. Strongly Disagree) | 529 (55.4) |
| Vaccine alters genes (Disagree. Strongly Disagree) | 512 (53.6) |
| Vaccine contains microchip (Disagree. Strongly Disagree) | 521 (54.6) |
| Vaccine contains fetus cell (Disagree. Strongly Disagree) | 526 (55.1) |
| Vaccine is only effective for infected people (Disagree. Strongly Disagree) | 598 (62.6) |
| Vaccine causes paralysis (Disagree. Strongly Disagree) | 582 (60.9) |
| Vaccine exempts precautionary measure (Disagree. Strongly Disagree) | 558 (58.4) |
| Vaccine causes allergic reaction (Disagree. Strongly Disagree) | 276 (28.9) |
| Vaccine causes death (Disagree. Strongly Disagree) | 417 (43.7) |
| Vaccine priority should be for elderly (Agree. Strongly agree) | 670 (70.2) |
| Vaccine is safe for immunocompromised person (Disagree. Strongly Disagree) | 242 (25.3) |
| Vaccine is safe for breastfeeding and pregnant (Agree. Strongly agree) | 247 (25.9) |
| Vaccine is safe for anaphylaxis (Disagree. Strongly Disagree) | 240 (25.1) |
| Vaccine alters Pandemic (Agree. Strongly agree) | 172 (18) |
| Willing to take vaccine (Agree. Strongly agree) | 484 (50.7) |
| Vaccine can end pandemic (Agree. Strongly agree) | 561 (58.7) |

**Attitude Category**

| Positive Attitude | 359 (37.6) |
| Negative Attitude | 596 (62.4) |

*Attitude scale category. Negative attitude=1-25. Positive attitude =>25
Table 6. Association of attitude toward COVID-19 Vaccine with Socio-demographic characteristics among study participants (n=955)

| Characteristics              | Negative Attitude Crude Odd Ratio COR [95% Confidence interval CI] (p-value) | Negative Attitude Adjusted odd Ratio AOR [95% Confidence interval CI] |
|-----------------------------|---------------------------------------------------------------------------------|---------------------------------------------------------------------|
| Age Category (years)        |                                                                                 |                                                                     |
| 18-30                       | 1                                                                               | 1                                                                   |
| 31-70                       | 1.04 [0.80-1.36] (0.739)                                                        | 1.29 [0.88-1.89] (0.178)                                             |
| Gender                      |                                                                                 |                                                                     |
| Male                        | 1                                                                               | 1                                                                   |
| Female                      | 1.53 [1.16-2.00] (0.002)                                                        | 1.51 [1.15-1.99] (0.003)                                            |
| Marital Status              |                                                                                 |                                                                     |
| Married                     | 1                                                                               | 1                                                                   |
| Single                      | 0.84 [0.64-1.09] (0.196)                                                        | 1.44 [0.99-2.09] (0.865)                                            |
| Occupation                  |                                                                                 |                                                                     |
| Health related              | 1                                                                               | 1                                                                   |
| Non-Health related          | 1.00 [0.77-1.30] (0.980)                                                        | 1.04 [0.80-1.37] (0.727)                                            |
| Smoking                     |                                                                                 |                                                                     |
| Never                       | 1                                                                               | 1                                                                   |
| Ever                        | 0.93 [0.67-1.30] (0.690)                                                        | 1.03 [0.73-1.45] (0.854)                                            |
| Past Medical History        |                                                                                 |                                                                     |
| No                          | 1                                                                               | 1                                                                   |
| Yes                         | 1.02 [0.77-1.36] (0.854)                                                        | 0.96 [0.72-1.29] (0.823)                                            |
| Vaccine willingness         |                                                                                 |                                                                     |
| Yes                         | 1                                                                               |                                                                     |
| No                          | 6.73 [5.00-9.05] (0.000)                                                        | 6.90 [5.11-9.32] (0.000)                                            |

4. DISCUSSION

To our knowledge, this is a first-of-its-kind study performed among the general population in the Hail province of KSA to assess the knowledge, attitude, and perception level of the COVID-19 vaccine. We used an e-survey for this study to avoid direct public contact and maintain social distancing in these times of the pandemic. The research study was performed to check the health literacy rate of the general population living in the Hail province, KSA, and their possible acceptance of the COVID-19 vaccine. In these times of the pandemic, health literacy in the general population is essential in controlling the disease [20]. In our study, nearly 2/3rd of the participants had appropriate knowledge regarding the COVID-19 pandemic, indicating that they have been well informed. In fact, the Saudi government is taking various steps to educate the general population regarding the pandemic and motivate them to get vaccinated [21].

The majority of the respondents in the present study knew possible modes of transmission of the virus and disease symptoms. As the study suggested, social media has played an essential role in increasing the health literacy rates of people. This result is similar to the study published by Saleem et al., where they found that the internet/social media was the first source of information regarding COVID-19 for those study participants [22]. The emergence and the extensive usage of social media have indeed made the public more educated regarding the current pandemic, as seen in some other studies [23, 24]. Overall, the respondents have a higher appropriate knowledge regarding the pandemic, but the female respondents have significantly less appropriate knowledge than males. This finding is similar to another study performed in Bangladesh [19], which reported a significantly higher knowledge score for male participants than females. However, our results are in contrast to another study from Saudi Arabia [18]. This discrepancy can be related to the higher educational level in that study compared to our study.

In our study, the high negative attitude towards the vaccine is a matter of concern. The Saudi Food and Drug Authority (SFDA) has approved vaccines from AstraZeneca and Pfizer/BioNtech to be used in the kingdom [25, 26]. The KAP e-surveys are usually preferred to plan and apply
The study reports a high knowledge level among the respondents residing in the Hail province. However, there is also a decreased willingness to be vaccinated, suggesting that more vaccine and health literacy seminars should be conducted to generate awareness among the general population in the Hail region.

DISCLAIMER
The research was not funded by any external agency; rather, it was funded by the personal efforts of the authors.

CONSENT
Since taking a written consent was difficult in these kinds of online surveys, a question was included at the start of the e-survey, taking respondents' consent. The respondents had the option to decline to take part in this study, and only those respondents' data was collected who agreed to participate in this study.

ETHICAL APPROVAL
The present research is a cross-sectional community-based study conducted between April 2021 and May 2021 among the general population residing in the Hail province of KSA. The study was conducted after getting the Ethical approval from Research Ethics Committee, University of Hail, Saudi Arabia (Ethical approval number – H-2021-156).

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COMPETING INTERESTS
Authors have declared that no competing interests exist.
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