

# A Cross-Sectional Analysis into the Willingness and Hesitancy to Test and Vaccinate Against COVID-19 Among the Elderly Population in the Kingdom of Saudi Arabia

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**Introduction:** COVID-19 remains a public health concern. Vaccinations, testing and tracing have been proven to provide strong protection against severe illness and death. Older adults are amongst the groups with an increased risk of severe illness. This study aimed to explore the willingness and hesitancy of the elderly population in the Kingdom of Saudi Arabia to test and vaccinate against COVID-19.

**Methods:** This cross-sectional study targeted participants aged 65 years and above. The questionnaire included both sociodemographic variables, and variables related to willingness and hesitancy to vaccinate and test for COVID-19 that were mainly based on existing literature. Bivariate analyses were performed to test for associations. Significance was set at the 0.05 level.

**Results:** The total sample of respondents was 502. The results show that 52.4% were not aware of a previous infection. Participants aged above 70 years and females were found to be more aware of a previous infection (51.6% and 53.1% respectively) ( $P < 0.05$ ). Also, 54.7% felt it necessary to test against COVID-19, and among those, 70.8% believed that testing would contain and control the spread. The results also show that 3.2% were not vaccinated to date, compared to 95.41% who had the complete dose as well as the recommended booster dose for elderlies. Age, sex and level of education were significantly associated with vaccine uptake, where participants aged between 65 and 70 years, males and high levels of education were associated with a complete vaccine uptake.

**Discussion:** The current findings add to the epidemiological evidence and show that the social network theory within the context of health may have played a role in self-awareness of previous infections. Also, social factors should be incorporated in public health interventions and public health campaigns targeting the elderly are still needed especially with the continued discovery of variants of interests.

**Keywords:** COVID-19, public health, health promotion, prevention, elderly

## Introduction

Since the coronavirus disease 2019 (COVID-19) epidemic was announced in March of 2020, there has been over 770,085,713 confirmed cases and 6,956,173 deaths worldwide as of the end of August 2023.<sup>1,2</sup> The pandemic spread is mostly due to its high rate of contagion and mutation, resistance to climatic variations, and simple mode of transmission. Several worrisome variants for COVID-19 have been identified, which include Delta and Omicron. As recently as the 9th of August, the EG.5 - a descendant sublineage of Omicron - has been assigned as a variant of interest due to its high ability to spread globally and contribute to a surge in hospitalisations.<sup>3</sup>

Worldwide, several measures were taken to control the spread and subsequent detrimental consequences of infection as recommended by international guidelines. These included lockdowns, curfews, and travel restrictions. In the Kingdom

of Saudi Arabia (KSA), the Ministry of Health (MoH) in cooperation with other governmental agencies, took several measures to contain and control the spread of infection. These included mass lockdowns, suspension of international flights and rapid deployments of testing protocols.<sup>4</sup> Furthermore, the MoH always maintained direct communication with its citizens via campaigns that promote personal protective measures, vaccinations and testing through several channels that included text messages, daily news reports and through official social media accounts.<sup>5</sup> The Saudi Data and Artificial Intelligence Authority had also launched the Tawakkalna mobile application which was and still is successfully able to support government efforts through the issuance of movement permits during curfew periods as well as showing the users' health immune status.<sup>6</sup>

Evidence has shown that the elderly population are considered among the most vulnerable in the face of COVID-19. Although, this has not been yet fully understood on a molecular level, it is clear that age alone is a significant risk factor for death due to the disease.<sup>7,8</sup> Also, severity of COVID-19 is significantly associated with the presence of comorbidities, such as cardiovascular diseases, hypertension, diabetes and respiratory disease which are more prevalent in this age group.<sup>8</sup> Therefore, since the arrival of vaccines to the KSA on December 2020, the priority was to vaccinate the most vulnerable groups which included patients with comorbidities, immunocompromised patients, all first line responders and naturally those aged 65 years of age and above.<sup>9</sup>

Despite COVID-19 restrictions, such as proof of vaccinations and mask mandates were lifted in March 2023, the importance of abiding by national and international guidelines is crucial in this age group. Although several studies have been published that explored the attitudes towards COVID-19 vaccinations, none have targeted this specific vulnerable age group. The only study that looked at adults and included 116 adults aged above 60 years, has found that the vaccination acceptance rate was low, and that this was mainly due to concerns regarding its safety and potential side effects.<sup>10</sup> Therefore, this study aimed to explore the willingness and hesitancy of the elderly aged 65 years and above regarding the uptake of both the COVID-19 tests and vaccines and explore the reasons of both.

## Materials and Methods

### Study Design and Participants

This cross-sectional study recruited elderly patients within the Eastern region of the KSA. The eligibility criteria were being aged 65 years or older. Patients who were diagnosed with neurocognitive disorders, such as dementia and Parkinson's disease were excluded from the study.

### Ethical Considerations

The study was approved by the Imam Abdulrahman Bin Faisal University's Institutional Review Board (IRB-2023-01-302). Participation in this study was voluntary and anonymous. To comply with ethical considerations of the research, consent to participate was obtained from all participants. The study complied with the principles of the Declaration of Helsinki.

### Sample Size and Sampling Technique

The minimum required sample size was 378. This was based on a prevalence of 43.85% for the willingness to vaccinate among adults in the KSA.<sup>10</sup> The precision of 5% and alpha level of 0.05 were used in the calculation of the sample size. The sample size calculation was performed in Epi info 7.0. Due to the sensitive and delicate nature of our target population, the subjects were enrolled via a non-probability sampling technique from community health centres where visits were usually for physical examinations. People were approached and invited to voluntarily participate in the study by responding to face-to-face interviews between the 1st and 31st of August 2023.

### Data Collection Tool and Processes

The questionnaire used in this study was developed based on an extensive review of the literature,<sup>11-13</sup> as well as after discussion between the research team. The tool had two main parts, the first was based on sociodemographic variables which included variables on age, sex, level of education (below high school, high school graduate, university or

postgraduate), whether the participant was a healthcare professional (yes/no), presence of chronic conditions (yes/no), living circumstances (alone/with family), perceived financial status (poor/good), had been familiar with a person who had been infected with COVID-19 (yes/no) and had been familiar with someone who had died from COVID-19 (yes/no).

The second part of the tool consisted of questions on attitudes of acceptance and hesitancy towards testing against COVID-19 as well as questions on attitudes of acceptance and hesitancy towards the COVID-19 vaccine. Two experts reviewed the questionnaire and approved the final version, the first a geriatric consultant and the second was a preventive medicine consultant to enhance content validity and ensure that all questions were within the Saudi context. A pilot study was performed on 20 elderly participants, and their responses were excluded from the final analysis. After the pilot study, no modifications on the tool were made.

## Statistical Analysis

All variables were coded and analysed using the Statistical Package for Social Sciences (SPSS) version 26.0.<sup>14</sup> For vaccine uptake, the outcome was categorised into three categories, the first was none for respondents who had no vaccines, partial for those who had only one dose of the vaccine, and complete for respondents with two, three and four vaccines. For descriptive statistics, frequencies and percentages were used for all categorical variables, and means  $\pm$  standard deviations for continuous variables. Cross tabulations using Chi-squared tests, and where applicable Fisher's Exact tests were performed to compute the p-value. The level of significance was set at 0.05.

## Results

The total number of elderly participants included in this study was 502. The mean age was  $70.34 \pm 5.85$ . The range of age of participants was 65 to 95 years. Males and females were similarly distributed.

### Sociodemographic and Health Characteristics in Relation to Self-Awareness of a Previous COVID-19 Infection

Table 1 shows the distribution of sociodemographic and health-related characteristics according to self-awareness of a previous COVID-19 infection. Among the total participants, 47.6% were aware of having previously acquired COVID-19. Statistically significant differences were observed with age, sex and level of education where a higher proportion of self-awareness of a previous COVID-19 infection was reported among those aged above 70 years (51.6%), females (53.1%) and high-school graduates (54.3%). Furthermore, elderly participants who were familiar with other people who had been previously infected with the virus or had died from infection with the virus reported significantly higher proportions of self-awareness of personal previous infection (53.0% and 61.9% respectively). Among those who were aware of being infected, the majority had undergone a test confirmation (84.1%) compared to 15.9% who did not.

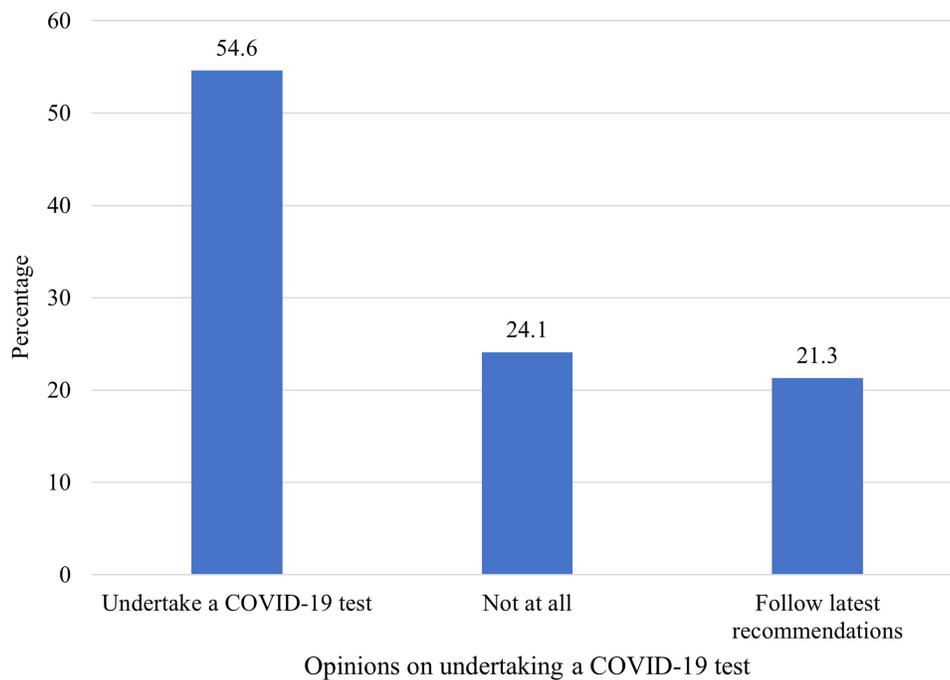
### Acceptance and Hesitancy to Undergo a COVID-19 Test Among the Elderly Participants

Figure 1 shows that more than half the participants (54.6%) would get tested for COVID-19 if they knew they had been in contact with a person(s) positive even if no symptoms are present. The highest reported reason for this response was the belief that testing may help to control the spread of the disease and protect others (70.8%). Other reasons included awareness of own responsibility as a citizen (62.8%), the willingness to receive appropriate care in case of a positive result (61.3%) and to oblige to the expectation of family and friends in taking the test (12.8%). The least reported reason for testing was fear of penalties in only 3.3% of the total participants.

Among the 24.1% participants not willing to undertake the test despite knowing that they had been in contact with other individuals who had been positive for COVID-19, the most reported reasons were feeling that the test was unnecessary if no symptoms are present (24.1%), believing there is nothing to do even if the result is positive (26.4%) and that the test is time consuming (24.8%) (Table 2).

**Table 1** Sociodemographic and Health Related Characteristics of the Elderly Participants in Relation to Their History of a COVID-19 Infection

Characteristics	Total N (%) 502 (100.0)	Self-Awareness of a Previous COVID-19 Infection		P-value
		No N (%) 263 (52.4)	Yes N (%) 239 (47.6)	
<b>Age (years)</b>				0.04
< 70	283 (56.4)	137 (48.4)	146 (51.6)	
≥ 70	219 (43.6)	126 (57.5)	93 (42.5)	
<b>Sex</b>				0.01
Males	246 (49.0)	143 (58.1)	103 (41.9)	
Females	256 (51.0)	120 (46.9)	136 (53.1)	
<b>Level of education</b>				0.01
Below high school	145 (28.9)	88 (60.7)	57 (39.3)	
High school graduate	223 (44.4)	101 (45.3)	122 (54.7)	
University graduate/Postgraduate	134 (26.7)	74 (55.2)	60 (44.8)	
<b>Healthcare professional</b>				0.07
Yes	14 (2.8)	7 (28.6)	10 (71.4)	
No	488 (97.2)	259 (53.1)	229 (46.9)	
<b>Chronic disease condition</b>				0.52
Yes	378 (75.3)	195 (51.6)	183 (48.4)	
No	124 (24.7)	68 (54.8)	56 (45.2)	
<b>Living circumstances</b>				0.65
Alone	23 (4.6)	11 (47.8)	12 (52.2)	
With a family	479 (95.4)	252 (52.6)	227 (47.4)	
<b>Perceived financial status</b>				0.84
Poor	206 (41.0)	109 (52.9)	97 (47.1)	
Good	296 (59.0)	154 (52.0)	142 (48.0)	
<b>Know someone once infected with COVID-19</b>				< 0.001
Yes	438 (87.3)	206 (47.0)	232 (53.0)	
No	64 (12.7)	57 (89.1)	7 (10.9)	
<b>Know someone who had died from COVID-19</b>				< 0.001
Yes	215 (42.8)	82 (38.1)	133 (61.9)	
No	287 (57.2)	181 (63.1)	106 (36.9)	



**Figure 1** Distribution of elderly participants opinions on undertaking a COVID-19 test.

## Acceptance and Hesitancy to Be Vaccinated Against COVID-19 Among the Elderly

Regarding the participants attitude towards the COVID-19 vaccine, the mean attitude score was  $31.93 \pm 5.51$  (Median 32, range = 18–54). Participants who had a negative attitude for the vaccine represented 58.6% of the total samples, whereas 41.4% had a positive attitude towards the vaccine.

Figure 2 shows that only 3.18% of the total participants did not receive the COVID-19 vaccine, whereas 1.39% had received one dose, 14.3% had received two doses, 75.7% had received the completed three doses and 5.4% had the recommended fourth vaccine.

Table 3 presents the associations between sociodemographic and health-related characteristics of participants and vaccine uptake. Statistically significant associations were observed for age, sex and educational status only where higher proportions of complete doses of the vaccines were observed for participants aged less than 70 (97.5%), and similarly for males (97.2%) and for high-school graduates (97.3%). No statistically significant differences were observed with other characteristics.

Table 4 presents each question regarding the attitude towards the vaccine on a five-point Likert's scale. The highest proportion of participants strongly agreed that the vaccine can help control the spread of infection (43.0%), and around one-third strongly disagreed with the statement that had they known they were going to be infected, they would not get the vaccine even if it were available (33.7%). Also, 36.6% strongly disagreed with the statement that if everyone else is vaccinated against COVID-19, they would have to be vaccinated themselves. The results also show that the highest proportion of participants strongly agreed that their decision to take the vaccine depends mainly upon recommendations from the MoH (43.8%), that the high vaccination uptake would lift the restrictions on movement (41.0%), and to allow clearance of immune status on the Tawakkalna application (37.7%).

## Discussion

During the COVID-19 pandemic era, implementing preventive measures including testing and vaccination to control the spread of the highly contagious virus requires the population's willingness to adopt this behaviour.<sup>15</sup> This study was able to assess the willingness and hesitancy of the elderly population in the KSA towards COVID-19 testing and vaccinations. Although few studies have had similar objectives, none have targeted this vulnerable age group. Several important

**Table 2** Acceptance and Hesitancy of Elderly Participants to Take a COVID-19 Test

Questions	N (%) *
<b>Reasons for the response (I would get tested for COVID-19, even without symptoms)</b>	
I believe this helps stop the spread of COVID-19 and Protect others	194 (70.8)
This is my responsibility as a citizen	172 (62.8)
I want to receive the appropriate care in case of a positive test	168 (61.3)
My friends and family would expect me to get tested	35 (12.8)
I would face penalties if I did not	9 (3.3)
<b>Reasons for the response (I would not get tested for COVID-19)</b>	
Unnecessary if no symptoms	33 (27.3)
There is nothing I can do, even if I get a positive test	32 (26.4)
It is too time-consuming	30 (24.8)
I am worried I will get infected at the testing site	21 (17.4)
I think testing will be painful/uncomfortable	19 (15.7)
I do not believe COVID-19 exists	16 (13.2)
I do not think the tests are reliable	11 (9.1)
People might blame me for my actions if I get a positive test	10 (8.3)
Getting tested would cost money (eg, transportation, buying the test. etc)	5 (4.1)
Might result in loss of income if test is positive	2 (1.7)
I am worried people will treat me badly if I get a positive test	4 (3.3)
I am not able to self-isolate in case I get a positive test	1 (0.8)
I might face fines or other penalties if I had violated official COVID restrictions	0

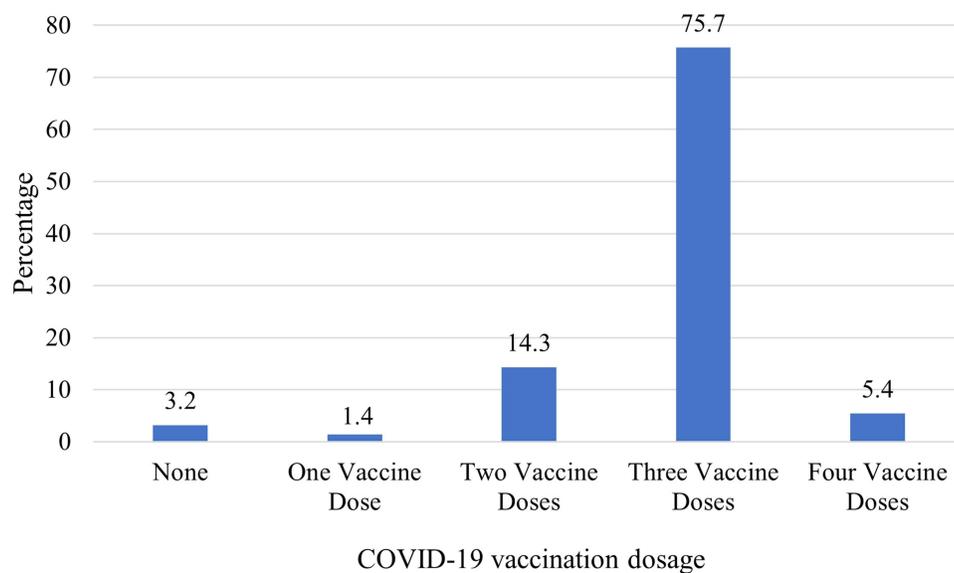
**Note:** \*Percentages ≠100%.

findings have emerged from the current analyses which give rise to policy recommendations during the next phase of planning towards the prevention of infection in this age group.

## Associations with Self-Awareness of a Previous COVID-19 Infection

Over half the participants were not aware of a previous COVID-19 infection, this finding is consistent with other research demonstrating that a significant proportion of COVID-19 infections are asymptomatic or minimally symptomatic and thus may go unnoticed.<sup>16</sup> These asymptomatic infections can still result in long-term health effects and contribute to the spread of the virus, and their share could be as high as 20% and possibly more among older adults.<sup>17,18</sup>

Furthermore, we found a statistically significant correlation between self-awareness of a previous COVID-19 infection and various sociodemographic characteristics. For instance, participants aged below 70 years reported a higher percentage of self-awareness compared to those aged 70 and older. Similarly, one hundred and thirty-six women reported being aware of their COVID-19 infection than men. Interestingly, the level of education also appeared to be a factor, with high-school graduates showing a higher percentage of self-awareness. This aligns with previous research suggesting that age, sex, and educational level can influence the perception and awareness of health-related issues, including infectious diseases.<sup>19,20</sup> The findings emphasize the importance of targeted public health strategies to increase



**Figure 2** Distribution of elderly participants in relation to COVID-19 vaccine uptake.

awareness and understanding of COVID-19 across all demographic groups, particularly those who may be less likely to recognize or report infection.<sup>21</sup>

Personal experiences and connections can significantly shape an individual's perception and awareness of a disease. In our study, we observed associations between the self-awareness of a previous COVID-19 infection and having prior knowledge of someone who had suffered from the disease or knowing someone who had died from it. This finding aligns with existing literature where for example, a study found that direct or indirect exposure to a disease could enhance the perceived severity and susceptibility, thereby influencing individuals' health behaviours and responses.<sup>22,23</sup> With respect to the older population, this finding is particularly relevant. Older adults are at a higher risk of severe outcomes from COVID-19; thus, their awareness and understanding of the disease could have significant implications for their health outcomes.<sup>24</sup> Additionally, these findings echo the social network theory in health contexts, which posits that individuals' health behaviours and attitudes are influenced by their social connections.<sup>25</sup> In this case, the social connection manifests as knowing someone infected or has died from COVID-19, which increases the individual's self-awareness of their infection. This concept may explain that, among those aware of being infected, the majority had undergone a COVID-19 test confirmation (84.1%). These findings underscore the importance of social factors in disease awareness and highlights the need for targeted public health interventions that consider these factors.

## Acceptance and Hesitancy to Undergo a COVID-19 Test Among the Elderly Participants

Our study's findings shed light on the attitudes of elderlies towards COVID-19 testing. Notably, none of the participants expressed fear of fines or penalties for violating any official COVID-19 related restrictions should they choose not to get tested. This may suggest a high level of compliance with public health measures among this group, consistent with prior research indicating that older adults are generally more likely to adhere to public health guidelines.<sup>26</sup> Interestingly, a significant proportion of our sample perceived COVID-19 testing as unnecessary in the absence of symptoms. This belief is contrary to the widespread consensus in the medical community, which emphasizes that asymptomatic individuals can still transmit the virus.<sup>27</sup> Lastly, the fear of being stigmatized or blamed by others if they tested positive also emerged as a contributing factor for test hesitancy. This finding aligns with previous studies that have highlighted stigma as a barrier to disease testing and disclosure in several contexts, including HIV and COVID-19.<sup>28,29</sup> These insights underscore the need for targeted communication strategies to address misinformation and stigma associated with COVID-19 testing, particularly among older adults.

**Table 3** Sociodemographic and Health Related Characteristics of Elderly Participants in Relation to Vaccine Uptake

Characteristic	Total N (%) 502 (100.0)	Vaccine Uptake			P-value
		None N (%) 16 (3.2)	Partial N (%) 7 (1.4)	Complete N (%) 479 (95.4)	
<b>Age (years)</b>					0.01
< 70	283 (56.4)	6 (2.1)	1 (0.4)	276 (97.5)	
≥ 70	219 (43.6)	10 (4.6)	6 (2.7)	203 (92.7)	
<b>Sex</b>					0.04
Males	246 (49.0)	3 (1.2)	4 (1.6)	239 (97.2)	
Females	256 (51.0)	13 (5.1)	3 (1.2)	240 (93.7)	
<b>Level of education</b>					0.04
Below high school	145 (28.9)	10 (6.9)	3 (2.1)	132 (91.0)	
High school graduate	223 (44.4)	3 (1.3)	3 (1.4)	217 (97.3)	
University graduate/Postgraduate	134 (26.7)	3 (2.2)	1 (0.7)	130 (97.1)	
<b>Healthcare professional</b>					0.49
Yes	14 (2.8)	1 (07.10)	0 (0.0)	13 (92.90)	
No	488 (97.2)	15 (03.1)	7 (01.4)	466 (95.5)	
<b>Chronic disease condition</b>					0.16
Yes	378 (75.3)	9 (2.4)	5 (1.3)	364 (96.3)	
No	124 (24.7)	7 (5.6)	2 (1.6)	115 (92.8)	
<b>Living circumstances</b>					0.18
Alone	23 (4.6)	1 (4.3)	1 (4.3)	21 (91.3)	
With a family	479 (95.4)	15 (3.1)	6 (1.3)	458 (95.6)	
<b>Perceived financial status</b>					0.21
Poor	206 (41.0)	5 (2.4)	5 (2.4)	196 (95.1)	
Good	296 (59.0)	11 (3.7)	2 (0.7)	283 (95.6)	
<b>History of previous COVID-19 infection</b>					0.62
Yes	239 (47.6)	8 (3.3)	2 (00.80)	229 (95.9)	
No	263 (52.4)	8 (3.0)	5 (01.90)	250 (95.1)	
<b>Know someone once infected with COVID-19</b>					0.66
Yes	438 (87.3)	15 (3.4)	7 (1.6)	416 (95.0)	
No	64 (12.7)	1 (1.6)	0 (0.0)	63 (98.5)	
<b>Know someone who had died from COVID-19</b>					0.22
Yes	215 (42.8)	8 (3.7)	5 (2.3)	202 (94.0)	
No	287 (57.2)	8 (2.8)	2 (0.7)	277 (96.5)	

**Table 4** Attitudes of Elderly Participants Regarding the Uptake of the COVID-19 Vaccine

Variable	Opinion Regarding the Vaccine (N= 502)				
	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
I believe vaccines can help control the spread of COVID-19	27(5.4)	67(13.3)	40(8.0)	152 (30.3)	216(43.0)
Had I known I would acquire COVID-19, I would not be vaccinated	169(33.7)	145(28.9)	42(8.4)	90(17.8)	56(11.2)
Once everyone else is vaccinated, I would not need the vaccine	184(36.6)	148(29.5)	43(8.6)	83(16.5)	44(8.8)
<b>My decision on vaccination depends on</b>					
Country in which the vaccine is produced	123(24.5)	149(29.6)	48(9.6)	123 (24.5)	59(11.8)
Recommendation from my family physician	31(6.1)	88(17.5)	26(5.2)	178 (35.5)	179(35.7)
Recommendation from the Ministry of Health	22(4.4)	50(10.0)	27(5.3)	183 (36.5)	220(43.8)
Whether the vaccine has had no side effects	61(12.2)	144(28.6)	61(12.2)	132 (26.3)	104(20.7)
Whether the vaccine is used in other countries	120(23.9)	219(43.6)	48(9.6)	81(16.1)	34(6.8)
Probability of acquiring COVID-19 while the vaccine is available	44(8.8)	98(19.4)	53(10.6)	171 (34.1)	136(27.1)
Obtaining clearance through the Tawakkalna application	40(8.0)	74(14.7)	29(5.8)	175 (34.8)	84(36.7)
Whether a high vaccination uptake would lift restrictions	29(5.6)	74(14.7)	24(4.8)	170 (33.9)	206(41.0)

## Acceptance and Hesitancy to Be Vaccinated Against COVID-19 Among the Elderly

With regard to vaccinations, age sex and educational level were significantly related to vaccine uptake. We found that full vaccine uptake was less among those aged above 70 years old compared to those aged between 65 and 70. The literature in this matter differs between geographical areas. For example, similar results to ours were present in China, however in Australia older adults tended to vaccinate in comparison to their younger counterparts.<sup>30,31</sup> It is likely that cultural and social factors have played a role in these differences. Furthermore, we found that vaccinations were less among females in comparison to males. In a systematic review of over sixty studies to identify gender differences in the intention to vaccinate, they found that males had a higher intention to vaccinate against COVID-19.<sup>32</sup> Since females play a central role in ensuring the health of their families and children, this difference between sexes should be an additional point of focus in future health campaigns. As for educational level, our results are consistent with those elsewhere in which we found that a lower educational level of was associated with a lower uptake of vaccinations.<sup>33</sup> In fact, 10 of the 16 elderlies in our study had a lower education level.

Reluctance to receive the COVID-19 vaccine either due to conspiracy beliefs or a lack of awareness are major obstacles facing health authorities. Confidence in vaccines is considered by the World Health Organisation as one of the significant factors that affect people's opinion towards taking the vaccine.<sup>34</sup> Similar to our results, studies exploring the attitudes and beliefs of the elderlies towards COVID-19 have found that beliefs in vaccine efficacy were the main factor driving peoples' intention towards receiving those vaccines.<sup>35</sup> Our findings, in line with international studies, reflect

a good level of confidence among Saudi participants in vaccine efficacy. Consequently, more than half of the study participants disagreed and strongly disagreed with the fact that their intention to take the vaccine will be reduced by knowing their previous infection status or the number of people receiving the vaccine. In contrast, a study conducted among Saudi young adults found that most of the participants were willing to take the vaccine only if it was taken by many people or if it was made mandatory.<sup>36</sup> However that study only targeted young adults who were not considered at a high risk of COVID-19 complications compared to the elderly which might make them feel less motivated to take the vaccine. Moreover, it was published during the early pandemic when the vaccine was just released to the public, which could justify the reluctance towards taking the novel vaccine. Furthermore, the high willingness in this study could also be explained by the availability of free vaccines to all Saudi residents provided by the government, which eliminates the cost barrier.

Additionally, almost two-thirds of the study participants agreed and strongly agreed that their decision to take the vaccine depends mainly on recommendations from their family physician and the MoH. Similarly, 66.2% of the elderly population in the US stated that their decision to take the vaccine is based on health care providers' recommendations.<sup>37</sup> This indicates confidence and trust in healthcare providers and public health campaigns.

Most of our respondents did not consider the country of vaccine production or whether the vaccine has been used in other countries as factors that would impact their decision towards vaccine uptake. In contrast to previous studies in the US and Jordan which found that people trust the safety of vaccines produced in the US and Europe.<sup>2,37</sup> Given the fact that the MoH launched the vaccination campaign through means accessible to all citizens, such as the use of the Sehhaty mobile application which facilitates registration to all vaccination centres around the country, is reassuring for the public. Thus, it was reported in a previous study that confidence in the decisions of the government was the strongest factor influencing participants positively toward vaccination.

Furthermore, most participants agreed and strongly agreed to the fact that the convenience of utilising public services and lifting gathering restrictions are positively influencing factors towards vaccine uptake. It is well known that the pandemic and the applied precautionary measures have negatively affected people's lives, and their careers, and consequently impacted their physical health and mental well-being.<sup>38</sup> Therefore, it is not surprising that the perceived benefits of vaccination, including less anxiety, less likelihood of getting infected with COVID-19, and easing of the preventative efforts were encouraging factors.

## Limitations of the Study

Although this study is the first to analytically explore the willingness and hesitancy of the elderly population in the KSA, there are a few limitations that may limit generalisations. The sampling technique employed was a non-probability sampling technique which inherently limits generalisation efforts to the general elderly population. However, this technique was chosen due to the nature of our target population. The elderly is a sensitive group of people who would not normally tolerate questioning, especially with regard to their own attitudes and opinions. Also, the tool consists of questions on attitudes and opinions, which are entirely subjective.

## Conclusion

This study explored the willingness and hesitancy of the elderly in the KSA towards COVID-19 testing and vaccination and has been able to add to the epidemiological literature on this matter. We found that over half the participants were not aware of a previous COVID-19 infection, and that this self-awareness of a previous infection was related to age, sex, level of education, and being familiar with someone who had been previously infected with COVID-19 and someone who had died due to this infection. Additionally, we were able to conclude that there is a high degree of compliance with regulations on COVID-19 testing. Also, willingness to vaccinate against COVID-19 were significantly associated with age, sex and level of education.

## Abbreviations

COVID-19, coronavirus disease 2019; KSA, Kingdom of Saudi Arabia; MoH, Ministry of Health; SPSS, Statistical Package for Social Sciences.

## Data Sharing Statement

The dataset used during the current study are available from the corresponding author on reasonable request.

## Ethics Approval and Informed Consent

The study was approved by the Imam Abdulrahman Bin Faisal University's institution review board (IRB-2023-01-302). All respondents were informed about the purpose of the study, and all participants consented voluntarily. Informed consent was obtained from all study participants.

## Author Contributions

All authors have made a significant contribution to the work reported here, whether it be in the conceptualisation, design of the study, acquisition of the data, analyses and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

## Disclosure

The authors report no conflicts of interest in this work.

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