



Clin Exp Vaccine Res 2023;12:209-215  
<https://doi.org/10.7774/cevr.2023.12.3.209>  
 pISSN 2287-3651 • eISSN 2287-366X

**Sheze Haroon Qazi<sup>1</sup>, Saba Masoud<sup>1</sup>,  
Miss Ayesha Usmani<sup>2</sup>**

<sup>1</sup>Community Dentistry Department, Islamabad Medical & Dental College, Islamabad; <sup>2</sup>Department of Research, Agha Khan University, Karachi, Pakistan

Received: September 15, 2022  
 Revised: April 3, 2023  
 Accepted: July 19, 2023

Corresponding author: Saba Masoud  
 Community Dentistry Department, Islamabad Dental Hospital, Islamabad Medical & Dental College, Main Murree Road, Near D Watson, Bhara Kahu, Islamabad, Pakistan  
 Tel: +92-3315857619, Fax: +92-518433145  
 E-mail: sabamasoud@hotmail.com

No potential conflict of interest relevant to this article was reported.

# Vaccine hesitancy: acceptance of COVID-19 vaccine in Pakistan

**Purpose:** The delay in acceptance or refusal to get vaccinated despite the availability of services is called vaccine hesitancy. The Global Polio Eradication Initiative in Pakistan faced consistent barriers preventing the eradication of the disease in the country. Similarly with the advent of the coronavirus disease 2019 (COVID-19) pandemic mass vaccination drives were initiated to a vaccine hesitant population. The aim of this study is to explore the prevalence and reasons for COVID-19 vaccine hesitancy in the Pakistani population.

**Materials and Methods:** Cross-sectional study conducted during July to September 2021 using a snowball sampling technique targeting the adult population of Pakistan. The modified version of the vaccine hesitancy questionnaire related to the Strategic Advisory Group of Experts on Immunization Vaccine Hesitancy matrix was distributed online.

**Results:** Out of 973 participants, 52.4% were immediately willing to take the vaccine and constituted the acceptance group whereas the remaining 47.6% who were still not sure formed the hesitant group. Support from leaders was found to be statistically significant for the difference between the hesitant and acceptance groups ( $p$ -value=0.027). Hesitant people were concerned about the effectiveness of the vaccine (60.9%) and potential side effects (57.9%) as it was not sufficiently tested prior to launch (44.7%). Age and education were significant factors affecting the acceptance of vaccination. The most trusted source of information regarding vaccination was health care workers (43.8%).

**Conclusion:** A moderately high prevalence of vaccine hesitancy was reported in Pakistan. To overcome it, policymakers need to address the reasons for it. Leaders, celebrities, and healthcare workers can play an instrumental role in dispelling conspiracy theories regarding vaccines and making the vaccination drive a success.

**Keywords:** Vaccine, Vaccination hesitancy, Pakistan

## Introduction

The coronavirus disease 2019 (COVID-19) pandemic has played mayhem worldwide. It has disrupted everyone's lives physically, mentally, socially, and economically. According to World Health Organization (WHO), 414,525,183 people have been infected with 5,832,333 deaths. In the Eastern Mediterranean region alone, this count has reached 20,589,856 [1]. In Pakistan, specifically 1,488,958 confirmed cases have been reported with 29,828 deaths as of February 16, 2022 [2].

Necessity is the mother of invention, historically pandemics and epidemics have triggered the development of many vaccines to protect the populations [3]. In the case of

COVID-19, the rapid transmission worldwide triggered the fast-track approval of multiple vaccines or their authorization in the pre-clinical/clinical trial phases straightaway. But once the vaccine rollout began amid other concerns, vaccine hesitancy also decelerated the mass vaccination agenda in many countries. Vaccine hesitancy refers to the delay in acceptance or refusal of vaccination despite the availability of vaccination services, as stated by the WHO Strategic Advisory Group of Experts on Immunization (SAGE) working group. It is multifaceted and context-specific, varying across time, place, and vaccines. Vaccine hesitancy is influenced by factors such as complacency, convenience, and confidence [4]. Pakistan is not new to the phenomenon of vaccine hesitancy, as the Global Polio Eradication Initiative has faced numerous challenges and consequent delays due to a vaccine-hesitant population [5].

WHO declared “vaccine hesitancy” as one of the top 10 global health threats in 2019 [6]. With the COVID-19 vaccine, the acceptance level has been diverse globally. A recent study conducted in the United States revealed that out of all those surveyed, 68% agreed to get vaccinated, but had concerns about side effects and efficacy [7]. Another global survey conducted in 2020 across 19 countries showed that in China, 89% of the population was willing to get the COVID-19 vaccination, while only 55% of the Russian population was likely to get vaccinated [8]. In Pakistan, a recent survey concluded that 65.7% of Pakistanis were willing to get vaccinated, 30% did not want to get vaccinated, and only 4.6% were unsure [9].

The Global Alliance for Vaccines and Immunizations (Gavi, Geneva, Switzerland), the vaccine alliance recommends that to develop herd immunity, 60% of individuals need to get vaccinated [10]. On the other hand, WHO states that the proportion of vaccine acceptance is unknown and can vary depending on multiple factors [11]. Immunization programs can only be lucrative when there is a high acceptance rate of the vaccine [12,13]. The regional average for vaccine dose administration in Asia is 4.5 doses for every 100 people, while in Pakistan, an average of 0.2 doses had been administered for every 100 people till March 2021. According to a Gallup poll conducted in March 2020, 43% of Pakistanis had not taken any precautionary measures to protect themselves from the coronavirus, which was the highest percentage among the 28 nations polled. The strikingly huge disparity that exists between Pakistan and the rest of the region can be attributed to multiple elements with vaccine hesitancy being one of the key factors.

Factors influencing vaccine hesitancy include risk, safety

and efficacy perception of the disease, general vaccination attitude, and past vaccination history among others [14]. Voluntary compliance to get vaccinated is vital for mass vaccination campaigns' success anywhere.

The present study explored the prevalence and reasons for vaccine hesitancy in the Pakistani population. This may help to tailor interventions targeting increasing vaccine acceptance and consequently immunization rates.

## Materials and Methods

A cross-sectional study was conducted during July–September 2021 using a snowball sampling technique targeting the adult population (18 years and above) of Pakistan. A modified version of the vaccine hesitancy survey questions related to the SAGE Vaccine Hesitancy matrix was distributed online (Supplement 1). Prior to distributing the questionnaire in accordance with the SAGE working group recommendations construct and content validity to assess the individual determinant of vaccine hesitancy of the survey questionnaire was assessed. Along with that pilot testing and cognitive testing of the questionnaire were done to ensure that the translated compendium did not lose its context and was validated. The internal consistency of the modified questionnaire was calculated for the last section on reasons for hesitancy the Cronbach  $\alpha$  value came out to be 0.743 for English language and 0.714 for Urdu. After approval from the institutional review board and consent, the questionnaire was shared online. The questionnaire was then shared online with 70 primary recipients ten each from Pakistan's seven demographic regions. They were requested to share the questionnaire further with their friends and family. The estimated sample size was 973 using the online Statulator calculator (<https://www.statulator.com/SampleSize/ssIP.html>) keeping the margin of error at 3%, 95% confidence level, and anticipated hesitancy proportion at 0.35 (35%). Once the sample size was reached the data collection was concluded. Completed forms were included while incomplete forms were excluded from the study. Complete confidentiality of information was assured to those participating in the study.

## Results

### Socio-demographic

A total of 973 respondents participated in this study. The study showed that 648 participants (66.6%) were fully vaccinated,

155 (15.9%) partially, and only 170 (17.5%) were unvaccinated. The percentage of females was higher 571 (58.7%) than males 402 (41.3%). Most of the participants 575 (59.1%) belonged to the age group 18–29 years followed by 331 (34%) and 67 (6.9%) in age groups of 30–49 years and 50 years above, respectively. As far as current province of residence is concerned, 298 participants (30.6%) were from the most populated province Punjab, followed by 222 (22.8%), 212 (21.8%), 123 (12.6%), 45 (4.6%), 37 (3.8%), and 36 (3.7%) from federal area, KPK, Sindh, Balochistan, Gilgit-Baltistan, and Kashmir, respectively.

Almost three-quarters of the study participants 733 (75.3%) were graduates or postgraduates and the rest 240 (24.7%) had intermediate-level degrees. The ratio of employed 459 (47.2%) to unemployed respondents 514 (52.8%) was almost the same. More than half 538 (55.3%) were earning up to 30,000 Pakistani rupees (PKR) monthly, whereas 141 (14.5%) and 294 (30.2%) were earning 31,000–50,000 PKR and 51,000 PKR & above, respectively.

**Contextual and vaccination specific questions/influences**

The percentage of participants, who agreed, disagreed, or were uncertain about the contextual and vaccination-specific questions, is displayed in the following stacked bar chart (Fig. 1). It was observed that the influences arising due to historic sociocultural, environmental, or political factors are quite convincing towards the acceptance of the vaccine. More than

50% of the participants agreed that leaders from different fields of life support vaccination, that distance/time constraints are not a significant issue in accessing vaccines, and that the vaccination process in Pakistan is efficient. The study also showed that of most participants 426 (43.8%) trusted healthcare workers the most, to provide information regarding COVID-19 vaccination. Whereas only 97 (10%) relied on media (radio, television, newspaper), 147 (15%) on government, 87 (8.9%) on family members, 75 (7.7%) on articles and journals, 72 (7.4%) on internal and only 69 (7.1%) on social media (Fig. 1).

**Individual and group influences**

Most of the respondents, 839 (86.2%), agreed that COVID-19 is a life-threatening disease, while 738 (75.8%) believed that the vaccine would protect them from serious illness. Additionally, 338 participants (34.7%) held the misconception that the COVID-19 virus is a biologically engineered man-made weapon (Fig. 2).

**Factors associated with vaccine hesitancy**

The reluctance of people to receive safe and recommended available vaccines, known as ‘vaccine hesitancy,’ was evaluated by dividing the participants into acceptance and hesitance groups based on their willingness to take the vaccine if it would be available by the government of Pakistan for all ages.

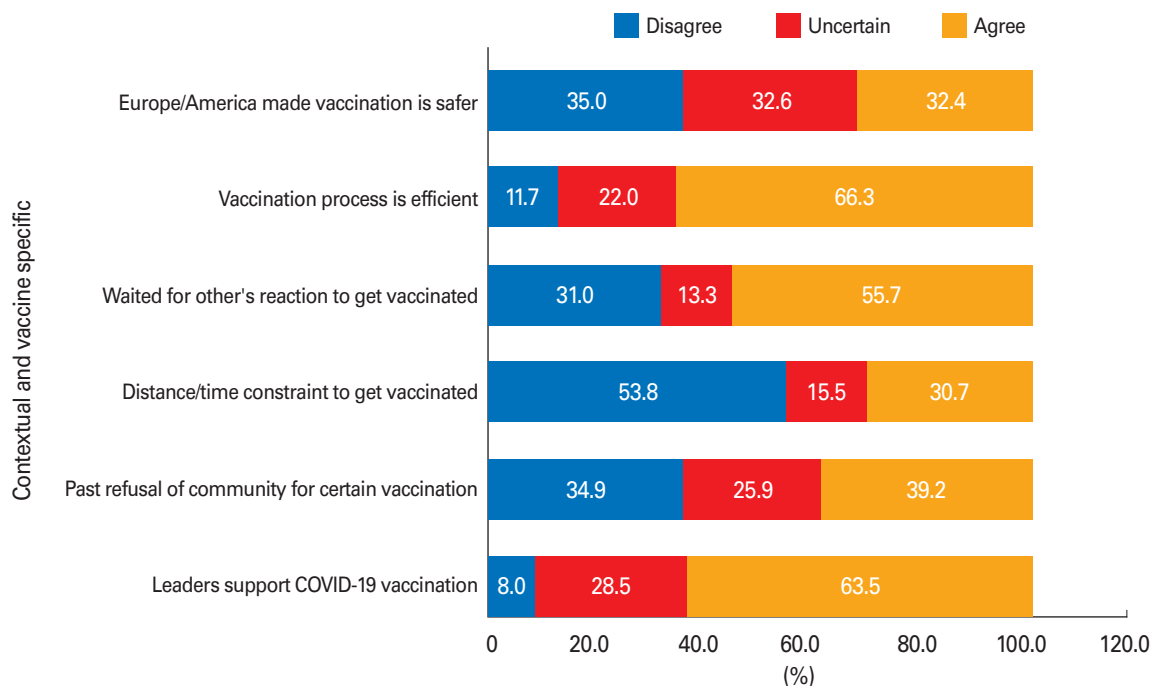


Fig. 1. Contextual and vaccine specific agreement status of the participants (n=973). COVID-19, coronavirus disease 2019.

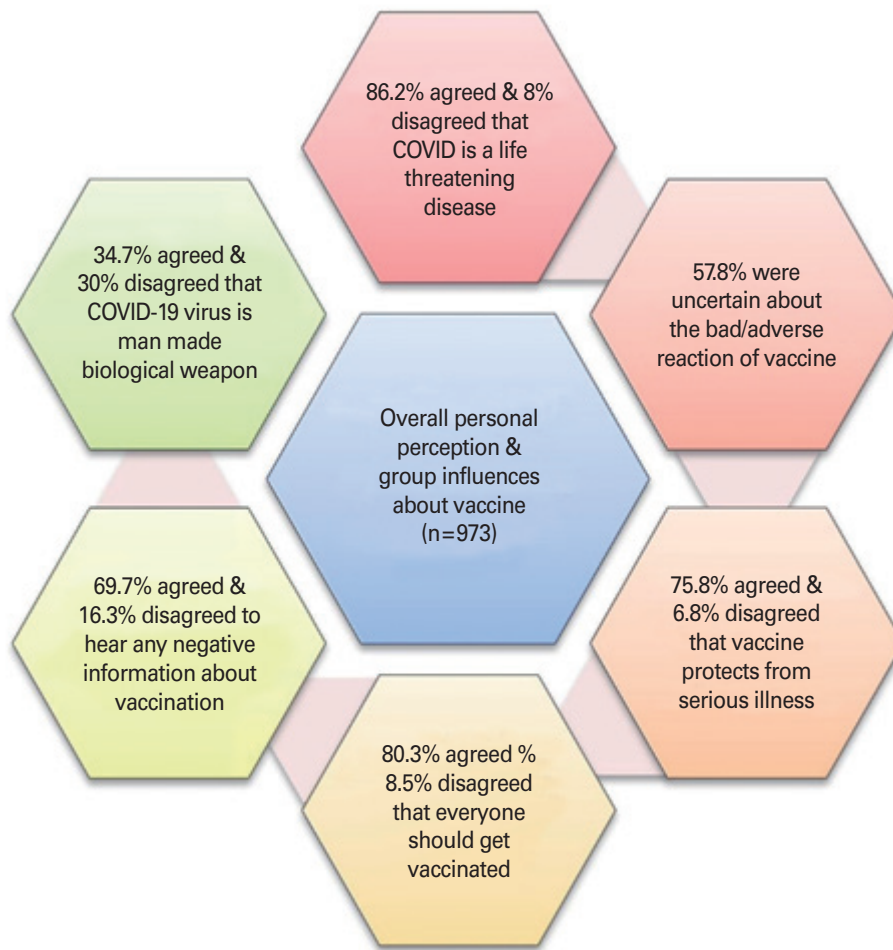


Fig. 2. Overall personal perception and group influences about coronavirus disease 2019 (COVID-19) vaccine (n=973).

Table 1. Comparison of hesitance and acceptance groups with respect to the reasons for the hesitation towards COVID-19 vaccine (n=973)

Concerns about	Hesitance group (n=463)			Acceptance group (n=510)			p-value <sup>a)</sup>
	Disagree	Uncertain	Agree	Disagree	Uncertain	Agree	
1. Effectiveness of the vaccine	70 (15.1)	111 (24.0)	282 (60.9)	115 (22.5)	106 (20.8)	289 (56.7)	0.012
2. Potential side effects	89 (19.2)	106 (22.9)	268 (57.9)	172 (33.7)	114 (22.4)	224 (43.9)	<0.001
3. Test prior to launch	111 (24.0)	145 (31.3)	207 (44.7)	206 (40.4)	141 (27.6)	163 (32.0)	<0.001
4. Magnetic chip insertion	297 (64.1)	100 (21.6)	66 (14.3)	406 (79.6)	60 (11.8)	44 (8.6)	<0.001
5. Infertility/sterility	208 (44.9)	142 (30.7)	113 (24.4)	345 (67.6)	111 (21.8)	54 (10.6)	<0.001
6. Young people don't need it	289 (62.4)	55 (11.9)	119 (25.7)	418 (82.0)	35 (6.9)	57 (11.2)	<0.001
7. COVID-19 is going away soon	281 (60.7)	80 (17.3)	102 (22.0)	423 (82.9)	44 (8.6)	43 (8.4)	<0.001
8. No COVID-19 in my area	324 (70.0)	60 (13.0)	79 (17.1)	406 (79.6)	46 (9.0)	58 (11.4)	0.002

Values are presented as number (%). Statistically significant results are marked in bold. COVID-19, coronavirus disease 2019.

<sup>a)</sup>By chi-square test.

Out of the total 973 participants, 510 (52.4%) who were immediately willing to take the vaccine constituted the acceptance group and the remaining 463 (47.6%) who were still not sure or gave an impression of delay in taking the vaccine formed

the hesitant group. The two groups were compared for any significant statistical difference for each concern separately (Table 1).

The acceptance and hesitance groups were significantly dif-

**Table 2.** Comparison of age groups with respect to the reasons for the hesitation towards COVID-19 vaccine in the hesitant group (n=463)

Concerns about	Age groups (yr)									p-value <sup>a)</sup>
	18–29 (n=298)			30–49 (n=138)			≥50 (n=27)			
	Disagree	Uncertain	Agree	Disagree	Uncertain	Agree	Disagree	Uncertain	Agree	
1. Effectiveness of the vaccine	50 (16.8)	62 (20.8)	<b>186 (62.4)</b>	16 (11.6)	40 (29.0)	82 (59.4)	4 (14.8)	9 (33.3)	14 (51.9)	0.208
2. Potential side effects	68 (22.8)	71 (23.8)	159 (53.4)	15 (10.9)	32 (23.2)	<b>91 (65.9)</b>	6 (22.2)	3 (11.1)	<b>18 (66.7)</b>	<b>0.018</b>
3. Test prior to launch	79 (26.5)	96 (32.2)	123 (41.3)	25 (18.1)	39 (28.3)	74 (53.6)	7 (25.9)	10 (37.0)	10 (37.0)	0.127
4. Magnetic chip insertion	196 (65.8)	57 (19.1)	45 (15.1)	89 (64.5)	34 (24.6)	<b>15 (10.9)</b>	12 (44.4)	9 (33.3)	6 (22.2)	0.117
5. Infertility/sterility	134 (45.0)	97 (32.6)	67 (22.5)	67 (48.6)	40 (29.0)	31 (22.5)	7 (25.9)	5 (18.5)	15 (55.6)	<b>0.003</b>
6. Young people don't need it	179 (60.1)	29 (9.7)	90 (30.2)	93 (67.4)	19 (13.8)	26 (18.8)	17 (63.0)	7 (25.9)	<b>3 (11.1)</b>	<b>0.007</b>
7. COVID-19 is going away soon	195 (65.4)	41 (13.8)	62 (20.8)	79 (57.2)	31 (22.5)	28 (20.3)	7 (25.9)	8 (29.6)	12 (44.4)	<b>0.001</b>
8. No COVID-19 in my area	216 (72.5)	38 (12.8)	<b>44 (14.8)</b>	99 (71.7)	15 (10.9)	24 (17.4)	9 (33.3)	7 (25.9)	11 (40.7)	<b>0.001</b>

Values are presented as number (%). Statistically significant results are marked in bold. COVID-19, coronavirus disease 2019.

<sup>a)</sup>By chi-square test.

ferent for all concerns. It is noteworthy that a very low percentage in the acceptance group agreed with five out of eight concerns and those were “the insertion of magnetic chip in the body, vaccine cause infertility, young people don’t need the vaccine, COVID-19 is going away soon, and COVID-19 does not exist in my area.” In both groups, the major concern for vaccine hesitancy was about the effectiveness of vaccination in protecting from disease followed by potential side effects and sufficient testing prior to its launch.

To explore the effect of support from leaders (religious, healthcare workers, celebrities) and the spread of positive/negative information in the community about some intervention, these two aspects were checked for any difference between the hesitant and acceptance groups. The difference came out to be statistically significant between the groups (p=0.027) for leaders’ support. Whereas, having heard any negative information did not prove to have a significant association with the development of acceptance or hesitation towards vaccination (p=0.201). Although a vast majority, 344 (67.5%) from the acceptance group and 344 (72.1%) from the hesitant group agreed that they had heard negative information regarding COVID-19 vaccination.

To explore the concerns among the 463 (47.6%) hesitant participants, the univariate analysis was carried out for the gender and age groups. The most important concerns for both genders were effectiveness, potential side effects, and pre-launch testing. However, a significant difference between the gender groups was found for “effectiveness” (p=0.005), “young people don’t need it” (p<0.001), “COVID-19 is going away soon” (p=0.036), and “COVID-19 is not in my area” (p=0.002).

When the age groups were compared for any difference re-

garding each concern separately, there was a statistically significant difference between them for “potential side effects” (p=0.018), “infertility/sterility” (p=0.003), “young people don’t need it” (p=0.007), “COVID-19 is going away soon” (p=0.001), and “COVID-19 is not in my area” (p=0.001). The younger participants (18–29 years old) were concerned about the effectiveness of the vaccine in protecting from disease the most. The elder participants (30–49 years old) and (50 years old & above) were most concerned about the potential side effects of the vaccine. All of these three age groups were least concerned about “no COVID-19 in my area,” “magnetic chip insertion,” and “young people don’t need it,” respectively (Table 2).

Overall, the association of hesitant and acceptance groups was found to be significant with age (p=0.006) and education level (p=0.019) whereas, there was an insignificant association with gender (p=0.18).

## Discussion

Vaccination against COVID-19 has been hailed as the most effective tool to prevent the spread of this deadly virus. Though a simple task, low- and middle-income countries are faced with an extremely challenging situation as apart from large populations, and a scarcity of resources for vaccination procurement and dissemination the success of the program also depends on the willingness of people to get vaccinated. The present study set out to explore the prevalence and reasons for vaccine hesitancy in Pakistan.

A recent survey conducted between June 2020 and January 2021, found that the average acceptance rate for COVID-19 vaccination across low- and middle-income countries was

80.3%, with the lowest acceptance in Burkina Faso (66.5%) and Pakistan (66.5%) [15]. Our study concluded an acceptance rate of 52.4% lower than the one stated by Solis Arce et al. [15]. Contrary to that more than half of the participants (66.6%) were fully vaccinated. Probably as the study participants were mostly graduates or postgraduates a finding similar to a Bangladesh study that concluded that the vaccine acceptability was higher among highly educated people [16]. In the present study when gender, age, and education groups were compared in the hesitance and acceptance groups, age and education were found to be substantial factors in influencing the readiness to get vaccinated.

In light of the contextual and vaccination-specific influences, one noteworthy finding was that the greatest number of participants' most trusted source of information regarding COVID-19 vaccination was healthcare workers followed by government sources. These findings are consistent with prior research that documents high levels of reliance on healthcare providers and the Centers for Disease Control and Prevention as sources of general COVID-19 information [17,18]. Based on their willingness to get vaccinated as soon vaccine was made available in Pakistan the acceptance group had a higher number of people (52.4%) than the hesitance group (47.6%). A vast majority of the participants (70%) in the study also agreed to the notion that they had heard some kind of negative information about the vaccine. But when the two groups acceptance and hesitant groups were compared, the results were statistically insignificant showing that negative information alone is not the driver of vaccine hesitancy.

The evaluation for specific conspiracy theories or beliefs showed that compared to the hesitance group the acceptance group showed no concern regarding any of the conspiracy theories such as magnetic chip insertion, infertility, or the non-existence of the deadly virus. A US study also found that belief in COVID-related conspiracy theories predicts resistance to both preventive behaviors and future vaccination for the virus [19]. Another interesting factor found in the study was that the support from leaders (religious, political, celebrities) was a significant factor influencing the willingness to get vaccinated or not. Similar to our findings a US randomized experiment suggested that a political speaker's endorsement of the COVID-19 vaccine may increase uptake among those who identify with that speaker [20]. In Pakistan religious leaders are influential in quite a large number of communities and can be utilized to advocate the ongoing vaccination campaign.

The present study concluded that the principal concern in

both the hesitance and acceptance groups was regarding the effectiveness of the vaccine, potential side effects, and its speedy launch with insufficient testing. A Malaysian study also found that the chief cause for hesitancy was fear of the side effects of the vaccine concerns about the safety, lack of information, and questions about the effectiveness of a new vaccine [21].

In conclusion, to date in Pakistan according to the Reuters COVID-19 tracker, 57.1% of the population is now fully vaccinated. Although these figures are not below par or distressing, we all know that an ounce of protection is worth a pound of cure so we need to keep moving forward.

The present study showed that literacy and age are key factors in influencing the readiness of people to get vaccinated. Along with that, it indicated that celebrities, healthcare workers, and political and religious leaders can play a pivotal role in making the COVID-19 vaccination program a success. Pakistan being a lower middle-income country and one of the most populous in the region can avoid the aftermath of this disease that we witnessed in our neighbors by devising cost-effective strategies utilizing the note-worthy findings of this study.

### ORCID

Sheze Haroon Qazi <https://orcid.org/0000-0001-9386-6193>

Saba Masoud <https://orcid.org/0000-0002-8421-0149>

Miss Ayesha Usmani <https://orcid.org/0000-0001-9250-0042>

### Supplementary Materials

Supplementary materials are available at Clinical and Experimental Experimental Vaccine Research website (<http://www.ecevr.org>).

### References

1. World Health Organization. Coronavirus (COVID-19) dashboard [Internet]. Geneva: World Health Organization; 2022 [cited 2022 Feb 17]. Available from: <https://covid19.who.int/>
2. World Health Organization. Coronavirus (COVID-19) dashboard, Pakistan [Internet]. Geneva: World Health Organization; 2022 [cited 2022 Feb 17]. Available from: <https://covid19.who.int/region/emro/country/pk>
3. Wood JM. Developing vaccines against pandemic influenza. *Philos Trans R Soc Lond B Biol Sci* 2001;356:1953-

- 60.
4. MacDonald NE; SAGE Working Group on Vaccine Hesitancy. Vaccine hesitancy: definition, scope and determinants. *Vaccine* 2015;33:4161-4.
  5. Hashim A. Vaccine hesitancy in Pakistan heightens risk of COVID resurgence. Al Jazeera [Internet]. 2021 Mar 5 [cited 2021 Jul 14]. Available from: <https://www.aljazeera.com/news/2021/3/5/in-pakistan-vaccine-hesitancy-heightens-risk-of-covid-19-resurge>
  6. Altman MJ. Reluctance to vaccinate named a top global health threat in 2019 [Internet]. New York (NY): United Nations Foundation; 2019 [cited 2021 Jul 12]. Available from: <https://unfoundation.org/blog/post/anti-vaxxers-named-top-global-health-threat-in-2019/>
  7. Pogue K, Jensen JL, Stancil CK, et al. Influences on attitudes regarding potential COVID-19 vaccination in the United States. *Vaccines (Basel)* 2020;8:582.
  8. Lazarus JV, Ratzan SC, Palayew A, et al. A global survey of potential acceptance of a COVID-19 vaccine. *Nat Med* 2021;27:225-8.
  9. Asad S, Qureshi J, Raheem M, Shah T, Zafar B. Vaccine hesitancy in Pakistan is growing: here's how it can be tackled [blog on the Internet]. [place unknown]: LSE COVID-19 Blog; 2021 [cited 2022 Feb 1]. Available from: <https://blogs.lse.ac.uk/covid19/2021/04/22/vaccine-hesitancy-in-pakistan-is-growing-heres-how-it-can-be-tackled/>
  10. Joi P. What is herd immunity [Internet]. [place unknown]: VaccinesWork; 2020 [cited 2021 Jul 12]. Available from: [https://www.gavi.org/vaccineswork/what-herd-immunity?gclid=Cj0KCQjw0K-HBhDDARIsAFJ6UGg2sTb5wx-plfFTg9UC3pZBGDPRI4wtzefAgVn2FthtFXCY3ib7JJf-caAmMEEALw\\_wcB](https://www.gavi.org/vaccineswork/what-herd-immunity?gclid=Cj0KCQjw0K-HBhDDARIsAFJ6UGg2sTb5wx-plfFTg9UC3pZBGDPRI4wtzefAgVn2FthtFXCY3ib7JJf-caAmMEEALw_wcB)
  11. World Health Organization. Coronavirus disease (COVID-19): herd immunity, lockdowns and COVID-19 [Internet]. Geneva: World Health Organization; 2020 [cited 2021 Jul 12]. Available from: [https://www.who.int/news-room/q-a-detail/herd-immunity-lockdowns-and-covid-19?gclid=Cj0KCQjw0K-HBhDDARIsAFJ6UGiGuXRRVWZeZP-6k5LD7c1zccVkCquC1xmOXY8XC8RNhkfgyD5dknpoaAsNPEALw\\_wcB#](https://www.who.int/news-room/q-a-detail/herd-immunity-lockdowns-and-covid-19?gclid=Cj0KCQjw0K-HBhDDARIsAFJ6UGiGuXRRVWZeZP-6k5LD7c1zccVkCquC1xmOXY8XC8RNhkfgyD5dknpoaAsNPEALw_wcB#)
  12. Harapan H, Wagner AL, Yufika A, et al. Acceptance of a COVID-19 vaccine in Southeast Asia: a cross-sectional study in Indonesia. *Front Public Health* 2020;8:381.
  13. Wang J, Jing R, Lai X, et al. Acceptance of COVID-19 vaccination during the COVID-19 pandemic in China. *Vaccines (Basel)* 2020;8:482.
  14. Neumann-Bohme S, Varghese NE, Sabat I, et al. Once we have it, will we use it?: a European survey on willingness to be vaccinated against COVID-19. *Eur J Health Econ* 2020; 21:977-82.
  15. Solís Arce JS, Warren SS, Meriggi NF, et al. COVID-19 vaccine acceptance and hesitancy in low- and middle-income countries. *Nat Med* 2021;27:1385-94.
  16. Mahmud S, Mohsin M, Khan IA, Mian AU, Zaman MA. Knowledge, beliefs, attitudes and perceived risk about COVID-19 vaccine and determinants of COVID-19 vaccine acceptance in Bangladesh. *PLoS One* 2021;16:e0257096.
  17. Earnshaw VA, Eaton LA, Kalichman SC, Brousseau NM, Hill EC, Fox AB. COVID-19 conspiracy beliefs, health behaviors, and policy support. *Transl Behav Med* 2020;10: 850-6.
  18. Fridman I, Lucas N, Henke D, Zigler CK. Association between public knowledge about COVID-19, trust in information sources, and adherence to social distancing: cross-sectional survey. *JMIR Public Health Surveill* 2020;6: e22060.
  19. Romer D, Jamieson KH. Conspiracy theories as barriers to controlling the spread of COVID-19 in the U.S. *Soc Sci Med* 2020;263:113356.
  20. Robertson CT, Bentele K, Meyerson B, Wood AS, Salwa J. Effects of political versus expert messaging on vaccination intentions of Trump voters. *PLoS One* 2021;16:e0257988.
  21. Syed Alwi SA, Rafidah E, Zurraini A, Juslina O, Brohi IB, Lukas S. A survey on COVID-19 vaccine acceptance and concern among Malaysians. *BMC Public Health* 2021;21: 1129.