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ORIGINAL ARTICLE

Reasons and Sources of Hesitancy Against COVID-19 Vaccine: A Cross-Sectional Study among General Public in Pakistan

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ABSTRACT

Introduction: Since Coronavirus Disease-2019 (COVID-19) is a respiratory infection which is transmitted by respiratory droplets, it has now spread all across the globe. There are various myths and misconceptions about this vaccination that act as a prime barrier to vaccinate majority of the population.

Methods: A cross-sectional-study was performed from all over Punjab province using convenience sampling technique. A sample size of 400 was gathered in this study by o digital and hardcopy questionnaires after the participants gave their consent.

Results: The willingness to vaccinate against COVID-19, was only 28.0% while the greater remainder of 72% opted for 'no' or 'maybe'. Our study prevailed that the most common reason of hesitancy among the population was that vaccine can cause blood to clot and people may die (15.6%). And the most frequent source emerged to be social media by 23%.

Discussion: The study revealed that people with no or low educational status were more uncertain or hesitant towards vaccine administration as well as those belonging to ages 41-50 years.

INTRODUCTION

In the course of human history, mankind has come across numerous contagious diseases which became the cause of death among the masses. According to World Health Organization (WHO), over the past decade almost 20 infectious agents caused several disease outbreaks and epidemics. COVID-19 infection caused by SARS-2-COV is just an addition to this list. The birth of novel Corona virus-19 took place on December 2019 in Wuhan, China with WHO labelling it as a pandemic on March 11,2020(Balkhair 2020).

Since COVID-19 is a respiratory infection which is transmitted by respiratory droplets, it has now spread all across the globe. As of 27 October 2021, it has affected 245 million people with 4.98 million deaths worldwide(worldometers 2021). In Pakistan, the first confirmed case of COVID-19 was reported on 26 February 2020 in Karachi(Hayat, Rosenthal et al. 2020). It has now spread to all provinces of Pakistan with 1.27 million confirmed cases and 28 thousand deaths, including 0.44 million cases only in Punjab(NCOC 2021).

To combat against COVID-19, the first FDA approved vaccine named Pfizer was introduced on 11 December 2020 in United States of America followed by Sinopharm made in China(Ledford 2020). On 3rd February 2020, the administration of Sinopharm vaccine started firstly to frontline health workers and later to general public of Pakistan(UNICEF 2021). As of 27 October 2021, only 39 million people are fully vaccinated against COVID-19 vaccine in a country of 220 million people(NCOC 2021).

Previous studies on COVID-19 vaccine revealed that vaccine hesitancy is a major hurdle. Vaccination of a major proportion (66%) of population is required to achieve herd immunity to control COVID-19 pandemic(SolísArce, Warren et al. 2021). As in other countries, a conspiracy theory against COVID-19 vaccine is spreading in Pakistan too. There are various myths and misconceptions about this vaccination that act as a prime barrier to vaccinate majority of the population. Pakistan having a weak health care system, dense population and inability to impose long-term lockdowns, cannot afford vaccine hesitancy, otherwise it can result in devastating outcomes(Khan, Mallhi et al. 2020).

Currently prevailing myths and misconceptions about COVID-19 vaccine are that vaccine contains a tracking device or chip, can change DNA, has dangerous side effects, can cause blood clotting, homosexuality and sterility(Saleem 2021).

Very few research articles have been published on COVID-19 vaccine hesitancy in Pakistan, hence this research is one of its kind to correctly identify reasons of hesitancy against COVID-19 vaccine administration, sources of hesitancy and how firmly people believe in their perception about COVID-19 vaccine(Khan, Mallhi et al. 2020).

The aims and objectives of this research are to find out the percentage of population in Punjab willing to receive vaccine, and those who aren't, their reasons of hesitancy and sources. The results and conclusions of this research will help Government of Pakistan to launch health awareness campaigns to eliminate myths and misconceptions regarding COVID-19 vaccine. These campaigns can enhance vaccine acceptance ratio among the masses.

MATERIAL AND METHODS

Study Design: We performed a cross-sectional, web-based anonymous survey using an online questionnaire. The Survey was conducted in the period between May to August 2021. Respondents were informed that their participation was voluntary, and they freely and willingly completed the consent form before attempting to fill the questionnaire. All research methods were performed in accordance with the relevant guidelines and regulations of the Declaration of Helsinki.

Study Population: The population of the study were those residing in the province of Punjab, Pakistan due to ease in access and convenience.

Sample size determination and sampling procedure: Sample size was calculated through online calculator, which gave a result of 380 participants as minimum sample size. However, to obtain slightly greater range of results and achieve a better representation the population, a sample size of 400 was used to reduce error and bias. The sampling technique used in this study was convenience sampling due to time restraints. A total of 400 eligible and completed responses were collected.

Source population: The data were collected using an online questionnaire via the Google Forms platform and hardcopy questionnaire. The survey team circulated the survey link to their network members. These participants were then asked to share the questionnaire link to individuals in their social circles. The hardcopy questionnaire was used for those participants who didn't have access to the internet or did not know how to navigate through the online form comfortably.

Criteria: The inclusion criteria of this research were ages between 20-60 years. The exclusion criteria were ages below 20 and above 60 years, those who are studying and working as medical or dental health professionals, those who had received one or both doses of COVID-19 vaccines and those diagnosed with COVID-19. The reason for this was during the time period in which the study was set, people below 20 were not eligible to receive COVID-19 vaccination as well as those who were already diagnosed by COVID-19 infection. Furthermore, individuals belonging to medical and dental fields were mandatorily required to be vaccinated as part of their course or job.

Measures: Our main goal of study was to assess the hesitancy of COVID-19 Vaccine among general population of Pakistan. Our questionnaire was primarily in English but it was also translated into Urdu to give full accountability and freedom to the participants to answer in the way they feel most comfortable. After the development of our initial questionnaire, it was validated and evaluated by pilot study which was performed by selecting a small sample of participants (n=25) which aided us in enhancing the questions and their responses.

The main purpose of the questionnaire was to assess whether the participants were willing to be vaccinated or not. This was done through giving options of 'yes', 'no' and 'maybe'. Another interest was to assess the reasons for COVID-19 vaccine hesitancy. Only the hesitant participants were given 12 options to select from. They were allowed to select one or more responses that were applicable to them. They were also given the choice to state their own reasons if they did not find any of the given options similar to their cause of hesitancy. We were also concerned what sources have been implicated in the emergence of these hesitancy issues. For this, we gave 11 options and one "other" option in which they stated their relevant sources. We also confirmed how firmly they believe in their reasons by giving 4 options: "Very strongly believe", "Strongly Believe", "Moderately Believe", Weakly Believe" in descending order. In addition to this, participants also responded to demographic questions that include age (Below 20 years, 20-30 years, 31-40 years, 41-50 years, 51-60 years, above 60 years), Gender (Male, Female), Highest level of education (None, Under Matric, Matric/O Levels, Intermediate/Fsc/A Levels, Undergraduate, Graduate, Postgraduate). The exclusion criteria used in the study was as follows: 1) Under 20 years 2) Above 60 years, 3) positive test for COVID-19, 4) studying or working in MBBS/BDS, 5) already vaccinated by 1st or 2nd dose of COVID-19 vaccine.

We used both online questionnaire via Google forms and hardcopy questionnaire to reach our audience. Before the participants filled out the questions, they were given consent form which they filled out willingly and without any external pressure. The participants did not receive any monetary benefits from participating in this research.

Statistical analysis: To determine the proportion of vaccine hesitant people and reasons of their hesitancy, we performed a multivariate logistic regression with age, gender, education status, residential area, wish to vaccinate, reasons of hesitancy against COVID-19 vaccine administration, sources of hesitancy and strength of belief in reasons for hesitancy as variables. The variables such as name and occupation were excluded, for which we had high rate of variation. We used IBM SPSS software (version:26.0) for all statistical analyses. Chi-square was applied to the collected data and p values were obtained to identify significant differences between responses of males and females, different age groups, educated vs non-educated and rural vs urban individuals regarding COVID-19 vaccine willingness and hesitancy. p value less than 0.05 was considered statistically significant.

RESULTS

This research included 400 participants who after giving their consent, filled their responses in the questionnaires they were provided. Many participants filled the questionnaire via. Google forms while the remainder filled them on hardcopy pages.

Majority of the participants were between ages 20-30 years (60.8%), and the remaining age groups were 31-40 years (19.8%), 41-50 years (12.3%), and 51-60 years (7.2%). About 52.3% of our sample population consisted of males and the remaining (47.8%) were females. In this study there were 78.5% educated and 21.5% uneducated participants. The sample distribution was such that there were 80.3% participants belonging to urban setting and 19.8% belonging to rural setting. When the participants were asked about their knowledge of COVID-19 vaccine, 96.3% gave positive response.

One of the major questions they were asked was about their willingness to vaccinate against COVID-19, to which only 28.0% selected 'yes' while the greater remainder of 72% selected 'no' or 'maybe' options. Our study prevailed that the most common reason of hesitancy among the population was that "vaccine can cause blood to clot and people may die" which was adjointly believed by 15.6% of the population. Other major hesitancy reasons included "vaccine can cause COVID-19 disease" (14.5%), "vaccine can make a person sterile" (14.5%), "COVID-19 vaccine can cause side effects like myalgias, headaches and chills etc" (13.6) ,"vaccine is a poisonous injection being injected by doctors to kill people and reduce the population" (12.2%) , other reasons (10.9%), "does not prevent COVID-19 or its complications" (8.0%), "Computer chip or tracking device is being inserted into human body via vaccine to control human thinking" (4.7%), "vaccine administration is against our religion" (1.8%), "administration of vaccine will change DNA" (1.8%), "vaccine can make people homosexual" (1.6%), and "vaccine is very expensive" (0.9%).

The study also included the search for the sources of the above stated hesitancies in which the most frequent source emerged to be social media by 23% of the sample population. 2ndmost prominent sources revealed by our research was relatives/family by 22.4% of the population. This was followed by friends (17.6%), personal perception (16.2%), neighborhood (8.7%), TV (4.4%), newspaper (3.1%), health workers (2.7%) hakeem and mosques (0.2% each) and 0.2% gave other responses.

When the participants were asked how firmly they believe in their reason for hesitancy, the most selected answer was "Moderately believe" (49.3%). After that "strongly believe" (21.1%), "very strongly believe" (14.9%) and weakly believe (14.5%)

This table shows all the above stated characteristic frequencies and percentages.

Table 1:

Variable		Frequency (f)	Percent (%)
Gender	Male	209	52.3
	Female	191	47.8
Age Groups	20-30	243	60.8
	31-40	79	19.8
	41-50	49	12.3
	51-60	29	7.2
Education	Uneducated	86	21.5
	Educated	314	78.5
Setting	Rural	79	19.8
	Urban	321	80.3
Have you heard about CVOID-19 vaccine?	Yes	385	96.3
	No	15	3.8
Do you wish to vaccinate against COVID-19?	Yes	112	28.0
	No or May be	288	72.0
Reasons of Hesitancy	Vaccine can cause COVID-19 disease.	65	14.5
	A computer chip/tracking device is being inserted into human body via vaccine to control human thinking.	21	4.7

	Vaccine can make a person sterile.	65	14.5
	Vaccine is poisonous injection being injected by doctors to kill people and reduce the population.	55	12.2
	Vaccine can cause blood to clot and person may die.	70	15.6
	Vaccine administration is against our religion.	8	1.8
	Administration of vaccine will change human DNA.	8	1.8
	COVID-19 vaccine does not prevent COVID-19 or its complications	36	8.0
	COVID-19 vaccine is very expensive.	4	0.9
	COVID-19 vaccine can make people homosexuals	7	1.6
	COVID-19 vaccine can cause side effects like myalgia, headaches and chills etc.	61	13.6
	Other Reasons	49	10.9
	Vaccine can cause COVID-19 disease.	65	14.5
Sources of hesitancy	Personal Perception	84	16.2
	Newspaper	16	3.1
	Social Media	119	23.0
	Relatives/Family	116	22.4
	Friends	91	17.6
	Neighbourhood	45	8.7
	TV	23	4.4
	Health Worker	14	2.7
	Hakeem	4	0.8
	Mosque	4	0.8
	Other Sources	1	0.2
	Personal Perception	84	16.2
How firmly do you believe in your reason for hesitancy against COVID-19 vaccine?	Weakly Believe	42	14.5
	Moderately Believe	142	49.3
	Strongly Believe	61	21.1
	Very Strongly Believe	43	14.9

Table 2:

Variable		Do you wish to vaccinate against COVID-19 vaccine?		p value
		Yes	No/May be	
		n(%)	n(%)	
Age (years)	20-30	88(36.2)	155(63.8)	0.0001
	31-40	14(17.7)	65(82.3)	
	41-50	5(10.2)	44(89.8)	
	51-60	5(17.2)	24(82.7)	
Gender	Male	56(26.8)	153(73.2)	0.574
	Female	56(29.3)	135(70.7)	
Education Status	Educated	105(33.4)	209(66.6)	0.0001
	Uneducated	7(8.1)	79(91.9)	
Residential Area	Rural	25(31.6)	54(68.4)	0.420
	Urban	87(27.1)	234(72.9)	

Table 3: compares reasons of hesitancy with different sample population characteristics.

Reasons of hesitancy	Age Group (Years)				Gender		Education status		Residential area	
	20-30	31-40	41-50	51-60	Male	Female	Educated	Uneducated	Rural	Urban
	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)
Vaccine can cause COVID-19 disease.	34 (14.7)	12 (10.9)	13 (18.1)	6 (17.1)	30 (13.2)	35 (15.8)	46 (13.8)	19 (16.4)	10 (14.3)	55 (14.5)
A computer chip/tracking device is being inserted into human body via vaccine to control human thinking.	15 (6.5)	1 (0.9)	5 (6.9)	0 (0.0)	13 (5.7)	8 (3.6)	20 (6.0)	1 (0.9)	2 (2.9)	19 (5.0)
Vaccine can make a person sterile.	32 (13.8)	22 (20.0)	9 (12.5)	2 (5.7)	27 11.9)	38 (17.1)	51 (15.3)	14 (12.1)	7 (10.0)	58 (15.3)
Vaccine is poisonous injection being injected by doctors to kill people and reduce the population.	20 (8.6)	18 (16.4)	10 (13.9)	7 (20.0)	31 (13.7)	24 (10.8)	31 (9.3)	24 (20.7)	15 (21.4)	40 (10.6)
Vaccine can cause blood to clot and person may die.	31 (13.4)	21 (19.1)	9 (12.5)	9 (25.7)	35 (15.4)	35 (15.8)	55 (16.5)	15 (12.9)	8 (11.4)	62 (16.4)
Vaccine administration is against our religion.	3 (1.3)	3 (2.7)	2 (2.8)	0 (0.0)	3 (1.3)	5 (2.3)	4 (1.2)	4 (3.4)	0 (0.0)	8 (2.1)
Administration of vaccine will change human DNA.	3 (1.3)	2 (1.8)	2 (2.8)	1 (2.9)	5 (2.2)	3 (1.4)	7 (2.1)	1 (0.9)	3 (4.3)	5 (1.3)
COVID-19 vaccine does not prevent COVID-19 or its complications	20 (8.6)	6 (5.5)	7 (9.7)	3 (8.6)	21 (9.3)	15 (6.8)	31(9.3)	5 (4.3)	2 (2.9)	34 (9.0)
COVID-19 vaccine is very expensive.	2 (0.9)	2 (1.8)	0 (0.0)	0 (0.0)	2 (0.9)	2 (0.9)	3 (0.9)	1 (0.9)	0 (0.0)	4 (1.1)
COVID-19 vaccine can make people homosexuals	4 (1.7)	3 (2.7)	0 (0.0)	0 (0.0)	4 (1.8)	3 (1.4)	6 (1.8)	1 (0.9)	1 (1.4)	6 (1.6)
COVID-19 vaccine can cause side effects like myalgia, headaches and chills etc.	39 (16.8)	9 (8.2)	8 (11.1)	5 (14.3)	25 (11.0)	36 (16.20	51 (15.3)	10 (8.6)	7 (10.0)	54 (14.2)
Other Reasons	29 (12.5)	11 (10.0)	7 (9.7)	2 (5.7)	31 (13.7)	18 (8.1)	28 (8.4)	21 (18.1)	15 (21.4)	34 (9.0)

With reference to table 2, the willingness to vaccinate was tested against various population characteristics. When compared with age groups, the individuals belonging to ages 41-50 years were most hesitant among all age groups against COVID-19 vaccine administration (89.8%). The least hesitant individuals belonged to age group 20-30 years (63.8%). The p value less than 0.05 was considered statistically significant. Whereas the p value for age groups when analyzed with willingness to vaccinate came out to be 0.0001 which indicates significant difference between responses of different age groups. When analysis was done to test the willingness of people belonging to different educational backgrounds, the result came out to be significant with p value of 0.0001 showing that uneducated people were more hesitant (91.9%) to get vaccinated as compared to educated ones (66.6%). With regard to gender (male/female) and residential setting(rural/urban), there was no significant difference between their responses for vaccination willingness.

The most common reason for hesitancy among individuals of age group 20-30 was found to be “COVID-19 vaccine can cause side effects like myalgias, headaches and chills etc. (16.8%)”, among 31-40 was “Vaccine can make a person sterile (20.0%)”, among 41-50 “Vaccine can cause COVID-19 disease (18.1%)”, and among 51-60 “Vaccine can cause blood to clot and person may die (25.7%)”.

The most prevailing reason among males was “Vaccine can cause blood to clot and person may die (15.4%)” and among females was “COVID-19 vaccine can cause side effects like myalgias, headaches and chills etc. (16.2%)”

Among the reasons given by educated people, the most significant was “Vaccine can cause blood to clot and person may die (16.5%)” and those given by uneducated people was“Vaccine is poisonous injection being injected by doctors to kill people and reduce the population. (20.7%)”

The most common misconception in rural areas was found tobe “Vaccine is poisonous injection being injected by doctors to kill people and reduce the population. (21.4%)” and in urban areas was found to be “Vaccine can cause blood to clot and person may die (16.4%)”

The graph depicts the prevalence of different reasons of hesitancy.

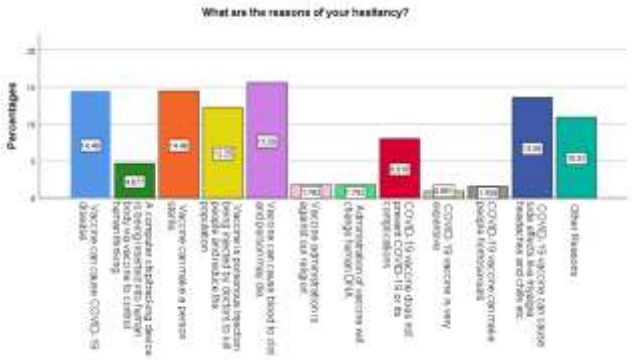
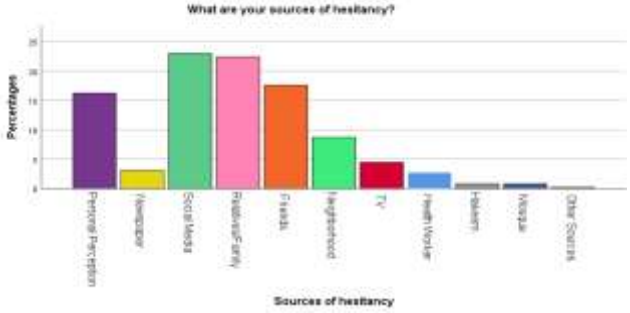


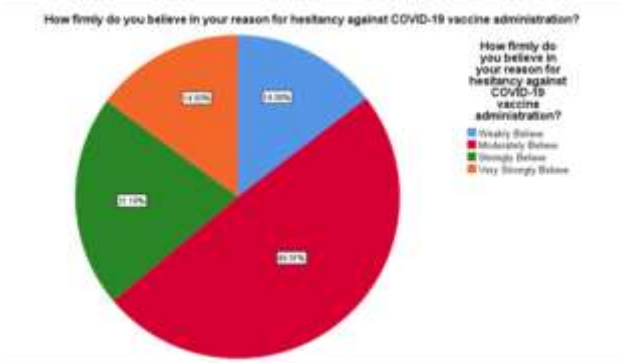
Table 4:

Sources of hesitancy	Age Group				Gender		Education status		Residential area	
	20-30	31-40	41-50	51-60	Male	Female	Educated	Uneducated	Rural	Urban
	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)
Personal Perception	49 (18.5)	23 (18.0)	8 (10.1)	4 (8.9)	55 (19.6)	29 (12.3)	66 (18.1)	18 (11.8)	10 (11.2)	74 (17.3)
Newspaper	8 (3.0)	4 (3.1)	2 (2.5)	2 (4.4)	10 (3.6)	6 (2.5)	12 (3.3)	4 (2.6)	0 (0.0)	16 (3.7)
Social Media	70 (26.4)	29 (22.7)	14 (17.7)	6 (13.3)	69 (24.6)	50 (21.2)	98 (26.8)	21 (13.8)	17 (19.1)	102 (23.8)
Relatives/Family	49 (18.5)	32 (25.0)	23 (29.1)	12 (26.7)	48 (17.1)	68 (28.8)	80 (21.9)	36 (23.7)	24 (27.0)	92 (21.5)
Friends	48 (18.5)	18 (14.1)	16 (20.3)	9 (20.0)	61 (21.7)	30 (12.7)	61 (16.7)	30 (19.7)	23 (25.8)	68 (15.9)
Neighborhood	14 (5.3)	11 (8.6)	12 (15.2)	8 (17.8)	13 (4.6)	32 (13.6)	14 (3.8)	31 (20.4)	12 (13.5)	33 (7.7)
TV	14 (5.3)	6 (4.7)	2 (2.5)	1 (2.2)	10 (3.6)	13 (5.5)	16 (4.4)	7 (4.6)	0 (0.0)	23 (5.4)
Health Worker	8 (3.0)	2 (1.6)	1 (1.3)	3 (6.7)	8 (2.8)	6 (2.5)	12 (3.3)	2 (1.3)	2 (2.2)	12 (2.8)
Hakeem	2 (0.8)	2 (1.6)	0 (0.0)	0 (0.0)	4 (1.4)	0 (0.0)	2 (0.5)	2 (1.3)	1 (1.1)	3 (0.7)
Mosque	2 (0.8)	1 (0.8)	1 (1.3)	0 (0.0)	3 (1.1)	1 (0.4)	4 (1.1)	0 (0.0)	0 (0.0)	4 (0.9)
Other Sources	1 (0.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.4)	0 (0.0)	1 (0.7)	0 (0.0)	1 (0.2)

The table 4.0 represents sources of hesitancy in comparison with different sample population characteristics. The most widely accepted source for their hesitancy was “social media, 26.4%” (20-30 age group), “Relatives/family, 25.0%” (31-40 ,41-50, and 51-60 age groups). In males the most common source was “social media (24.6%)” and in females was “relatives/family (28.8%).” Among the educated population, the most prevailing source for hesitancy was “social media (26.8%)” and among the uneducated population was “relatives/family (23.7%).” The source for hesitancy of most (27.0%) rural population was found to be “relatives/family” and of most (23.8%) urban population was found to be “social media”.

The graphical representation of different sources of hesitancy is as follows.





When the firmness in the belief of the reason given by the respondents was questioned, it was discovered that most of the hesitant population had "moderate belief (49.3%).

The following pie chart represents the percentage variation in firmness in their belief of hesitancy.

DISCUSSION

This study was conducted to discover the reasons of hesitancy among the sample population of Pakistan and the sources giving rise to such rationale. Out of the study population of 400 participants, only 28.0% showed willingness to vaccinate against COVID-19. While the vast majority of 72.0% were uncertain or hesitant. This result was very worrisome especially because this research was conducted in the time frame of May to August 2021, during which Pakistan was facing the 4th wave of COVID-19 since the start of this novel virus disease in December 2019. Other researches were conducted before the launch of the first COVID-19 vaccine but they also indicated vaccine hesitancies all over the globe.(Fisher, Bloomstone et al. 2020) (Robertson, Reeve et al. 2021)In UK, the hesitancy rate was reported to be around 35%. Countries such as Russia, Italy, United States and France also exhibited higher rate of vaccine hesitancy. IT was also established that the young population were more willing to accept the vaccine in China. On the other hand, the elderly population were more likely to accept the vaccine in Germany and France.(Sallam 2021)

Our study revealed that people with no or low educational status were more uncertain or hesitant towards vaccine administration as well as those belonging to ages 41-50 years. According to our study, gender was not a driving force for uncertainty against COVID-19 vaccination. This supports the idea that those individuals with poor educational background tend to have less knowledge and awareness about COVID-19 infection and vaccine. They have limited understanding about the severity and complications that can occur by infection of the novel corona virus and the remarkable benefits that the vaccine has to offer. When the study looked into the various reasons for hesitancy in the Pakistani population, it was discovered that the most widely believed causes of hesitancy was that vaccination can cause blood clotting and they may die because of it. Other major reasons came out to be that vaccine can cause COVID-19 disease, side effects like headaches and myalgias, and sterility. However, in the uneducated population, it has been observed that the most common cause of hesitancy was that they believed the vaccine is poisonous and is being used by doctors to reduce the population of Pakistan. The source of such belief in these uneducated individuals was discovered to be family/relatives. The uneducated population has the same reason of hesitancy as the rural area population. This supports the idea that those residing in rural areas of Pakistan are mostly uneducated and hence they are more prone to believe in various vaccine conspiracy theories that run widely in the country. These people also have no authentic source of information and hence they are more susceptible to believe in myths and hearsay that reaches to them through their various relatives or family members.(Fisher, Bloomstone et al. 2020) To face this issue, at community level, training programs for the heads of the villages and underdeveloped regions can be introduced to clear their misconceptions and educate them about the vaccination benefits.(Danabal, Magesh et al. 2021) Interventions should be developed to provide factual and accurate information about the COVID-19 infection and its prevention via vaccine through the trusted heads of various districts to whom uneducated population of the rural areas will be more eager to listen to.

When the results of our study were analyzed, it brought to light that different misconceptions of the corona vaccine prevailed in different age groups. In the younger population of age 20-30 years, they believed that the vaccine caused greater side effects and their source being social media. To target this age group population, they should try to lessen the anxiety regarding the side effects of the vaccine and the hostile environment that rises around the vaccination center. Involving celebrities and social media influencers to normalize vaccine uptake may also prove to be helpful.In the event that side effects do arise, they should be properly cared for by providing suitable incentives. Truthful and correct information dissemination about vaccine via social media should be conveyed. And various social media heads should set up teams to monitor the integrity of the information spread about the COVID vaccines via social media platform.

In the ages 31-40 years, their most common fear was that vaccine can cause sterility with their source being family and relatives. To target this population, behavioral interventions can be implemented as well as emotional and environmental support can be given during all phases of the vaccination process. Online educational interventions and dialogue-based interventions can also be employed.(Fisher, Bloomstone et al. 2020)

In our study's most hesitant population range (41-50 years), the most frequent hesitancy reason was that the vaccine itself can cause the coronavirus infection which they heard and believed from their family and friends. Interventions include awareness campaigns about the precise knowledge of the COVID-19 disease, its transmission and its effects. The people should also be given complete knowledge about the vaccine, its process and its advantages. Their misconception should be targeted not by dismissing their concerns but rather keeping a two-way open communication to clear their apprehension. Measures should be taken to make the vaccine more available and accessible to the public at reasonable costs. In our remaining age group of 51-60 years, the reason for their uncertainty was that vaccine can cause blood clotting and consecutive death. The above-mentioned interventions can also be used to tackle the misconceptions in these ages as well.

The last main objective of the study was to evaluate the degree to which they believed in their reason for hesitancy. The outcome was that the belief of most of the sample population was moderate. This indicates hope that several interventions can be developed and administered which may prove to be fruitful to protect the population against the dreadful COVID-19 infection and its complications.(Harrison and Wu 2020) This can be done by destabilizing the anti-vaccine campaigns. The mass media has a critical role in our society as well as religious leaders who should promote vaccine application.(Khan, Mallhi et al. 2020)

Our study has numerous strengths. According to our knowledge, this study is one of the few studies based on the population of Pakistan to assess the COVID-19 vaccine willingness and hesitancy, reasons for hesitancy and their sources of hesitancy. Many research articles previously published were before the emergence and marketing of any corona virus vaccine. While our research was based in the time set after the development of the vaccine and when national and international vaccination drives were already in place. The timing of our study also coincided with the peak of the 4th corona wave in Pakistan. This allowed for more realistic and practical results to be interpreted about their hesitancy concerns.

Our study also has many limitations. Firstly, it was geographically restricted to mostly the province of Punjab and

hence it cannot be representative of the whole population of Pakistan. Secondly, those who were already vaccinated were not included in our study. Therefore, we were unable to obtain data of how many of them were enforced to vaccinate themselves against their will and due to community pressure and so this aspect of the study cannot be apprehended. Moreover, the study failed to include the variety of different vaccines that are currently available to the population and their vaccine preference. We also could not conclude if different vaccine types would have any effect on their vaccine hesitancy beliefs. In addition, our study did not take into consideration any medial ailment of the participants or any other supplementary information. Further research is required to better outline the impacts and effects of different vaccines of the population and to bring interferences accordingly.

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