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Assessment of the Prevalence and Determinants of Vaccine Hesitancy in Pakistan

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Abstract:

Background: Global efforts were critical in controlling the COVID-19 pandemic, and the World Health Organization declared it no longer a public health emergency of international concern in May 2023. Pakistan faced six waves and used every available resource to combat the pandemic. Public knowledge, attitudes, and practices (KAP) are key to the success of preventative interventions.

Objective: The goal of this study was to examine KAP through an online study of the general population and to evaluate the prevalence and determinants of COVID-19 vaccine hesitancy in Pakistan.

Methods: Between October and December 2021, a survey of the public was undertaken in several areas across Pakistan. A questionnaire was designed with questions focused on participant`s KAP, and statistical analyses were conducted to observe the normality of the data, knowledge, attitude and practice scores and the correlation between knowledge and attitude.

Results: Out of 688 participants surveyed, 98% expressing a preference for the vaccine over contracting the disease-causing SARS-CoV-2 virus. Overall, the study respondents had a positive attitude (95%) towards preventive measures to protect against pandemic-related issues and had more interest in the vaccine if it were provided free of cost and if the vaccine could be provided at their homes (74%). For participants in this study, knowledge and attitude remained dependent and positively correlated ($p < 0.05$).

Conclusion: This study identified limitations in public health communication techniques used to promote the COVID-19 vaccine that prevented widespread uptake of prevention measures. Additionally, this study revealed that age, education, and gender were statistically significant determinants for vaccine hesitancy (practices) and should likely be considered while making policies for health promotion programs.

Keywords: COVID-19, Vaccine hesitancy, KAP, Vaccine knowledge, Practices, Pakistan.

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1. INTRODUCTION

The current Coronavirus (COVID-19) pandemic, caused by the virus severe acute respiratory syndrome coronavirus (SARS-CoV-2), is the world's worst public health emergency, causing massive mortality and morbidity as well as enormous economic damage. COVID-19 has already infected over 300 million people globally, resulting in over five million fatalities as of January 2022. In Asia alone, there were approximately 188,455 new cases in January of 2022, with more than 500 fatalities [1]; in Pakistan, more specifically, there were more than 50,000 active cases on this date [2].

The average number of people a single infected person in a completely susceptible population can expect to transmit a virus to has increased from two to three individuals for the original Wuhan SARS-CoV-2 virus and to five to six individuals for the Omicron variant of the SARS-CoV-2 virus [3]. As a result, vaccinated communities are more likely to shift their focus away from preventing SARS-CoV-2 infections and toward recognizing that the virus is endemic in order to reduce major disease, hospitalization, and mortality [4].

When the first batch of COVID-19 vaccines from China arrived in Pakistan on February 3, 2021, Pakistan began its coronavirus immunization campaign. The vaccine was originally given to medical personnel who were treating COVID-19 patients and was later made available to those over the age of 60 through a nationwide campaign. By September 2021, the vaccine was available anyone 12 years or older [5]. Pakistan's overall population is 207.77 million people, with an average household size of 6.45 people and a national population growth rate of 2.4% from 1998 to 2017. The literacy rate in the nation is 58.92%, and 64% of the population is under the age of 30, with 29% between the ages of 15 and 29 [6, 7].

As vaccine hesitancy and confidence are important predictors of vaccine uptake, it is important to understand what causes hesitancy. Vaccine confidence refers to the belief in vaccines, vaccine providers, and the research, protocols, and regulations that underpin them. Vaccine hesitation refers to a fear of vaccines based on a particular belief or underlying principle [8]. Hesitation may also be affected by comorbidities such as pre-existing illness or chronic disease [9, 10]. Vaccine apprehension and low confidence can lead to immunization rejection or postponement. As described by the Strategic Advisory Group of Experts on Immunization working group on vaccine hesitancy, both vaccination hesitation and confidence are complicated and may be impacted by various causes, and are roughly divided into three categories: (1) sociopolitical and cultural elements in the situation, (2) individual and group impacts, (3) vaccine specific factors [11].

Vaccine acceptance is currently a major challenge, raising concerns about public trust in the COVID-19 immunization process, even in developed countries. Similar myths and conspiracies have also been reported for measles, poliovirus, rubella, and mumps, with myths and misinformation leading to decreased vaccination [12, 13]. Vaccine reluctance [14] can be related to misconceptions, disinformation, and conspiracies in vaccination efficacy and practicality or to a complete rejection of vaccination [15]. These are the challenges that plague public trust when it comes to vaccination side effects.

Vaccine beliefs and education levels have been researched in Canada, the United States, and other nations. Concerns about vaccination safety were also prevalent in communities with a high level of education [16]. The most frequently cited beliefs about vaccines include that 1) vaccines can cause disease, 2) that infants' immune systems can be saturated if they are injected with too many vaccines too frequently, 3) that vaccines contain dangerous and that children with underlying health conditions and are more vulnerable to vaccine side effects, 4) that the purpose of vaccines is to make money, and 5) that naturally immunity is more powerful than it can become with vaccines [17].

Pakistan has a tumultuous history with vaccinations for children and adults, as well as public distrust and vaccine apprehension. One significant example is the country's failure to eradicate poliovirus owing to conspiracy beliefs. Pakistanis' cultural and religious views are at the basis of poliovirus and other vaccination debates [18]. Conspiracies and falsehoods, according to research done in Sindh, a large province in Pakistan, are key impediments to vaccination adoption in the region [19]. This is in line with the results of most immunization programs, which are often influenced by public concerns about vaccine effectiveness and safety [20-23]. An estimated 5–10% of people are adamantly opposed to vaccinations, while a considerable majority are “vaccine hesitant” (VH). In many anti-vaccine societies, concerns about vaccine safety are a major factor [24]; however, other research [25] has discovered that reasons behind vaccination rejection are complex and may include factors, such as education level, stigma, perceived and real side effects, as well as information from neighbors and other sources. The goal of this study was to examine knowledge, attitudes, and practices (KAP) through an online study of the general population. To our knowledge, this is the first examination of vaccination hesitancy and predictors in the Pakistani community. This is significant because vaccine uptake varies widely around the world due to social and geographic factors. The goal of this study was to assess the prevalence and risk factors determining COVID-19 vaccine hesitancy (VH) among the Pakistani population.

2. METHODS

2.1. Participants

Study enrollment took place between October to December 2021 from Pakistan’s twin cities of Islamabad and Rawalpindi. With a population of about 3.1 million, the greater Islamabad-Rawalpindi metropolitan area is Pakistan's fourth-largest by population. Adults aged 18 to 58 years with no doctor-documented mental disorder completed an online survey focused on the knowledge,

attitudes, and practices (KAP) around COVID-19. This study received ethical approval from the Commission on Science and Technology for Sustainable Development in the South (COMSATS) University Islamabad's Ethics Review Committee under protocol number CUI-Reg/Notif-2482/21/2001 and followed the Helsinki Declaration.

This study used a calculated sample size model estimated using the Raosoft sample size calculation technique [26]. The sample size was calculated using the Raosoft sample size calculation method based on a 99% confidence interval, a 5% error rate, and a 50% response distribution. Using this procedure, a random sample size of 688 persons from Pakistan's entire population was calculated, and the survey was distributed to this number of participants.

2.2. Procedures

Upon enrollment, participants were provided with the survey and consent forms. If enrollment criteria were met, participants completed the 116-question survey (Supplemental Information 1). Survey questions focused on a variety of questions including ones focused on knowledge, attitudes, and practices (KAP) as well as demographic information and religious influences. All survey data were entered into Microsoft Excel spreadsheets and then cleaned, organized, and analyzed using Statistical Package for Social Sciences (SPSS version 26). Knowledge, attitude, and practice scores were calculated using numerical scores. Every question had 3 possible answers *i.e.*, 1=Yes, 2=No and 3=Don't know, and the reverse for the wrong statements. One score was provided to the correct response *i.e.*, 'Yes', and a zero score was given to 'No' or neutral answer. The knowledge and practices of the respondents were categorized into three categories: Low (0-49% correct answers), Moderate (50-69% correct answers) and High (70-100% correct answers). Similarly, attitude responses were also divided into two parts: Negative (0-49% correct statements) and Positive (50-100% correct answers).

Correlation coefficients (r) were calculated between knowledge, attitude, and practice levels using the Pearson correlation method in SPSS. The Pearson Chi-square test was applied to identify the significant characteristics of the respondents associated with their knowledge and attitude level. The normality of the data was assessed with skewness and kurtosis, and Levene's test was used to check variance homogeneity. A significance level of 0.05 was applied to the comparisons presented in the following tables.

3. RESULTS

A total of 688 validated questionnaires were completed online between October and December 2021. The demographic information of the study participants is presented in Table **1**. Most of the participants were male (57.4%), 42.6% were female. Most of the participants were from Punjab (50.6%) and had postgraduate education (37.5%) (Table **1**). Many of the respondents (51.9%) were students, and nearly all the participants (99.6%) listed Islam as their religion. The typical household surveyed represented a nuclear family (48.3%), with 5 to 10 individuals living in a household (63.1%).

Table 1. Sociodemographic background of the participants.

Features		Frequency (n=688)	Percentage (%)
Gender	Female	293	42.6
	Male	395	57.4
Age	18-25	257	37.4
	26-35	153	19.9
	36-45	185	26.9
	46-55	93	13.5
Religion	Christianity	1	0.1
	Hinduism	1	0.1
	Islam	685	99.6
	Other	1	0.1
Education	Below Matric	90	13.1
	Graduate	197	28.6
	Illiterate	56	8.1
	Matric	20	2.9
	Postgraduate	258	37.5
	Undergraduate	67	9.7

(Table 1) contd.....

Features		Frequency (n=688)	Percentage (%)
Occupation	Businessman	12	1.7
	Daily wage labor	63	9.2
	Government employee	140	20.3
	Healthcare worker	7	1.0
	Housewife/ Home maker	68	9.9
	Private job	27	3.9
	Student	357	51.9
	Teacher	14	2.0
Family type	Extended	41	6.0
	Joint	315	45.8
	Nuclear	332	48.3
Monthly Income (Pakistani Rupees, PKR)	10,000 - 20,000	54	7.8
	21,000 - 30,000	94	13.7
	31,000 - 40,000	123	17.9
	less than 10,000	154	22.4
	More than 40,000	263	38.2
Area of living	Rural	358	52.0
	Urban	330	48.0
Geographical area	Azad Jammu & Kashmir (AJK)	64	9.3
	Balochistan	23	3.3
	Gilgit- Baltistan (GB)	27	3.9
	Islamabad Capital Territory (ICT)	146	20.9
	Khyber Pakhtunkhwa (KPK)	40	5.8
	Punjab	348	50.6
	Sindh	40	5.8
How many people live in your house?	1 to 5	185	26.9
	10+	69	10.0
	5 to 10	434	63.1

3.1. Knowledge

For the evaluation of participants' knowledge, there were 33 questions (Supplemental Information 1) evaluating a variety of factors regarding COVID-19 infection, testing, and vaccination. In the survey group (n=688), the average knowledge score was 18.81, with a standard deviation of 7.28. Within this group, 222 participants were scored as having a “good” level of knowledge on COVID-19 infection, testing, and vaccination, with a mean of 26.19 (standard deviation of 1.60). While 229 participants scored in the moderate level and 237 scored in the poor knowledge level. When evaluating demographic characteristics associated with higher knowledge scores (Table **2**), several factors were important in a higher understanding of COVID-19 information. In particular, age, gender, area of living, occupation, and monthly income were all related to higher knowledge scores.

Table 2. The effect of demographic characteristics on the participants’ knowledge scores.

-		Good		Moderate		Poor		-
		n=688	%	n=688	%	n=688	%	*p*-value
Gender	Female	87	29.7	124	42.3	82	28.0	-
	Male	135	34.2	105	26.6	155	39.2	0.000*
Age	18-25	65	25.3	113	44.0	84	30.7	-
	26-35	52	38.0	51	37.2	39	24.8	-
	36-45	65	35.1	52	28.1	69	36.8	-
	46-55	40	40.9	13	14.0	45	45.2	0.000*
Religion	Christianity	0	0.0	0	0.0	1	100.0	-
	Hinduism	0	0.0	0	0.0	1	100.0	-
	Islam	222	32.4	229	33.4	234	34.2	-
	Other	0	0.0	0	0.0	1	100.0	0.454

(Table 2) contd.....

-		Good		Moderate		Poor		-
		n=688	%	n=688	%	n=688	%	*p*-value
Education	Below Matric	34	37.8	24	26.7	32	35.6	-
	Graduate	70	35.5	58	29.4	69	35.0	-
	Illiterate	15	26.8	15	26.8	26	46.4	-
	Matric	4	20.0	6	30.0	10	50.0	-
	Postgraduate	77	29.8	103	39.9	78	30.2	-
	Undergraduate	22	32.8	23	34.3	22	32.8	0.137
Occupation	Businessman	4	33.3	2	16.7	6	50.0	-
	Daily wage labor	20	31.7	9	14.3	34	54.0	-
	Government employee	61	43.6	23	16.4	56	40.0	-
	Healthcare worker	1	14.3	2	28.6	4	57.1	-
	Housewife/ Home maker	29	42.6	19	27.9	20	29.4	-
	Private job	5	18.5	8	29.6	14	51.9	-
	Student	98	27.5	162	45.4	97	27.2	-
	Teacher	4	28.6	4	28.6	6	42.9	0.000*
Family type	Extended	8	19.5	22	53.7	11	26.8	-
	Joint	103	32.7	98	31.1	114	36.2	-
	Nuclear	111	33.4	109	32.8	112	33.7	0.066
Monthly Income	10,000 - 20,000	17	31.5	16	29.6	21	38.9	-
	21,000 - 30,000	29	30.9	24	25.5	41	43.6	-
	31,000 - 40,000	42	34.1	40	32.5	41	33.3	-
	less than 10,000	63	40.9	38	24.7	53	34.4	-
	More than 40,000	71	27.0	111	42.2	81	30.8	0.006*
Area of living	Rural	164	45.8	73	20.4	121	33.8	-
	Urban	58	17.6	156	47.3	116	35.2	0.000*
Geographical area	Azad Jammu & Kashmir (AJK)	23	35.9	23	35.9	18	28.1	-
	Balochistan	10	43.5	6	26.1	7	30.4	-
	Capital	0	0.0	2	100.0	0	0.0	-
	Gilgit- Baltistan (GB)	12	44.4	8	29.6	7	25.9	-
	Islamabad (ICT)	49	34.0	53	36.8	42	29.2	-
	Khyber Pakhtunkhwa (KPK)	11	27.5	11	27.5	18	45.0	-
	Punjab	102	29.3	118	33.9	128	36.8	-
	Sindh	15	37.5	8	20.0	17	42.5	0.256
How many people live in your house?	1 to 5	67	36.2	58	31.4	60	32.4	-
	10+	21	30.4	24	34.8	24	34.8	-
	5 to 10	134	30.9	147	33.9	153	35.3	0.767

Table 3. The effect of demographic characteristics on the participants' attitude scores.

-		Negative		Positive		
		n=688	%	n=688	%	*p*-value
Gender	Female	75	25.6	218	74.4	-
	Male	164	41.5	231	58.5	0.000*
Age	18-25	83	30.4	179	69.6	-
	26-35	37	23.4	105	76.6	-
	36-45	77	39.5	112	60.5	-
	46-55	42	45.2	53	54.8	0.000*
Religion	Christianity	1	100.0	0	0.0	-
	Hinduism	1	100.0	0	0.0	-
	Islam	237	34.6	448	65.4	-
	Other	0	0.0	1	100.0	0.231

(Table 3) contd.....

-		Negative		Positive		
		n=688	%	n=688	%	*p*-value
Education	Below Matric	36	40.0	54	60.0	-
	Graduate	66	33.5	131	66.5	-
	Illiterate	25	44.6	31	55.4	-
	Matric	10	50.0	10	50.0	-
	Postgraduate	83	32.2	175	67.8	-
	Undergraduate	19	28.4	48	71.6	0.176
Occupation	Businessman	5	41.7	7	58.3	-
	Daily wage labor	35	55.6	28	44.4	-
	Government employee	57	40.7	83	59.3	-
	Healthcare worker	4	57.1	3	42.9	-
	Housewife/ Home maker	14	20.6	54	79.4	-
	Private job	15	55.6	12	44.4	-
	Student	106	29.7	251	70.3	-
	Teacher	3	21.4	11	78.6	0.000*
Family type	Extended	14	34.1	27	65.9	-
	Joint	106	33.7	209	66.3	-
	Nuclear	119	35.8	213	64.2	0.840
Monthly Income	10,000 - 20,000	21	38.9	33	61.1	-
	21,000 - 30,000	45	47.9	49	52.1	-
	31,000 - 40,000	46	37.4	77	62.6	-
	less than 10,000	48	31.2	106	68.8	-
	More than 40,000	79	30.0	184	70.0	0.023*
Area of living	Rural	128	35.8	230	64.2	-
	Urban	111	33.6	219	66.4	0.560
Geographical area	Azad Jammu & Kashmir (AJK)	16	25.0	48	75.0	-
	Balochistan	9	39.1	14	60.9	-
	Capital	0	0.0	2	100.0	-
	Gilgit- Baltistan (GB)	9	33.3	18	66.7	-
	Islamabad (ICT)	48	33.3	96	66.7	-
	Khyber Pakhtunkhwa (KPK)	17	42.5	23	57.5	-
	Punjab	123	35.3	225	64.7	-
	Sindh	17	42.5	23	57.5	0.509
How many people live in your house?	1 to 5	59	31.9	126	68.1	-
	10+	18	26.1	51	73.9	-
	5 to 10	162	37.3	272	62.7	0.121

Table 4. Correlation coefficient (r) between knowledge and attitude.

-		Knowledge	Attitude
Knowledge	Pearson Correlation	1	0.930**
	Sig. (2-tailed)	-	0.000
	N	688	688
Attitude	Pearson Correlation	0.930**	1
	Sig. (2-tailed)	0.000	-
	N	688	688

Note: **. Correlation is significant at the 0.05 level (2-tailed).

3.2. Attitude

For the evaluation of participants' attitudes, there were 31 questions (Supplemental Information 1) evaluating individuals' overall attitude toward COVID-19 and vaccine-related hesitancy. The average attitude score was 18.55 with a standard deviation of 7.1, and 35% (n = 235) of the participants had a negative attitude toward the vaccine or were classified as hesitant. Similar to knowledge scores, for attitude (Table **3**) several demographic factors contributed to the attitude score, including gender, age, occupation, and monthly income ($p < 0.05$). Additionally, although 65% of the survey respondents showed that they were not hesitant toward the COVID-19 vaccine itself, many (52.33%) did have a negative attitude toward the presentation of the vaccine in the media.

When knowledge and attitude were evaluated together (Table **4**), the correlation between knowledge scores and attitude scores was statistically significant ($p < 0.05$). For participants in this study, knowledge and attitude remained dependent and positively correlated (Table **4**).

3.3. Practice

While examining practices for the study participants, there were 40 questions (Supplemental Information 1) evaluating individuals' practices regarding COVID-19 infection, testing, and vaccination. The average practice score was 22.71, with a standard deviation of 8.80. In the case of COVID-19 practices, 35% (n = 243) were classified as following "good" practices, while 28% (n = 198) were at the "moderate" level, and 37% (n = 253) were at the "poor" level. For COVID-19 practices, the demographic factors that contributed most were gender, age, and education, as seen in Table **5** ($p < 0.05$).

Table 5. The effect of demographic characteristics on the participants' practices scores.

-		Good		Moderate		Poor		-
		n=688	%	n=688	%	n=688	%	*p*-value
Gender	Female	89	30.4	117	39.9	87	29.7	0.000*
	Male	154	39.0	75	19.0	166	42.0	-
Age	18-25	72	28.0	106	41.2	81	30.7	-
	26-35	62	45.3	41	29.9	38	24.8	-
	36-45	67	36.2	34	18.4	88	45.4	-
	46-55	42	44.1	11	10.8	46	45.2	0.000*
Religion	Christianity	0	0.0	0	0.0	1	100	-
	Hinduism	0	0.0	0	0.0	1	100	-
	Islam	243	35.5	192	28.0	250	36.5	-
	Other	0	0.0	0	0.0	1	100	0.521
Education	Below Matric	38	42.2	13	14.4	39	43.3	-
	Graduate	76	38.6	59	29.9	62	31.5	-
	Illiterate	15	26.8	10	17.9	31	55.4	-
	Matric	4	20.0	5	25.0	11	55.0	-
	Postgraduate	85	32.9	84	32.6	89	34.5	-
	Undergraduate	25	37.3	21	31.3	21	31.3	0.004*
Occupation	Businessman	4	33.3	4	33.3	4	33.3	-
	Daily wage labor	20	31.7	5	7.9	38	60.3	-
	Government employee	66	47.1	16	11.4	58	41.4	-
	Healthcare worker	1	14.3	1	14.3	5	71.4	-
	Housewife/ Home maker	29	42.6	19	27.9	20	29.4	-
	Private job	6	22.2	9	33.3	12	44.4	-
	Student	112	31.4	134	37.5	111	31.1	-
	Teacher	5	35.7	4	28.6	5	35.7	0.000*
Family type	Extended	10	24.4	21	51.2	10	24.4	-
	Joint	117	37.1	75	23.8	123	39.0	-
	Nuclear	116	34.9	96	28.9	120	36.1	0.008*
Monthly Income	10,000 - 20,000	17	31.5	14	25.9	23	42.6	-
	21,000 - 30,000	35	37.2	15	16.0	44	46.8	-
	31,000 - 40,000	46	37.4	28	22.8	49	39.8	-
	less than 10,000	64	41.6	41	26.6	49	31.8	-
	More than 40,000	81	30.8	94	35.7	88	33.5	0.008*
Area of living	Rural	169	47.2	51	14.2	138	38.5	-
	Urban	74	22.4	141	42.7	115	34.8	0.000*
Geographical area	Azad Jammu & Kashmir (AJK)	26	40.6	10	15.6	28	43.8	-
	Balochistan	10	43.5	3	13.0	10	43.5	-
	Capital	0	0.0	2	100.0	0	0.0	-
	Gilgit- Baltistan (GB)	11	40.	8	29.6	8	29.6	-
	Islamabad (ICT)	55	38.2	40	27.8	49	34.0	-
	Khyber Pakhtunkhwa (KPK)	15	37.5	8	20.0	17	42.5	-
	Punjab	110	31.6	114	32.8	124	35.6	-
	Sindh	16	40.	7	17.5	17	42.5	0.086

(Table 5) contd.....

-		Good		Moderate		Poor		-
		n=688	%	n=688	%	n=688	%	*p*-value
How many people live in your house?	1 to 5	72	38.9	60	32.4	53	28.6	-
	10+	27	39.1	18	26.1	24	34.8	-
	5 to 10	144	33.2	114	26.3	176	40.6	0.076

4. DISCUSSION

As it faces a fifth wave of the new coronavirus, Pakistan, a country of 207 million people [6], is seeing a dramatic increase in COVID-19 infections [5]. Pakistan shares its longest border with India, the world's second-most SARS-COV-2 affected country. In reaction to the catastrophic second wave, Indian hospitals are rushing for beds and oxygen, posing a new threat to Pakistan [27, 28]. However, vaccination uptake in Pakistan was delayed due to worries about the vaccine's safety and efficacy [22]. COVID-19 vaccine hesitancy has been studied all around the world [20, 23, 29, 30], and vaccination acceptance and hesitancy rates differ between nations.

Earlier research on vaccine attitudes indicated geographical differences in vaccine safety and efficacy perceptions [8, 31]. Vaccine safety was least certain in higher-income countries, with 72 – 73% of individuals in Northern America and Northern Europe agreeing that vaccinations are safe. Despite significant fluctuation in Eastern European nations, this percentage was much lower in Western Europe (59%) and Eastern Europe (50%), (from 32% in Ukraine, 48% in Russia, to 77% in Slovakia). However, in low-income regions, the majority of people think that vaccinations are safe, with the greatest percentages in South Asia (95%) and Eastern Africa (92%) [32]. In terms of vaccination effectiveness, a similar pattern was seen, with Eastern Europe being the location where individuals are least likely to agree that vaccines are effective, compared to South Asia and Eastern Africa [32].

Another predictor is religion, which is the most commonly researched factor in vaccination reluctance studies worldwide. Greater levels of religiosity have been linked to a higher rate of vaccination refusal in studies [33]. Except for the components used in vaccinations and religious consciousness, this study showed no religious role in vaccine myths, conspiracies, or disinformation that led to vaccine rejection as 59.9% of the participants said that they will not consider religious point of view before getting vaccinated and also many of the respondents have already heard about the rumors like vaccination is a strategy of the non-Muslims against the Muslims and as vaccine is also produced by the non-Muslim countries but still a majority of the participants were ready to have themselves and their children vaccinated even though respondents said that they weigh the opinions of Religious Scholars about vaccines. Although some participants mentioned that they were more concerned about the formulation because of the concept of halal and haram in Islam, this did not affect the view of most of our study participants on the uptake of the vaccine.

Additionally, education level is a critical indication of vaccination rejection, with illiterate and less educated people showing higher rejection and more faith in myths and conspiracies, in line with previously reported data from Canada and other countries [16]. Our findings also demonstrated that less educated participants had objections about the safety of vaccinations and that educated participants were in favor of protection through vaccines, with the results showing that participants were less susceptible the myths about vaccinations as their education level increased.

Despite the ever-increasing responsibility of the media in the public's vaccination reluctance, these relationships have been relatively understudied. On the one hand, the media is a powerful instrument that has been frequently used in vaccination efforts across the world [34]. In our study, 65% of the survey respondents showed that they were not hesitant toward the COVID-19 vaccine itself; however, many (52.33%) did have a negative attitude toward the presentation of the vaccine in the media. Much of this negative attitude stemmed from the misleading stories and misconceptions emerging from social media sources and political pundits [35]. Negative vaccination-related information communicated through the media, social media, or interpersonal contact, had an influence on the public and contribute to vaccine reluctance. We saw in this study that many of the participants agreed that they had reconsidered the choice to choose to vaccinate themselves and their children, whether they were currently vaccinated or not, due to the reports they had seen or heard on social media, including trends from Twitter, stories on Facebook and Instagram. Despite this, the bulk of the respondents agreed that if they came across a rumor or a misconception, or negative information about COVID-19 vaccination, they would still consider it seriously based on the results of scientific research.

Another factor that has been discussed in this study, government influence. According to our findings, people trust the current government to provide credible information about vaccine products and vaccination campaigns (64.2%). Also, more than half of the participants (52.9%) were convinced that the government would purchase the highest quality vaccines available for COVID-19. In our study, participants were willing to vaccinate whereas participants in cities in the United States who had high or very high confidence in their current national government were less likely to accept the vaccine [36].

A recent study [37] found a 20–25% hesitation rate among Canadian and American adults in May 2020. COVID-19 vaccination hesitancy was reported to be 41% and 26% in Italy and France, respectively [38, 39]. A

global poll of 19 nations found that Russia had the lowest acceptance rate (less than 55%) while China had the greatest acceptance rate (90%) [29]; and in Indonesia vaccination acceptance rates of more than 90% were found [40]. According to our study, Pakistan had a lower prevalence of vaccination hesitancy (15-20%) than the United States (20%) [23] and Egypt (27%) [41].

In contrast, vaccination apprehension in our research population was lower than in Australia (41%) [42], and Saudi Arabia (55.3%) [43]. Vaccine acceptance is heavily influenced by one's beliefs. Our findings revealed major concerns regarding the COVID-19 vaccine's safety and effectiveness, influence of government and media, gender discriminations and financial factors. Our findings corroborate those of studies done in other countries, which found that the COVID-19 vaccine's safety and effectiveness were the primary concerns [40, 44-47].

Concerns about effectiveness and safety were among the top reasons given by research participants in surveys looking at the reasons for COVID-19 vaccine rejection [48-51]. One possible explanation for COVID-19 vaccine safety difficulties and vaccination reluctance in Pakistan is the vaccine's Chinese origin. The Chinese vaccine, which was distributed with other vaccinations from the World Health Organization's COVAX program, made up the majority of the statewide immunization push in Pakistan. Acording to Kreps *et al*., respondents were less inclined to accept COVID-19 vaccines developed in countries other than the United States because of vaccine features related to vaccination choice. Following the development of vaccinations in the United Kingdom, the Chinese vaccine was particularly controversial [52]. During our study period, October to December 2021, there were few administrative changes around COVID-19 policy. The vaccine was offered to anyone 12 or older, while travel and other activities were restricted for non-vaccinated individuals. Although these restrictions may have affected the uptake and hesitancy of some of the population, these administrative changes remained in effect after the end of our study.

Shekhar *et al*. observed a greater proportion of predicted vaccination hesitation among females than men in a recent survey of U.S. healthcare professionals [53]. This contradicts our findings, as our study revealed no link between gender and vaccination hesitancy, despite the fact that males had a higher degree of knowledge than females and females had more positive attitudes. In line with the findings of a 2011 systematic review [54], which found no consistent relationship between participant age and vaccine uptake, our study found a significant relationship between hesitancy rate and participant age, with people in the 18-24 age group being more likely to be vaccinated than those in the other age groups. The belief in conspiracy theories and misleading and inaccurate information regarding COVID-19 vaccinations spread through social media and the internet was the second most common anxiety mentioned by our survey participants. This study result is also in line with the findings of a recent study done in Pakistan's Sindh province [19]. Multiple COVID-19 pandemic conspiracy theories have been quickly spreading throughout the world [55, 56]. These conspiracy theories are based in part on medical skepticism or a general distrust of and lack of faith in medical institutions and professionals [35]. Other important hurdles to immunization were views that a vaccine could not rescue people from SARS-Cov-2 and that vaccination was unnecessary if preventative measures were adopted [19].

There are several important limitations to the results we present here. First, the limited sample size compared to the size of the overall population of Pakistan. Indicating that the sample may not be representative of the overall population of the country. Also, by conducting this study online, the responses may be subject to potential biases as a result of the time needed to fill out a complex form using a computer or mobile device. Additionally, as with any study, it is difficult to understand how generalizable findings are to the entire population of a country, even with random sampling methods.

This study has identified the key determinants and drivers behind vaccine hesitancy in a variety of demographics in Pakistan, including age and education level. These findings can be used to develop targeted interventions and policies to address the issue of vaccine hesitancy, such as the development of tailored communication campaigns for different segments of the population based on their beliefs, the development of culturally sensitive interventions, investment in Risk Communication and Community Engagement (RCCE), the implementation of behavior change strategies, and addressing access barriers by streamlining vaccination processes, increasing clinic or vaccination site accessibility, and exploring mobile vaccination options.

Furthermore, this study's findings can be used for a policy that addresses systemic barriers to vaccination, such as expanding vaccination sites, ensuring convenient service hours, and outreach campaigns, particularly in rural areas. Additionally, policies promote the training of healthcare workers on effective communication in order to address vaccine hesitancy and build trust with the public.

CONCLUSION

COVID-19, a pandemic that has wreaked havoc on all aspects of development and affected numerous things around the world, including education, is indescribable. The current study found that the general population in Pakistan has a good understanding of COVID-19, but it also revealed many disparities in public awareness and practices about the disease. The survey further identified the sources of information for the public, which could be used to raise understanding of infectious diseases apart from coronavirus in the same community. However, the findings show that age, education, and gender should be considered while making policies for personalized health promotion programs. Potential areas of future research include exploring these demographics when designing interventions in vaccine uptake.

LIST OF ABBREVIATIONS

SARS-CoV-2	=	Severe Acute Respiratory Syndrome Coronavirus 2
COVID-19	=	Coronavirus disease caused from SARS-CoV-2
KAP	=	knowledge, attitudes, and practices
VH	=	vaccine hesitancy

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study received ethical approval from the Commission on Science and Technology for Sustainable Development in the South (COMSATS) University Islamabad's Ethics Review Committee under protocol number CUI-Reg/Notif-2482/21/2001 approved on August 3, 2021.

HUMAN AND ANIMAL RIGHTS

No animals were used that are the basis of the study. The reported human experiments were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975.

CONSENT FOR PUBLICATION

Informed consent was obtained from all participants of this study.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

Data supporting the findings of this article are available by request from the corresponding author [E.B].

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CONFLICT OF INTEREST

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REFERENCES

[1] Asia and the Middle East: The latest coronavirus counts, charts and maps. Available from: https://www.reuters.com/graphics/world-coronavirus-tracker-and-maps/regions/asia-and-the-middle-east/

[2] Pakistan COVID - coronavirus statistics - worldometer. 0000. Available from: https://www.worldometers.info/coronavirus/country/pakistan/

[3] Callaway E. Beyond omicron: What's next for COVID's viral evolution. Nature 2021; 600(7888): 204-7. http://dx.doi.org/10.1038/d41586-021-03619-8

[4] Hunter P. The spread of the COVID -19 coronavirus. EMBO Rep 2020; 21(4): e50334. http://dx.doi.org/10.15252/embr.202050334

[5] COVID-19 health advisory platform. Available from: https://www.researchgate.net/figure/COVID-19-Health-Advisory-Platform-by-Ministry-of-National-Health-Services-Regulations_fig1_371133012

[6] Final results (Census-2017). Available from: https://www.pbs.gov.pk/content/final-results-census-2017

[7] Unleashing the potential of a young Pakistan. 2018. Available from: https://hdr.undp.org/content/unleashing-potential-young-pakistan

[8] Larson HJ, de Figueiredo A, Xiahong Z, *et al*. The state of vaccine confidence 2016: Global insights through a 67-country survey. EBioMedicine 2016; 12: 295-301. http://dx.doi.org/10.1016/j.ebiom.2016.08.042

[9] Fendler A, de Vries EGE, GeurtsvanKessel CH, *et al*. COVID-19 vaccines in patients with cancer: Immunogenicity, efficacy and safety. Nat Rev Clin Oncol 2022; 19(6): 385-401. http://dx.doi.org/10.1038/s41571-022-00610-8

[10] Caturano A, Pafundi PC, Sasso FC, Dendramis G, Brugada P, Russo V. Brugada syndrome and COVID-19 vaccines. Europace 2021; 23(12): 1871-2. http://dx.doi.org/10.1093/europace/euab211

[11] MacDonald NE. Vaccine hesitancy: Definition, scope and determinants. Vaccine 2015; 33(34): 4161-4. http://dx.doi.org/10.1016/j.vaccine.2015.04.036

[12] Vulpe SN, Rughiniş C. Social amplification of risk and "probable vaccine damage": A typology of vaccination beliefs in 28 European countries. Vaccine 2021; 39(10): 1508-15. http://dx.doi.org/10.1016/j.vaccine.2021.01.063

[13] Ahmed SS, Schur PH, MacDonald NE, Steinman L. Narcolepsy, 2009 A(H1N1) pandemic influenza, and pandemic influenza vaccinations: What is known and unknown about the neurological disorder, the role for autoimmunity, and vaccine adjuvants. J Autoimmun 2014; 50: 1-11. http://dx.doi.org/10.1016/j.jaut.2014.01.033

[14] Hussain SF, Boyle P, Patel P, Sullivan R. Eradicating polio in Pakistan: An analysis of the challenges and solutions to this security and health issue. Global Health 2016; 12(1): 63. http://dx.doi.org/10.1186/s12992-016-0195-3

[15] Crescitelli DME, Ghirotto L, Sisson H, *et al*. A meta-synthesis study of the key elements involved in childhood vaccine hesitancy. Public Health 2020; 180: 38-45. http://dx.doi.org/10.1016/j.puhe.2019.10.027

[16] Wei F, Mullooly JP, Goodman M, *et al*. Identification and characteristics of vaccine refusers. BMC Pediatr 2009; 9(1): 18. http://dx.doi.org/10.1186/1471-2431-9-18

[17] Dubé E, Vivion M, MacDonald NE. Vaccine hesitancy, vaccine refusal and the anti-vaccine movement: Influence, impact and implications. Expert Rev Vaccines 2015; 14(1): 99-117. http://dx.doi.org/10.1586/14760584.2015.964212

[18] Ali M, Ahmad N, Khan H, Ali S, Akbar F, Hussain Z. Polio vaccination controversy in Pakistan. Lancet 2019; 394(10202): 915-6. http://dx.doi.org/10.1016/S0140-6736(19)32101-4

[19] Abbas Q, Mangrio F, Kumar S. Myths, beliefs, and conspiracies about COVID-19 Vaccines in Sindh, Pakistan: An online cross-sectional survey. Authorea 2021; 2021 http://dx.doi.org/10.22541/au.161519250.03425961/v1

[20] Fu C. Acceptance of and preference for COVID-19 vaccination in healthcare workers: A comparative analysis and discrete choice experiment. medRxiv 2022; 2020.04.09.20060103.

[21] Sarwar A, Nazar N, Nazar N, Qadir A. Measuring vaccination willingness in response to COVID-19 using a multi-criteria-decision making method. Hum Vaccin Immunother 2024; 17(12): 4865-72. http://dx.doi.org/10.1080/21645515.2021.2004836

[22] National command operation center. Available from: https://en.wikipedia.org/wiki/National_Command_and_Operation_Center

[23] Thunstrom L, Ashworth M, Finnoff D, Newbold S. Hesitancy towards a COVID-19 vaccine and prospects for herd immunity. 2020. Available from: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3593098

[24] MacDonald NE, Smith J, Appleton M. Risk perception, risk management and safety assessment: What can governments do to increase public confidence in their vaccine system? Biologicals 2012; 40(5): 384-8. http://dx.doi.org/10.1016/j.biologicals.2011.08.001

[25] Johnson NF, Velásquez N, Restrepo NJ, *et al*. The online competition between pro- and anti-vaccination views. Nature 2020; 582(7811): 230-3. http://dx.doi.org/10.1038/s41586-020-2281-1

[26] Sample size calculator by Raosoft, Inc. 0000. Available from: http://www.raosoft.com/samplesize.html

[27] Bhuyan A. Experts criticise India's complacency over COVID-19. Lancet 2021; 397(10285): 1611-2. http://dx.doi.org/10.1016/S0140-6736(21)00993-4

[28] Jain VK, Iyengar KP, Vaishya R. Differences between First wave and Second wave of COVID-19 in India. Diabetes Metab Syndr 2021; 15(3): 1047-8. http://dx.doi.org/10.1016/j.dsx.2021.05.009

[29] Lazarus JV, Ratzan SC, Palayew A, *et al*. A global survey of potential acceptance of a COVID-19 vaccine. Nat Med 2021; 27(2): 225-8. http://dx.doi.org/10.1038/s41591-020-1124-9

[30] Black S, Rappuoli R. A crisis of public confidence in vaccines. Sci Transl Med 2010; 2(61): 61mr1. http://dx.doi.org/10.1126/scitranslmed.3001738

[31] Wagner AL, Masters NB, Domek GJ, *et al*. Comparisons of vaccine hesitancy across five low- and middle-income countries. Vaccines 2019; 7(4): 155. http://dx.doi.org/10.3390/vaccines7040155

[32] Wilson SL, Wiysonge C. Social media and vaccine hesitancy. BMJ Glob Health 2020; 5(10): e004206. http://dx.doi.org/10.1136/bmjgh-2020-004206

[33] Reuben R, Aitken D, Freedman JL, Einstein G. Mistrust of the medical profession and higher disgust sensitivity predict parental vaccine hesitancy. PLoS One 2020; 15(9): e0237755. http://dx.doi.org/10.1371/journal.pone.0237755

[34] Zhou L, Ampon-Wireko S, Xu X, Quansah PE, Larnyo E. Media attention and vaccine hesitancy: Examining the mediating effects of Fear of COVID-19 and the moderating role of trust in leadership. PLoS One 2022; 17(2): e0263610. http://dx.doi.org/10.1371/journal.pone.0263610

[35] Khan TM, Chiau LM. Polio vaccination in Pakistan: By force or by volition? Lancet 2015; 386(10005): 1733. http://dx.doi.org/10.1016/S0140-6736(15)00689-3

[36] Trent M, Seale H, Chughtai AA, Salmon D, MacIntyre CR. Trust in government, intention to vaccinate and COVID-19 vaccine hesitancy: A comparative survey of five large cities in the United States, United Kingdom, and Australia. Vaccine 2022; 40(17): 2498-505. http://dx.doi.org/10.1016/j.vaccine.2021.06.048

[37] Taylor S, Landry CA, Paluszek MM, Groenewoud R, Rachor GS, Asmundson GJG. A proactive approach for managing COVID-19: The importance of understanding the motivational roots of vaccination hesitancy for SARS-CoV2. Front Psychol 2020; 11: 575950. http://dx.doi.org/10.3389/fpsyg.2020.575950

[38] Graffigna G, Palamenghi L, Boccia S, Barello S. Relationship between citizens' health engagement and intention to take the COVID-19 vaccine in Italy: A mediation analysis. Vaccines 2020; 8(4): 576. http://dx.doi.org/10.3390/vaccines8040576

[39] Watel PP, Seror V, Cortaredona S, *et al*. A future vaccination campaign against COVID-19 at risk of vaccine hesitancy and politicisation. Lancet Infect Dis 2020; 20(7): 769-70. http://dx.doi.org/10.1016/S1473-3099(20)30426-6

[40] 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. http://dx.doi.org/10.3389/fpubh.2020.00381

[41] Abdelhafiz AS, Mohammed Z, Ibrahim ME, *et al*. Knowledge, perceptions, and attitude of Egyptians towards the novel coronavirus disease (COVID-19). J Community Health 2020; 45(5): 881-90. http://dx.doi.org/10.1007/s10900-020-00827-7

[42] Edwards B, Biddle N, Gray M, Sollis K. COVID-19 vaccine hesitancy and resistance: Correlates in a nationally representative longitudinal survey of the Australian population. PLoS One 2021; 16(3): e0248892. http://dx.doi.org/10.1371/journal.pone.0248892

[43] Magadmi RM, Kamel FO. Beliefs and barriers associated with COVID-19 vaccination among the general population in Saudi Arabia. BMC Public Health 2021; 21(1): 1438. http://dx.doi.org/10.1186/s12889-021-11501-5

[44] Syed Alwi SAR, 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(1): 1129. http://dx.doi.org/10.1186/s12889-021-11071-6

[45] Neumann-Böhme 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(7): 977-82. http://dx.doi.org/10.1007/s10198-020-01208-6

[46] Lin C, Tu P, Beitsch LM. Confidence and receptivity for COVID-19 vaccines: A rapid systematic review. Vaccines 2020; 9(1): 16. http://dx.doi.org/10.3390/vaccines9010016

[47] Callaghan T, Moghtaderi A, Lueck JA, *et al*. Correlates and disparities of intention to vaccinate against COVID-19. Soc Sci Med 2021; 272: 113638. http://dx.doi.org/10.1016/j.socscimed.2020.113638

[48] Fisher KA, Bloomstone SJ, Walder J, Crawford S, Fouayzi H, Mazor KM. Attitudes toward a potential SARS-CoV-2 vaccine. Ann Intern Med 2020; 173(12): 964-73. http://dx.doi.org/10.7326/M20-3569

[49] Yoda T, Katsuyama H. Willingness to receive COVID-19 vaccination in Japan. Vaccines 2021; 9(1): 48. http://dx.doi.org/10.3390/vaccines9010048

[50] Ruiz JB, Bell RA. Predictors of intention to vaccinate against COVID-19: Results of a nationwide survey. Vaccine 2021; 39(7): 1080-6. http://dx.doi.org/10.1016/j.vaccine.2021.01.010

[51] Yigit M, Parlakay OA, Senel E. Evaluation of COVID-19 vaccine refusal in parents. Pediatr Infect Dis J 2021; 40(4): e134-6. http://dx.doi.org/10.1097/INF.0000000000003042

[52] Kreps S, Prasad S, Brownstein JS, *et al*. Factors associated with us adults' likelihood of accepting COVID-19 vaccination. JAMA Netw Open 2020; 3(10): e2025594. http://dx.doi.org/10.1001/jamanetworkopen.2020.25594

[53] Shekhar R, Sheikh AB, Upadhyay S, *et al*. COVID-19 vaccine acceptance among health care workers in the United States. Vaccines 2021; 9(2): 119. http://dx.doi.org/10.3390/vaccines9020119

[54] Nguyen T. Acceptance of a pandemic influenza vaccine: A systematic review of surveys of the general public. Infect Drug Resist 2011; 4: 197-207.

[55] Biddlestone M, Green R, Douglas KM. Cultural orientation, power, belief in conspiracy theories, and intentions to reduce the spread of COVID-19. Br J Soc Psychol 2020; 59(3): 663-73. http://dx.doi.org/10.1111/bjso.12397

[56] Georgiou N, Delfabbro P, Balzan R. COVID-19-related conspiracy beliefs and their relationship with perceived stress and pre-existing conspiracy beliefs. Pers Individ Dif 2020; 166: 110201. http://dx.doi.org/10.1016/j.paid.2020.110201