

# COVID-19 Vaccine Hesitancy Among the Population of Quetta-Associated Beliefs and Barriers

Samreen Misbah, Syed Fawad Mashhadi, Hassan Ilyas, Muhammad Bilal, Saad Zia, Hamza Amjad

Army Medical College/National University of Medical Sciences (NUMS) Rawalpindi Pakistan

## ABSTRACT

**Objectives:** This study aimed to determine the prevalence of hesitancy towards COVID-19 vaccination among the adult population of Quetta and the likelihood predictors of hesitancy towards COVID-19 vaccination.

**Study Design:** Analytical cross-sectional study.

**Place and Duration of Study:** Study was conducted at Quetta, from Nov 2021 to May 2022.

**Methodology:** A total of 396 individuals participated in the study. Along with socio-demographic details, participants responded to the COVID-VAX scale and questions from WHO determinants of vaccine-hesitancy. A relationship was modelled between WHO determinants of vaccine-hesitancy, socio-demographic characteristics and vaccine-hesitancy using logistic regression.

**Results:** Results showed that majority of individuals were vaccine-hesitant (67.2%). The final model obtained significant predictors among contextual influences as demonstrated past bad experiences on vaccination, non-belief in risking their own and family's health for being non-vaccinated and negative influences by an influential person. Among individual influences, knowledge about someone having bad experiences to vaccines, confusion about scheduling of vaccines, lack of trust in the healthcare system and provider, disbelieving in immunization as a social norm and concerns regarding vaccine. Among factors directly related to vaccine/vaccination, difficult vaccination schedule, fear of pain/needles, and non-willingness to pay for vaccination were found as significant predictors of the COVID-19 vaccine-hesitancy ( $p$ -value <0.05).

**Conclusions:** More than half of the participants showed hesitancy towards COVID-19 vaccine. Factors contributing to vaccine-hesitancy must be addressed to build confidence regarding COVID-19 vaccines among the people to attain the goal of herd immunization against COVID-19.

**Keywords:** COVID-19 Vaccines, Logistic Models, Prevalence, Vaccination, World health organization (MeSH).

**How to Cite This Article:** Misbah S, Mashhadi SF, Ilyas H, Bilal M, Zia S, Amjad H. COVID-19 Vaccine Hesitancy among the Population of Quetta – Associated Beliefs and Barriers. *Pak Armed Forces Med J* 2022; 72(Suppl-4): S730-736. DOI: <https://doi.org/10.51253/pafmj.v72iSUPPL-4.9647>

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

## INTRODUCTION

World Health Organization considered vaccine hesitancy, that is there is rejection or deferral for vaccine even though it is available, as a greatest global threat in 2019.<sup>1</sup> Reported vaccine acceptance for COVID-19 vaccine studied in 23 countries during 2021 was 75.2%. Though it was more as compared to 2020, but estimated still low for control of pandemic.<sup>2</sup> Pakistan started its immunization campaign against the COVID-19 in February 2021. As per December 31, 2021, almost 32% of Pakistanis were fully vaccinated, and 43.9% had received only the first dose; it has been increased till August 10, 2022 to almost 58.9% of Pakistanis fully vaccinated, and 62.7% only the first dose.<sup>3</sup> Administration of the vaccines to an adequate proportion of the population can help halt the further spread of severe infections by creating herd immunity.<sup>4</sup> The exact percentage of the people vaccinated to reach herd immunity against COVID-19 is unknown. However, with the emergence of newer strains of the COVID-19 virus, the number may be as

high as 85–90% of the population.<sup>5</sup>

People's trust in vaccines is the most crucial factor for any immunization campaign to succeed, as general public perceptions about vaccines are the ultimate decider of success or failure of these campaigns, and vaccine-hesitancy limits uptake.<sup>6</sup> Vaccine-hesitancy has always remained a substantial challenge for Pakistan. The country's inability to eliminate vaccine-preventable diseases such as polio is primarily attributed to conspiracy theories about vaccination.<sup>7</sup>

Baluchistan is the most affected province of Pakistan by the problem of vaccine-hesitancy.<sup>8</sup> The coronavirus pandemic is not over, with new variants being discovered. Therefore, it is essential to understand who is at more risk and safeguard them.<sup>9</sup> Evidence has suggested that to reduce misrepresentation from non-authentic sites it is essential that tailored made information as per need of local people should be available to increase acceptance for vaccination.<sup>10</sup> Continuation of vaccination campaign demands overcoming the significant challenges to make it a success by addressing identified factors.<sup>7</sup> As there is not much data available on attitudes of people

**Correspondence:** Dr Samreen Misbah, Department of Community Medicine, Army Medical College, Rawalpindi, Pakistan

of Baluchistan regarding COVID-19 vaccination, there is a need to improve our understanding of factors responsible for COVID-19 vaccine-hesitancy in these areas. This will help design and put forth a plan for appropriate behavior changing strategies to enhance the uptake of the COVID-19 vaccine.

## METHODOLOGY

This analytical cross-sectional study was conducted in Quetta from May to September 2022. After receiving approval from ethical review committee (reference number ERC/ID/22/04), non-probability sampling was used to collect data. The sample size was calculated using Raosoft sample size calculator which estimated a sample of 384 (5% margin error, 95% C.I.).<sup>11</sup>

**Inclusion Criteria:** Individuals of age 18 years and above, of either gender, whether or not vaccinated for COVID-19 participated in the study.

**Exclusion Criteria:** Participants who did not give consent were excluded from the study.

Face to face data collection was done by distributing questionnaires in either Urdu or English language depending upon their education and ability to understand. Participants were required to fill out a consent form before they are given the questionnaire to obtain their willingness in the survey. The questionnaire consisted of three sections; socio-demographic characteristics, the COVID-VAX scale and questions devised by the WHO SAGE Working Group for determinants of vaccine-hesitancy. The specific set of questions used was adapted from a previous study.<sup>12</sup> The questions were modified to address the COVID-19 vaccines specifically. "COVID-VAX" is a modified version of the Vaccinations Attitude Examination (VAX) scale previously adapted in a study.<sup>13</sup> The questionnaire was also translated into Urdu, and face & content validity of the study instrument was confirmed by experts including its Urdu translation.

Statistical Package for Social Sciences (SPSS) version 26.0 was used for data analysis. An expert reviewed all thirty-five questions to determine non-hesitant and hesitant answers. For all questions from four to thirty-five (except questions 4, 5, 11, 12, 13, 15, 16, 20, 24, 29, 30, 32, 34, 35) choosing "YES" was a non-hesitant response and "NO" was the hesitant response. Responses from WHO determinants of vaccine-hesitancy were represented as frequencies. Vaccine-hesitancy status was calculated based on the respondent's score on the COVID-VAX scale. Participants with higher scores were labelled as "hesitant"

compared to participants with lower scores as "non-hesitant", with a cut-off value set at 50% score (36 out of a total score of 72). To determine significant predictors of vaccine-hesitancy, WHO determinants of vaccine-hesitancy and socio-demographic factors were examined for association with vaccine-hesitancy status using the Chi-square test ( $p$ -value  $<0.05$ ). Univariate binary logistic regression followed by multivariate binary logistic regressions (forward regression model) was used to determine significant predictors ( $p$ -value  $<0.05$ ) of vaccine-hesitancy among the participants.

## RESULTS

Out of 500 distributed questionnaires, 404 were returned with 80.8% response rate. A total sample of 396 was analyzed for vaccine-hesitancy after excluding eight participants because of incomplete forms.

Among participants with age range of 18-69 years and mean age  $33.8 \pm 12.083$ , approximately 278(70.2%) were male and 118(29.8%) female. Most of them, 279(70.5%) were from urban areas, majority, 268(67.7%) were undergraduate, while 40(10.1%) were educated till primary/secondary, 3(0.8%) had a diploma and 85(21.5%) were post graduates. A significant number, 215(54.3%) of participants were unemployed, 104(26.3%) had income more than Rs 25,000, 117(29.5%) had Rs 25,000-Rs 50,000, 105(26.5%) had Rs 50,000-Rs 1 Lac, and 70(17.7%) had more than Rs 1 Lac monthly income. Mostly, 349(88.1%) received both doses of COVID-19 vaccine, 24(6.1%) received only one dose while 23(5.8%) didn't get the vaccine and majority of them, 345(87.1%) were not suffering from any chronic illness. The prevalence of vaccine-hesitancy was 67.2% (266).

Omnibus tests of model coefficients showed it is a significant model ( $p$ -value less than 0.05). Hosmer and Lemeshow test showed that model does fit the data ( $p$ -value more than 0.05). Overall percentage/ total accuracy of the model found to be 73.5%. Univariate analysis was run to see the relation of all predictors with outcome keeping the cutoff value  $p < 0.05$ . Among demographic variable it showed that male participants are 1.6 times more likely to be hesitant (OR=1.639, 95% CI=1.046-2.567). Factors like age, education, income, chronic diseases didn't show any association Table-I. There was also no significant association between vaccine-hesitancy and number of sources of information, with religious beliefs among contextual influences and with not receiving enough information about safety of vaccine, acceptance for new introduced vaccine, with hesitant status among factors related to

## COVID-19 Vaccine Hesitancy among the Population

vaccine itself, therefore were not included in further analysis.

To avoid spurious association Univariate analysis

against the COVID-19 vaccine (95 % CI; 1.473-4.043), Table-II. Among individual and group influences factors associated with more vaccine hesitancy were;

**Table-I: Binary Logistic Regression Analysis demonstrating demographic predictors of vaccine hesitancy amongst participants**

Factors	Study Parameter		Univariate Logistic Regression			Multivariate Logistic Regression		
	Hesitant	Non-Hesitant	p-value	Un-Adjusted OR	95% CI for UOR	p-value	Adjusted OR	95% CI for AOR
<b>Gender</b>								
Male	196(70.5%)	82(29.5%)	1			1		
Female	70(59.3%)	48(40.7%)	0.031*	1.639	1.046-2.567	0.211	1.492	0.797-2.791
<b>Income</b>								
< Rs 25,000	81(77.9%)	23(22.1%)	1					
Rs.25,000-Rs.50,000	78(66.7%)	39(33.3%)	0.065	0.568	0.311-1.037	0.185	1.816	0.752-4.385
Rs.50,000-Rs-1 Lac	69(65.7%)	36(34.3%)	0.052	0.544	0.295-1.006	0.905	1.052	0.460-2.405
> Rs 1 Lac	38(54.3%)	32(45.7%)	0.001*	0.337	0.174-0.652	0.506	1.319	0.583-2.980

**Table-II: Binary Logistic Regression Analysis demonstrating contextual influences as predictors of vaccine hesitancy amongst participants**

Factors	Study Parameter		Univariate Logistic Regression			Multivariate Logistic Regression		
	Hesitant	Non-Hesitant	p-value	Un-Adjusted OR	95% CI for UOR	p-value	Adjusted OR	95% CI for AOR
<b>Contextual influences</b>								
Historical influences-No	173(60.5%)	113(39.5%)	1			1		
Yes	93(84.5%)	17(15.5%)	0.000	0.280	0.158-0.494	0.003*	2.531	1.380- 4.642
Risking own/ family's health for being non-vaccinated-Yes	185(60.9%)	119(39.1%)	1			1		
No	81(88%)	11(12%)	0.000	0.211	0.108-413	0.003*	0.329	0.158-.685
Compulsion for vaccination-Yes	185(61.1%)	118(38.9%)	1			1		
No	81(87.1%)	12(12.9%)	0.000	0.232	0.121-0.444	0.238	0.635	0.298-1.350
Trust in government decisions-Yes	201(62.4%)	121(37.6%)	1			1		
No	65(87.8%)	9(12.2%)	0.000	0.230	0.111-0.479	0.087	0.480	0.208-1.111
Willingness to Spend time to get vaccination- Yes	196(62.8%)	116(37.2%)	1			1		
No	70(83.3%)	14 (16.7%)	0.001	0.338	0.182-0.627	0.635	0.838	0.404-1.739
Trust in pharmaceutical companies-Yes	161(59.6%)	109(40.4%)	1			1		
No	105(83.3%)	21(16.7%)	0.000	0.295	0.174-0.501	0.053	0.554	0.305-1.007
Negative Influence of a celebrity-No	144(59.3%)	99(40.7%)	1			1		
Yes	122(79.7%)	31(20.3%)	0.000	0.370	0.231-0.591	0.001*	2.440	1.473-4.043

was followed by Multivariate analysis keeping the cut-off value for significance < 0.1. Among contextual influences following factors were associated with more vaccine hesitancy; Odds of being vaccine hesitant was 2.531 times higher among participant remembering any discouraging event from the past (95 % CI; 1.380-4.642). Participants who thought people are not risking own and family's health for being non-vaccinated were 3.03 times the odds of being hesitant. Odds of being vaccine hesitant was 2.440 times higher among participants who were doubted if a celebrity advocates

knowing someone who has had a bad reaction to vaccine have 1.995 times the odds of being hesitant (95% CI;1.148-3.467). Participants who don't have acquaintance of someone ill because they were not vaccinated were 2.070 times the odds of being hesitant. Confusion about scheduling of vaccine have 2.206 times the odds of being hesitant (95 % CI; 1.258-3.868). Participants who did not trust in health system and provider were 3.300 times the odds of being hesitant. Concerns regarding COVID-19 vaccine have 1.721 times the odds of being hesitant (95% CI; 1.003-2.954).

## COVID-19 Vaccine Hesitancy among the Population

Considering to get vaccination should be a social norm was 15.15 times the odds of being hesitant, Table-III. Among factors related to vaccine itself, odds of being vaccine hesitant was 1.979 times higher among participants who thought vaccine schedule is difficult to follow (95 % CI; 1.084-3.613). Participants not willing to pay out of pocket for vaccine were 1.709 times the odds of being hesitant. Fear of pain/needles have 1.987 times the odds of being hesitant (95 % CI; 1.027-3.844) Table-IV.

the continuum and may or may not accept vaccines, or delay getting it based on different concerns.<sup>14</sup> This study has showed high vaccine hesitancy among participants of Quetta indicating a significantly alarming percentage of hesitant individuals.

In our study, disbelieving in immunization as a social norm was the strongest predictor of vaccine-hesitancy. Several studies have shown a positive association between social norms and intentions to get vaccinated.<sup>15</sup> People often will not readily accept

**Table-III: Binary Logistic Regression Analysis demonstrating Individual and group influences as predictors of vaccine hesitancy amongst participants**

Factors	Study Parameter		Univariate logistic regression			Multivariate logistic regression		
	Hesitant	Non-Hesitant	p-value	Un-Adjusted OR	95% CI for UOR	p-value	Adjusted OR	95% CI for AOR
<b>Individual and Group Influences</b>								
Knowing someone who has had a bad reaction to vaccine -No	138(58.2%)	99(41.8%)	1			1		
Yes	128(80.5%)	31(19.5%)	0.000	0.338	0.211-0.540	0.014*	1.995	1.148-3.467
Acquaintance of someone ill because they were not vaccinated - No	140(78.2%)	39(21.8%)	1			1		
Yes	126(58.1%)	91(41.9%)	0.000	2.593	1.660-4.049	0.007*	0.483	0.285-0.818
Vaccine strengthens immune response -Yes	193(61.5%)	121(38.5%)	1			1		
No	73(89%)	9(11%)	0.000	0.197	0.095-0.408	0.586	0.783	0.325-1.887
Better ways are available than vaccines -Yes	133(76.4%)	41(23.6%)	1			1		
No	133(59.9%)	89(40.1%)	0.001	0.461	0.296-0.716	0.302	1.314	0.782-2.208
Confusion about scheduling of vaccine- No	142(58.4%)	101(41.6%)	1			1		
Yes	124(81%)	29(19%)	0.000	0.329	0.204-0.530	0.006*	2.206	1.258-3.868
Trust in Health System & Provider-Yes	195 (60.7%)	126(39.3%)	1			1		
No	71(94.7%)	4(5.3%)	0.000	0.087	0.031-0.245	0.040*	0.303	0.097-0.948
Vaccine benefits are more than risks- Yes	132 (79%)	35(21%)	1			1		
No	134(58.5%)	95(41.5%)	0.000	2.674	1.695-4.219	0.057	1.667	0.986-2.818
Vaccine preventable diseases are serious-Yes	186(62.4%)	112(37.6%)	1			1		
No	80(81.6%)	18 (18.4%)	0.001	0.374	0.213-0.656	0.174	0.629	0.322-1.228
Concerns regarding COVID-19 vaccine-No	134(59.3%)	92(40.7%)	1			1		
Yes	132(77.6%)	38(22.4%)	0.000	0.419	0.268-0.656	0.049*	1.721	1.003-2.954
Vaccination as a social norm-Yes	197(60.4%)	129(39.6%)	1			1		
No	69(98.6%)	1(1.4%)	0.000	0.022	0.003-0.161	0.010*	0.066	0.008-0.527

### DISCUSSION

Vaccine-hesitancy differs from utter vaccine refusal or complete acceptance without having any concerns. Individuals belonging to this category lie on

something new, and adoption of new behaviors, attitudes and values is facilitated with group support. Negative past experiences with vaccination, as shown by participants of this study can also lead to the

## COVID-19 Vaccine Hesitancy among the Population

development of hesitancy. A study has shown that individuals with experience or knowledge of bad reactions to vaccines had lower confidence, which is also associated with delays and refusal.<sup>16</sup> Kim *et al.* reported that participants showed hesitancy towards receiving a second dosage of the COVID-19 vaccine after knowing the association of thrombosis and thrombocytopenia syndrome (TTS) with the COVID-19 vaccine.<sup>17</sup> Several other studies have shown an

association between past experiences with vaccines and attitudes toward vaccines.<sup>18,19</sup>

There can be various meanings of term “trust” in vaccines or vaccination including trust in the product, in the provider and in the healthcare system regarding the vaccination programs.<sup>20</sup> Participants of this study who did not trust in health system and provider were more hesitant towards COVID-19 vaccination. In another study confidence in healthcare providers was

**Table-IV: Binary Logistic Regression Analysis Demonstrating factors directly related to vaccine/vaccination**

Factors	Study Parameter		Univariate logistic regression			Multivariate logistic regression		
	Hesitant	Non-Hesitant	p-value	Un-Adjusted OR	95% CI for UOR	p-value	Adjusted OR	95% CI for AOR
<b>Vaccine Specific Issues</b>								
Safety of COVID-19 vaccine- Yes	221(64.1%)	124(35.9%)	1			1		
No	45(88.2%)	6(11.8%)	0.001	0.238	0.099-0.573	0.076	0.383	0.132-1.105
Enough information about safety of vaccine- Yes	190(64.6%)	104(35.4%)	1			1		
No	76(74.5%)	26(25.5%)	0.000	2.593	1.660-4.049	0.826	0.935	0.515-1.700
Preference on route of vaccine-No	149(60.1%)	99(39.9%)	1			1		
Yes	117(79.6%)	30(20.4%)	0.000	0.386	0.240-0.620	0.139	1.523	0.872-2.661
Easy and welcoming access to immunization Yes	207(63.5%)	119(36.5%)	1			1		
No	59(84.3%)	11(15.7%)	0.001	0.324	0.164-0.641	0.202	0.600	0.274-1.315
Knowledge of vaccine schedule -Yes	183(63.3%)	106(36.7%)	1			1		
No	83(77.6%)	24(22.4%)	0.008	0.499	0.299-0.834	0.239	0.694	0.378-1.274
Believe in taking vaccine on schedule-Yes	219(64.2%)	122(35.8%)	1			1		
No	47(85.5%)	8(14.5%)	0.003	0.306	0.140-0.668	0.661	0.810	0.316-2.075
Difficult vaccine schedule-No	155 (58.9%)	108(41.1%)	1			1		
Yes	111(83.5%)	22(16.5%)	0.000	0.284	0.169-0.478	0.026*	1.979	1.084-3.613
Free vaccine is not of no value-No	173(60.7%)	112(39.3%)	1			1		
Yes	93(83.8%)	18(16.2%)	0.000	0.299	0.171-0.522	0.309	1.406	0.729-2.712
Willing to pay out of pocket for vaccine-Yes	123(59.7%)	83(40.3%)	1			1		
No	143(75.3%)	47(24.7%)	0.001	0.487	0.316-0.750	0.035*	0.585	0.356-0.962
Fear of pain/needles-No	164(59.4%)	112(40.6%)	1			1		
Yes	102(85%)	18(15%)	0.000	0.258	0.148-0.450	0.041*	1.987	1.027-3.844
Trust on professional administering vaccine -Yes	214(64.8%)	11 (35.2%)	1			1		
No	52(78.8%)	14(21.2%)	0.030	0.491	0.264-0.934	0.926	0.964	0.450-2.068
Misbehavior of healthcare professionals-No	162(61.1%)	103(38.9%)	1			1		
Yes	104(79.4%)	27(20.6%)	0.000	0.408	0.250-0.667	0.206	1.461	0.812-2.631
Advise against vaccine by healthcare professional-No	176(60.9%)	113(39.1%)	1			1		
Yes	90(84.1%)	17(15.9%)	0.000	0.294	0.166-0.520	0.138	1.675	0.847-3.313

considered a strong predictor of vaccine acceptance.<sup>21</sup> A study conducted in Iran emphasized development of generalized trust and willingness among people through government as well as health official.<sup>22</sup> Our study participants although showed disbelieving in immunization as a social norm, however, advice against vaccine by healthcare professional was not a strong predictor for vaccine hesitancy.

A study showed that potential “trypanophobia” or fear of needles could enhance concern about COVID-19 vaccines among individuals. Present study is also consistent with the results reported by Daniel *et al.* that if an individual has needle phobia, it increases vaccine-hesitancy, keeping in mind other ongoing challenges including “therapeutic unmet needs”.<sup>23</sup> Due to internet and social media public has now more access to a vast amount of information including evidence-based and poor-quality data all in one place. The misinformation is amplified when influential celebrities show anti-vaccination behavior.<sup>24</sup> Our study also showed that if celebrities endorse anti-vaccination behavior, it will influence individuals’ perceptions of vaccines creating doubts.

Our study also showed an association between knowledge and awareness regarding COVID-19 vaccines and vaccine-hesitancy. Though Pakistan has better overall immunization coverage, the province of Baluchistan is hit hard by several conflicts hindering the progress of immunization programs. This has been effected more by low literacy rate and considerably low knowledge about vaccines making it difficult especially for women, to develop a basic understanding of vaccination and the importance of herd immunity.<sup>8</sup> Evidence has shown that individuals with better education have more awareness about vaccination resulting in less hesitancy and more likely to ensure complete immunization.<sup>25</sup>

The strength of our study is that it is one of the early studies to explore WHO determinants and vaccine hesitancy. In addition, our analysis allows understanding of vaccine-hesitancy in Quetta; as to the best of our literature search, no such previous study has been conducted there.

#### LIMITATION OF STUDY

The findings are based on an individual’s self-perceptions that may change with time. The convenience sampling method could have created an inherent bias, which means that the sample is unlikely to represent the whole population. Social desirability bias could also affect the results.

#### CONCLUSION

The prevalence of COVID-19 vaccine-hesitancy is alarmingly high among adult population of Quetta. Factors governing this vaccine-hesitant attitude are negative influence regarding vaccinations by a celebrity, past bad experiences on immunization, lack of knowledge and awareness, lack of trust in the health system and provider, disbelieve in immunization as a social norm, fear of pain/needles, difficult vaccination schedule and any discouraging historical influences. These factors must be addressed to build confidence regarding vaccines among people to attain the goal of fighting this global pandemic by achieving herd immunity.

**Conflicts of Interests:** None.

#### Author’s Contributions

Following authors have made substantial contributions to the manuscript as under:

SM: Design, Questionnaire review, Statistical Analysis, Final manuscript & approval for the final version to be published.

SFM: Final Manuscript, Proof reading & approval for the final version to be published.

HI: Concept, Design, Statistical Analysis, Data Collection, Final Manuscript & approval for the final version to be published.

MB: Data Collection, Questionnaire, Introduction & approval for the final version to be published.

SZ: Introduction, Discussion, Results & approval for the final version to be published.

HA: Abstract, Discussion, Questionnaire & approval for the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

#### REFERENCES

1. MacDonald NE, Eskola J, Liang X, Chaudhuri M, Dube E, Gellin B, et al. Vaccine hesitancy: Definition, scope and determinants. *Vaccine* 2015; 33(34): 4161–4164.
2. Lazarus J V, Wyka K, White TM, Picchio CA, Rabin K, Ratzan SC, et al. Revisiting COVID-19 vaccine hesitancy around the world using data from 23 countries in 2021. *Nat Commun* 2022; 13(1): 3801-3805. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/35778396>
3. Details I. COVID-19 Situation ! last updated 12 Aug 2022; 2(1): 1-7. Available at: <https://covid.gov.pk/adlksfjlskdj-alsdjfalskdjf>
4. Danabal KGM, Magesh SS, Saravanan S, Gopichandran V. Attitude towards COVID 19 vaccines and vaccine hesitancy in urban and rural communities in Tamil Nadu, India – a community based survey. *BMC Health Serv Res* 2021; 21(1): 1-10. Available at <https://doi.org/10.1186/s12913-021-07037-4>
5. Muhajarine N, Adeyinka DA, McCutcheon J, Green KL, Fahlman M, Kallio N. COVID-19 vaccine hesitancy and refusal and associated factors in an adult population in Saskatchewan, Canada: Evidence from predictive modelling. *PLoS One* 2021; 16(11 November): 1-18. Available at: <http://dx.doi.org/10.1371/journal.pone.0259513>

## COVID-19 Vaccine Hesitancy among the Population

6. Arshad MS, Hussain I, Mahmood T, Hayat K, Majeed A, Imran I, et al. A national survey to assess the covid-19 vaccine-related conspiracy beliefs, acceptability, preference, and willingness to pay among the general population of Pakistan. *Vaccines* 2021; 9(7): 1-13. Available at :<https://www.mdpi.com/2076-393X/9/7/720>
7. Khan YH, Mallhi TH, Alotaibi NH, Alzarea AI, Alanazi AS, Tanveer N, et al. Threat of COVID-19 vaccine hesitancy in Pakistan: The need for measures to neutralize misleading narratives. *Am J Trop Med Hyg* 2020; 103(2): 603-604. Available at: <https://pubmed.ncbi.nlm.nih.gov/32588810>
8. Khan EA, Panezai MI, Shahid B, Shahabuddin A, Akber S. Increasing the demand for vaccination through mHealth in Quetta City, Balochistan in Pakistan. *J Glob Heal Reports* 2021; 5. Available at: <https://www.joghr.org/article/28999-increasing-the-demand-for-vaccination-through-mhealth-in-quetta-city-balochistan-in-pakistan>
9. Welsh CE, Sinclair DR, Matthews FE. Static Socio-Ecological COVID-19 Vulnerability Index and Vaccine Hesitancy Index for England. *Lancet* 2020; xx(January): 1-13. Available at: [https://www.researchgate.net/publication/357440645\\_Static\\_Socio-Ecological\\_COVID-19\\_Vulnerability\\_Index\\_and\\_Vaccine\\_Hesitancy\\_Index\\_for\\_Eng](https://www.researchgate.net/publication/357440645_Static_Socio-Ecological_COVID-19_Vulnerability_Index_and_Vaccine_Hesitancy_Index_for_Eng)
10. Kricorian K, Civen R, Equils O. COVID-19 vaccine hesitancy: misinformation and perceptions of vaccine safety. *Hum Vaccines Immunother* 2022; 18(1): e1950504-1--e1950504-8.
11. Sample PM, Calculator S. Sample size calculator. 2004; (707): 5-7. [Internet] available at: <https://www.calculator.net/sample-size-calculator.html?type=1&cl=95&ci=5&pp=50&ps=55&x=119&y=16%0A> <http://www.raosoft.com/samplesize.html>
12. Musa AF, Soni T, Cheong XP, Nordin R Bin. Vaccine hesitancy among parents in Kuala Lumpur: a single center study. *F1000Research* 2019; 8(1): 1653-1655.
13. Shacham M, Greenblatt-Kimron L, Hamama-Raz Y, Martin LR, Peleg O, Ben-Ezra M. Increased COVID-19 vaccination hesitancy and health awareness amid COVID-19 vaccinations programs in Israel. *Int J Environ Res Public Health* 2021; 18(7): 3804
14. Morgan M, Rogers-Carter1 2 JAV 2 KBGAFPMTMMR, Christian-son1 JP. Measuring vaccine hesitancy: Field testing the WHO SAGE Working Group on Vaccine Hesitancy survey tool in Guatemala *Physiol Behav* 2017; 176(12): 139-148.
15. Graupensperger S, Abdallah DA, Lee CM. Social norms and vaccine uptake: College students' COVID vaccination intentions, attitudes, and estimated peer norms and comparisons with influenza vaccine. *Vaccine* 2021; 39(1): 2060-2067.
16. Nowak GJ, Cacciatore MA. Parents' confidence in recommended childhood vaccinations: Extending the assessment, expanding the context *Glen. Hum Vaccines Immunot* 2017; 13(3): 687-700.
17. Kim MH, Son NH, Park YS, Lee JH, Kim DA, Kim YC. Effect of a hospital-wide campaign on COVID-19 vaccination uptake among healthcare workers in the context of raised concerns for life-threatening side effects. *PLoS One* 2021; 16(10): 1-14. Available at: <http://dx.doi.org/10.1371/journal.pone.0258236>
18. Dolu İ, Turhan Z, Dilcen HY. COVID-19 Vaccine Acceptance is associated with Vaccine Hesitancy, Perceived Risk and Previous Vaccination Experiences. *Disaster Med Public Health Prep.* 2021; 23(1): 1-9
19. Landicho-Guevarra J, Reñosa MDC, Wachinger J, Endoma V, Aligato MF, Bravo TA, et al. Scared, powerless, insulted and embarrassed: Hesitancy towards vaccines among caregivers in Cavite Province, the Philippines. *BMJ Glob Heal* 2021; 6(9): 1-11.
20. Larson HJ, Clarke RM, Jarrett C, Eckersberger E, Levine Z, Schulz WS, et al. Measuring trust in vaccination: A systematic review. *Hum Vaccines Immunother* 2018; 14(7): 1599-1609. doi: 10.1080/21645515.2018.1459252
21. Rozek LS, Jones P, Menon A, Hicken A, Apsley S, King EJ. Understanding Vaccine Hesitancy in the Context of COVID-19: The Role of Trust and Confidence in a Seventeen-Country Survey. *Int J Public Health* 2021; 66(5): 636255. <https://doi.org/10.3389/ijph.2021.636255>
22. Ahorsu DK, Lin CY, Yahaghai R, Alimoradi Z, Broström A, Griffiths MD, et al. The mediational role of trust in the healthcare system in the association between generalized trust and willingness to get COVID-19 vaccination in Iran. *Hum Vaccines Immunother* 2022; 18(1): 1-8. Available at: <https://doi.org/10.1080/21645515.2021.1993689>
23. Forman R, Shah S, Jeurissen P, Jit M, Mossialos E. COVID-19 vaccine challenges: What have we learned so far and what remains to be done? *Health Policy (New York)* 2021; 125(5): 553-567. Available at: <https://doi.org/10.1016/j.healthpol.2021.03.013>
24. Jing R, Fang H, Wang H, Wang J. The Role of General Attitudes and Perceptions Towards Vaccination on the Newly-Developed Vaccine: Results From a Survey on COVID-19 Vaccine Acceptance in China. *Front Psychol* 2022; 13(May): 1-13. doi: 10.3389/fpsyg.2022.841189. eCollection 2022
25. Voo JYH, Lean QY, Ming LC, Hanafiah NHM, Al-Worafi YM, Ibrahim B. Vaccine knowledge, awareness and hesitancy: A cross sectional survey among parents residing at sandakan district, sabah. *Vaccines* 2021; 9(11): 1-12. doi: 10.3390/vaccines9111348.