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Hesitancy towards COVID-19 Vaccine among Students of Medical and Allied Health Sciences in Pakistan: A cross sectional study

Cover Page Footnote

The administration of Khyber Medical University is acknowledged for support to conduct this study

Hesitancy Towards COVID-19 Vaccine Among Students of Medical and Allied Health Sciences in Khyber Pakhtunkhwa

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Abstract

Objective: To measure COVID-19 vaccine hesitancy and its associated factors among medical and allied health sciences students of Khyber Pakhtunkhwa.

Methodology: This cross-sectional survey was conducted online using Google survey platform in March 2021. Study population comprised of medical and allied health sciences students studying in medical/allied health sciences academic institutes in Khyber Pakhtunkhwa. The web-based online link was provided to around 800 students to fill in the questionnaire via email, WhatsApp and/or social media network. Response rate was around 50%. The main outcome variable was vaccine hesitancy. Factors associated with vaccine hesitancy were explored by bivariate and multivariate regression analysis.

Results: Out of 398 medical and allied health sciences students, there were 193 (48.5%) males and 205 (51.5%) females with mean age was 22.6 ± 2.8 years. The vaccine hesitancy rate was found to be 52.8%. A significant relationship between vaccine hesitancy and gender was observed. Other factors including lack of adequate knowledge about vaccines ($p < 0.001$), Chinese origin of vaccines ($p < 0.001$), lack of knowledge that vaccination can reduce the chances of acquiring infection ($p < 0.001$), fear of potential side effects ($p < 0.001$) and hidden agenda behind free forceful vaccination ($p = 0.045$), were found to be main barriers or reasons responsible for COVID-19 vaccine hesitancy among medical and allied health sciences students.

Conclusion: Important associated barriers with COVID-19 vaccine hesitancy included gender, lack of information, fear of side effects, lack of trust in imported and Chinese vaccines, and perception of hidden agenda behind COVID-19 vaccination.

Keywords: COVID-19, Developing countries, Health occupations, Medical students, Vaccine hesitancy

1. Introduction

Since the beginning of COVID-19 pandemic, the world is trying hard to win the battle against SARS-CoV-2 coronavirus. Up till now, the most effective preventive strategy against COVID-19 has been vaccination, followed by social distancing, wearing mask and hand sanitization.¹ In Pakistan, the vaccination campaign started in February 2021, and after intensive campaign the government has managed to administer about 252 million doses,² with which 120 million² people have been fully vaccinated, 54.0%³ of the population till April 27th, 2022. The required target of getting at least 70% of

the population fully vaccinated, in order to avail complete benefits of vaccination, still needs a lot more efforts to be achieved. With newly-emerging strains of SARS-CoV-2 lurking around the corner, it is need of the time to get majority of the population vaccinated against coronavirus as quickly as possible.⁴

According to World Health Organization (WHO), vaccine hesitancy can be the biggest challenge in uptake of vaccines throughout the world and it is ranked among top ten threats to the global public health by WHO.⁵ Vaccine hesitancy is defined as “The practice of refusing or delaying vaccination despite the availability of vaccination services”.⁶

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Vaccine hesitancy towards COVID-19 vaccine is not limited to developing countries, but is also quite prevalent in high income countries including US and Italy. A scoping review had reported mean hesitancy rate of 30% among high income countries, ranging from 7.0 to 77.9%.⁷

In context of Pakistan, keeping history in view, vaccine hesitancy has always been a real time challenge specially in terms of expanded program on immunization against poliomyelitis and measles, mumps, rubella (MMR). This shows that Pakistani population in general is reluctant towards vaccines, due to various cultural, ethnic, social and religious believes.^{8,9} As per SAGE working group, three major influencing factors are attributed to vaccine hesitancy including “confidence” in terms of trust towards vaccine effectiveness/safety and healthcare profession, “complacency” when there is disease denial or general perception of low risk, and “convenience” regarding availability, affordability and accessibility of vaccines.⁶

In Pakistan, due to limited availability of resources, vaccination program started with targeting high priority groups including frontline healthcare workers, medical & allied health sciences staff/students and general population of more than 65 years age.¹⁰ Maximum vaccination coverage was desired among healthcare workers due to their frontline warrior role in the battle against COVID-19, followed by other medical/allied healthcare staff and students who act as backup support in unexpected high burden crisis situation and also because they are the future of medicine profession.¹¹

In view of vaccine hesitancy, medical/allied health sciences students can play an important role in mitigating the barriers fostering reluctance towards COVID-19 vaccination. It is important to capacitate medical youth with importance of vaccines during their course of education, considering them as future healthcare providers, who will be ultimately entrusted with counselling vaccine hesitant behaviours. In other words, positive attitude of medical/allied health sciences students towards COVID-19 vaccines could influence the vaccination decisions of general public in future.¹²

Therefore, as a first necessary step, it is important to understand the vaccination perception and extent of hesitancy & acceptance of medical/allied health sciences students towards COVID-19 vaccine and booster shots. Literature shows a couple of studies conducted on similar subject in Pakistan in recent past,^{13,14} but there is a lack of evidence on COVID-19 vaccine hesitancy among medical/allied health sciences students from province of Khyber Pakhtunkhwa. In lieu of which a cross sectional survey

was conducted in Khyber Pakhtunkhwa province to measure the extent of vaccine hesitancy and to determine associated factors among medical/allied health sciences students which will help in identifying the ways to improve vaccine acceptance among students in order to ultimately improve overall public acceptance of COVID-19 vaccination program.

2. Methodology

The study was designed as a cross-sectional survey, conducted online using Google survey platform in March 2021. The study was ethically approved from Advanced Studies Review Board (ASRB) Khyber Medical University, Peshawar. Study population comprised on medical and allied health sciences students studying in health sciences academic institutes at Khyber Pakhtunkhwa province. The institutes were selected on the basis of convenience, and permission was sought from registrars of academic institutions before data collection. Minimum required sample size of 400 was calculated using Epi-Info online sample size calculator, considering 47.0%¹⁴ vaccine hesitancy among medical student, 95% confidence level, 80% study power and 10% precision. Non-probability convenience sampling technique was used to collect data from medical/allied health sciences students enrolled at selected academic institutes. The web-based online link was provided to around 500 students to fill in the questionnaire via email, WhatsApp and/or social media network. Students voluntarily consented to participate in the study, and their identity was ensured to be protected. The questionnaire was adapted from published literature. It comprised of 20-items, divided in two parts, first seven questions were targeted to collect sociodemographic characteristics of participants, while remaining 13 questions were related to COVID-19 vaccine information, acceptance, trust towards imported and local vaccines, vaccine efficacy and safety, and perceived barriers.

The main outcome variable was vaccine hesitancy, measured by asking a closed ended question would you like to take the COVID-19 vaccine if/when available, with five possible options; definitely yes, yes but somewhat reluctant, definitely no, no but somewhat reluctant, and not sure. Percentage of participants who totally agreed to get vaccinated were considered as vaccination acceptors while all remaining were considered as vaccination hesitant. Study data was exported from Google-survey excel sheet to data analysis software. Analysis was performed by using STATA software, version 14.0.

Descriptive statistics of continuous variables was reported as mean/standard deviation, while for categorical variables frequency/percentages were used. The primary study outcome, vaccine hesitancy was reported in percentage. Univariate analysis for factors associated with vaccination hesitancy was done by using Chi-square test, and logistic regression was used to calculate odds ratios along with 95% confidence interval and p-values. A significance value of ≤ 0.05 will be considered significant in this study.

3. Results

Out of 800 invitations, 410 filled questionnaires were received with a response rate of 51.2%. After data cleaning, 12 entries were discarded due to incomplete responses, and final sample of 398 was considered for analysis. There were 398 medical and allied health sciences students who participated. The mean age was 22.6 ± 2.8 years, with range of 17–36 years. There were 193 (48.5%) males with mean age of 23.4 ± 2.7 years, whereas 205 (51.5%) females with mean age of 21.8 ± 2.7 years, among responders. There were 220 (55.3%) students from medical sciences including medicine and dentistry, while 178 (44.7%) were from allied health sciences including nursing, pharmacy and physiotherapy. Among medical students ($n = 220$), there were 66 (30.0%) males and 154 (70.0%) females with mean age of 22.4 ± 2.7 years. Similarly, among allied health sciences students ($n = 178$), there were 127 (71.3%) and 51 (28.7%) males and females respectively, with mean age of 22.9 ± 2.9 years. Summary characteristics of study responders are reported in [Table 1](#).

For measuring COVID-19 vaccine hesitancy and acceptance, the study participants were asked if they would agree to take the COVID-19 vaccine when available for the first time in Pakistan. Approximately half of the responders agreed that they will definitely take the COVID-19 vaccine upon availability, with a vaccine acceptance rate of 47.2%. On the other hand, 159 (39.9%) responders wanted to wait for some time before getting the vaccination against COVID-19 after initial availability, 24 (6.0%) responders were not sure whether they would agree to take the vaccination or not, and 27 (6.8%) refused to take the vaccine. Therefore, the vaccine hesitancy in this study was calculated to be 52.8%, which is quite high.

A significant relationship between vaccine hesitancy and gender was observed. Females were generally more hesitant to COVID-19 vaccine as compared to males (57.1% vs 42.9%, $p = 0.017$). Whereas, no significant relationship was found in terms of field of study (medical/allied), history of COVID-19 infection (yes/no) and year of study. [Fig. 1](#) shows vaccine hesitancy comparison with respect to gender, field of study and history of COVID-19 infection.

Simple group comparisons using Chi-Square test revealed significant association between vaccine hesitancy and gender ($p = 0.017$), adequate/inadequate information regarding vaccines ($p < 0.001$), confidence/distrust in western vaccines ($p < 0.001$), confidence/distrust in Chinese vaccines ($p < 0.001$), worriedness of getting infected after vaccination ($p < 0.001$), belief/disbelief in the fact that vaccination reduces chances to getting infected ($p < 0.001$), worriedness about vaccine side effects ($p < 0.001$) and belief/disbelief in the fact that COVID-19

Table 1. Sociodemographic characteristics of study responders ($n = 398$).

Characteristics	Overall ($n = 398$)	Field of Study	
		Medical ($n = 220$)	Allied Health Sciences ($n = 178$)
Mean Age (years)	22.6 ± 2.8	22.4 ± 2.7	22.9 ± 2.9
Age range (years)	17–36	17–32	18–36
Gender	Male	66 (30.0%)	127 (71.3%)
	Female	154 (70.0%)	51 (28.7%)
Province	KPK	182 (82.7%)	174 (97.8%)
	Punjab	23 (5.8%)	2 (1.1%)
	Federal ICT	19 (4.8%)	2 (1.1%)
Year of study	First	56 (25.5%)	1 (0.6%)
	Second	47 (11.8%)	40 (22.5%)
	Third	89 (22.4%)	48 (27.0%)
	Forth	72 (18.1%)	33 (18.5%)
	Fifth	62 (15.6%)	49 (22.3%)
House job/Internship	71 (17.8%)	28 (12.7%)	43 (24.2%)
History of COVID-19 infection	54 (13.6%)	36 (16.4%)	18 (10.1%)
History of chronic diseases	5 (1.3%)	1 (0.5%)	4 (2.2%)

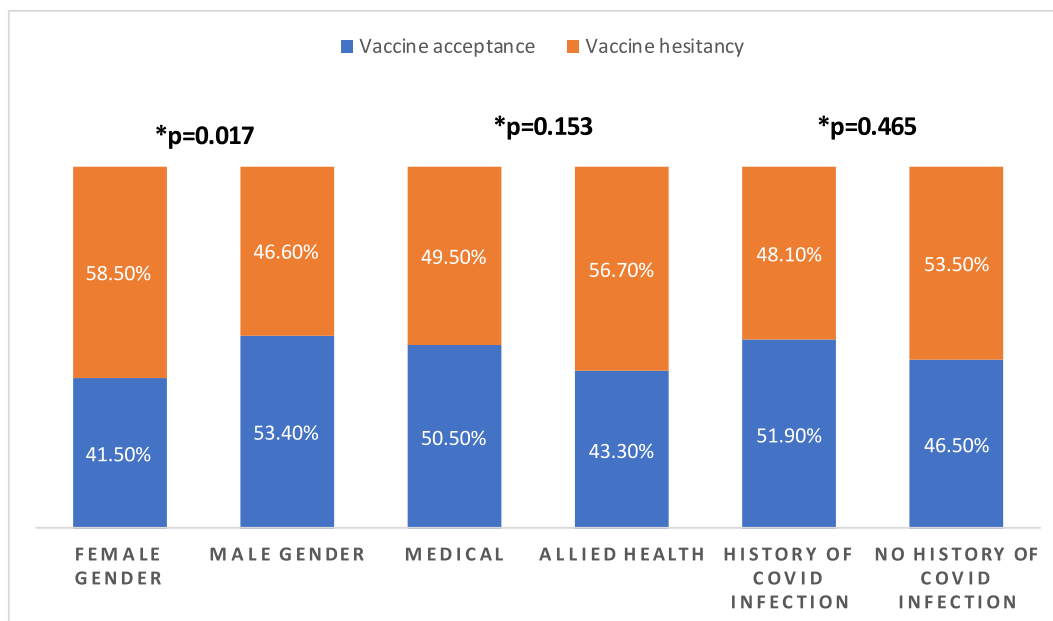


Fig. 1. Comparison of vaccine hesitancy/acceptance among gender, field of study and history of COVID-19 infection groups (*Chi-square p-values).

vaccination has some kind of inbuilt hidden agenda ($p < 0.001$).

Table 2 enlists responses to various questions related to knowledge/perceptions about COVID-19 vaccine and comparison with vaccine hesitancy. Overall, 118 (29.6%) responders believed to have adequate information regarding COVID-19 vaccines, whereas significantly lesser number of such believers belonged to vaccine hesitancy group (21.0% vs 39.4%, $p < 0.001$). For USA and UK manufactured imported COVID-19 vaccines, 108 (27.1%) responders were not confident in using those vaccines, and the number of unconfident responders was higher in vaccine hesitant group ($p < 0.001$). For China manufactured vaccine, 126 (31.6%) responders were not confident about the vaccines with significantly higher proportion belonging to vaccine hesitant group ($p < 0.001$).

It was found that 126 (31.6%) participants failed to agree with the fact that vaccination can be a good thing and one may feel less worried about getting infected with COVID-19, and significantly greater number of these responders were found to be vaccination hesitant ($p < 0.001$). There were about 31.5% responders who were not sure or disagreed with the statement that vaccination reduces the chance of getting COVID-19 infection and related complications, 80% of which belonged to vaccine hesitancy group ($p < 0.001$). About half of the responders, 209 (52.5%) strongly agreed and agreed with the worrisome of possible side-effects of vaccination interfering with routine activities, and

vaccination hesitant responders were more worrisome as compared to acceptors ($p < 0.001$). There were 277 (69.6%) and 281 (70.6%) responders who strongly agreed and agreed to be worried about vaccine efficacy and safety respectively, and these concerns were equally distributed among hesitant and acceptive group ($p = 0.819$, $p = 0.136$). It was found that 255 (64.0%) responders were concerned about fake vaccines, 229 (57.5%) were worried about cold chain maintenance, 152 (38.1%) were skeptical about permissibility of vaccination on religious grounds, and there was significant relationship between these factors and vaccine hesitancy. While 164 (41.2%) feared hidden motives behind eagerness of authorities to administer the vaccine freely and forcefully, and such individuals were more likely to be vaccine hesitant ($p < 0.001$).

Factors including male gender ($p = 0.018$), lack of adequate knowledge about vaccines ($p < 0.001$), Chinese origin of vaccines ($p < 0.001$), lack of knowledge that vaccination can reduce the chances of acquiring infection ($p < 0.001$), fear of potential side effects ($p < 0.001$) and hidden agenda behind free forceful vaccination ($p = 0.045$), were found to be main barriers or reasons responsible for COVID-19 vaccine hesitancy among medical and allied health sciences students.

Results of bivariate and multivariate logistic regression reporting odds ratios along with 95% confidence interval and p-values are given in Table 3. Males were 40% less likely to possess COVID-19 vaccine hesitancy as compared to females (OR = 0.6,

Table 2. Comparison of knowledge and perceptions about vaccines with attitude towards COVID-19 vaccination.

	Overall (n = 398)	Attitude towards COVID-19 vaccination		p
		Acceptance (n = 188)	Hesitancy (n = 210)	
You believe you have adequate information regarding the COVID19 Vaccine?				
• Yes	118 (29.6%)	74 (39.4%)	44 (21.0%)	<0.001
• No	101 (25.4%)	44 (23.4%)	57 (27.1%)	
• I am not sure	179 (45.0%)	70 (37.2%)	109 (51.9%)	
Confidence in using USA & UK manufactured imported COVID-19 vaccine?				
• Completely confident	50 (12.6%)	41 (21.8%)	9 (4.3%)	<0.001
• Confident	116 (29.1%)	83 (44.1%)	33 (15.7%)	
• Neutral	124 (31.2%)	44 (23.4%)	80 (38.1%)	
• Not confident	77 (19.3%)	15 (8.0%)	62 (29.5%)	
• Completely not confident	31 (7.8%)	5 (2.7%)	26 (12.4%)	
• I am not sure	179 (45.0%)	70 (37.2%)	109 (51.9%)	
Confidence in using China manufactured COVID-19 vaccine?				
• Completely confident	37 (9.3%)	30 (16.0%)	7 (3.3%)	<0.001
• Confident	97 (24.4%)	75 (39.9%)	22 (10.5%)	
• Neutral	138 (34.7%)	57 (30.3%)	81 (38.6%)	
• Not confident	95 (23.9%)	21 (11.2%)	74 (35.2%)	
• Completely not confident	31 (7.8%)	5 (2.7%)	26 (12.4%)	
• I am not sure	179 (45.0%)	70 (37.2%)	109 (51.9%)	
Vaccination is a good idea because I will feel less worried about catching COVID-19?				
• Strongly agree	85 (21.4%)	61 (32.4%)	24 (11.4%)	<0.001
• Agree	204 (51.3%)	107 (56.9%)	97 (46.2%)	
• Neutral	66 (16.6%)	14 (7.4%)	52 (24.8%)	
• Disagree	33 (8.3%)	4 (2.1%)	29 (13.8%)	
• Strongly disagree	10 (2.5%)	2 (1.1%)	8 (3.8%)	
• I am not sure	179 (45.0%)	70 (37.2%)	109 (51.9%)	
Vaccination decreases my chance of getting COVID-19 or its complications?				
• Strongly agree	85 (16.3%)	65 (34.6%)	20 (9.5%)	<0.001
• Agree	188 (47.2%)	98 (52.1%)	90 (42.9%)	
• Neutral	95 (23.9%)	21 (11.2%)	74 (35.2%)	
• Disagree	25 (6.3%)	3 (1.6%)	22 (10.5%)	
• Strongly disagree	5 (1.3%)	1 (0.5%)	4 (1.9%)	
• I am not sure	179 (45.0%)	70 (37.2%)	109 (51.9%)	
I am worried that the possible side-effects of COVID-19 vaccination would interfere with my routine activities?				
• Strongly agree	65 (16.3%)	25 (13.3%)	40 (19.0%)	<0.001
• Agree	144 (36.2%)	55 (29.3%)	89 (42.4%)	
• Neutral	110 (27.6%)	49 (26.1%)	61 (29.0%)	
• Disagree	70 (17.6%)	50 (26.6%)	20 (9.5%)	
• Strongly disagree	9 (2.3%)	9 (4.8%)	0 (0.0%)	
• I am not sure	179 (45.0%)	70 (37.2%)	109 (51.9%)	

(continued on next page)

Table 2. (continued)

	Overall (n = 398)	Attitude towards COVID-19 vaccination		p
		Acceptance (n = 188)	Hesitancy (n = 210)	
I am concerned about the efficacy of the COVID-19 vaccination?				
• Strongly agree	79 (19.8%)	36 (19.1%)	43 (20.5%)	0.819
• Agree	198 (49.7%)	96 (51.1%)	102 (48.6%)	
• Neutral	99 (24.9%)	44 (23.4%)	55 (26.2%)	
• Disagree	17 (4.3%)	10 (5.3%)	7 (3.3%)	
• Strongly disagree	5 (1.3%)	2 (1.1%)	3 (1.4%)	
I am concerned about the safety of the COVID-19 vaccination?				
• Strongly agree	100 (25.1%)	43 (22.9%)	57 (27.1%)	0.136
• Agree	181 (45.5%)	93 (49.5%)	88 (41.9%)	
• Neutral	75 (18.8%)	28 (14.9%)	47 (22.45)	
• Disagree	33 (8.3%)	18 (9.6%)	15 (7.1%)	
• Strongly disagree	9 (2.3%)	6 (3.2%)	3 (1.4%)	
I am concerned of the faulty/fake COVID-19 vaccine?				
• Strongly agree	124 (31.2%)	59 (31.4%)	65 (31.0%)	0.063
• Agree	131 (32.9%)	56 (29.8%)	75 (35.7%)	
• Neutral	80 (20.1%)	33 (17.6%)	47 (22.4%)	
• Disagree	54 (13.6%)	34 (18.1%)	20 (9.5%)	
• Strongly disagree	9 (2.3%)	6 (3.2%)	3 (1.4%)	
I am concerned about the Cold Chain maintenance of COVID-19 vaccine?				
• Strongly agree	67 (16.8%)	35 (18.6%)	32 (15.2%)	0.191
• Agree	162 (40.7%)	82 (43.6%)	80 (38.1%)	
• Neutral	143 (35.9%)	63 (33.5%)	80 (38.1%)	
• Disagree	23 (5.8%)	8 (4.3%)	15 (7.1%)	
• Strongly disagree	3 (0.8%)	0 (0.0%)	3 (1.4%)	
I am concerned about permissibility on religious grounds?				
• Strongly agree	44 (11.1%)	19 (10.1%)	25 (11.9%)	0.157
• Agree	108 (27.1%)	50 (26.6%)	58 (27.6%)	
• Neutral	116 (29.1%)	48 (25.5%)	68 (32.4%)	
• Disagree	89 (22.45)	45 (23.9%)	44 (21.0%)	
• Strongly disagree	41 (10.3%)	26 (13.8%)	15 (7.1%)	
There might be hidden motives behind eagerness of authorities to administer vaccine forcefully and free for all?				
• Strongly agree	60 (15.1%)	31 (16.5%)	29 (13.8%)	<0.001
• Agree	104 (26.1%)	44 (23.4%)	60 (28.6%)	
• Neutral	110 (27.6%)	38 (20.2%)	72 (34.3%)	
• Disagree	83 (20.9%)	45 (23.9%)	38 (18.1%)	
• Strongly disagree	41 (10.3%)	30 (16.0%)	11 (5.2%)	

95% CI 0.4–0.9, $p = 0.018$). Students who thought they had adequate information about COVID-19 vaccines, were 62% less likely to have vaccine hesitancy as compared to those who thought they are not well informed about COVID-19 vaccines (OR = 0.38, 95% CI 0.2–0.6, $p < 0.001$). Following the same pattern, students who strongly disagreed with the fact that vaccination reduces the complications of infection were found to be 10 times more hesitant as compared to students who strongly agreed with the same fact (OR = 10.1, 95% CI 2.0–51.3, $p = 0.005$). Similarly, students who strongly disagreed with the fact that vaccination actually reduces the chances of getting infected were found to be 13 times more likely to be vaccine hesitant (OR = 13.0, 95% CI 1.37–123.08, $p = 0.025$) as compared to those who strongly agreed with the fact. The COVID-19 vaccine hesitancy was about 5 times more commonly reported by students who had fear of vaccination side effects as compared to those who didn't had fear of side effects (OR = 4.7, 95% CI 2.6–8.4, $p < 0.001$). Students who considered that there is a hidden agenda behind COVID-19 vaccination campaign in Pakistan were 150% more likely to have vaccine hesitancy as compared to those who thought otherwise (OR = 2.5, 95% CI 1.08–6.00, $p = 0.032$). It was observed that 96% of the students who were completely confident about vaccines imported from western countries including United States and United Kingdom were not hesitant of vaccination as compared to those who were completely not confident about western vaccines (OR = 0.04 (0.13–0.14), $p < 0.001$). For multivariate regression, the model was built by considering all significant risk factors identified via bivariate regression. The pseudo-R square for present model was reported to be 0.495 ($p = 0.197$). It was noted that having adequate knowledge about vaccines reduced the vaccine hesitancy ($p = 0.012$), similarly confidence in Chinese vaccines also reduced vaccine hesitancy ($p = 0.004$). On the other hand, fear of side effects was positively associated with vaccine hesitancy ($p = 0.036$) and lack of knowledge that vaccine can reduce complications of infection was also found to be positively associated ($p = 0.011$, $p = 0.04$) with vaccine hesitancy among medical and allied health sciences students.

4. Discussion

The aim of current study was to assess rate of COVID-19 vaccine hesitancy among medical and allied health sciences students studying at academic institutions in province of Khyber Pakhtunkhwa. Healthcare staff can play an important role in

motivating uptake of vaccination among their patients and general public. As medical and allied health sciences students are future force of healthcare human resource, its very important to assess vaccine hesitancy existing in this population and also to identify potential barriers or reasons owing to it. This would provide basis for designing and implementing strategies in future to improve vaccine acceptance in medical and health sciences students.

The results of this study reported vaccine hesitancy rate of 47.2% among medical and health sciences students of Khyber Pakhtunkhwa province. The data identified certain factors and barriers that might be responsible for COVID-19 vaccine hesitancy, including female gender, lack of adequate knowledge about vaccines ($p < 0.001$), Chinese origin of vaccines ($p < 0.001$), lack of knowledge that vaccination can reduce the chances of acquiring infection ($p < 0.001$), fear of potential side effects ($p < 0.001$) and hidden agenda behind free forceful vaccination ($p = 0.045$).

The vaccine hesitancy reported in our study is relatively higher as compared to some other studies reported in the literature, the reason for which can be the time at which we conducted our study, that is March 2021 when COVID-19 vaccination campaign was newly launched in Pakistan and many uncertainties about COVID-19 vaccines safety/efficacy existed. Literature reported highest hesitancy rates initially when concept of COVID-19 vaccination was new, and most of the healthcare workers, students and general population was skeptical about it, which was diluted to some extent as time passed by and COVID-19 vaccine became more acceptable.¹⁶ A systematic review published by Mustapha T et al.¹⁷ reported pooled vaccine hesitancy of 18.5% among students and trainees of various healthcare professions. Other studies conducted by Jain J et al.¹⁸ in India, Saied SM et al.¹⁸ in Egypt, Lucia VC et al.¹⁵ in USA, Barello A et al.¹⁹ in Italy, Mahdi BM et al.²⁰ in Iraq and Tavalacci MP²¹ et al. in France, reported COVID-19 vaccine hesitancy of 10.3%, 46%, 23.0%, 13.9%, 65.2% and 42.0% respectively among medical students.

In our study gender was identified to be associated with vaccine hesitancy. Females were found to be more hesitant towards COVID-19 vaccination as compared to males (57.1% vs 42.9%, $p = 0.018$). Similar findings were reported in another study, where female gender was found to be more vaccine hesitant as compared to males (OR = 2.09, 95% CI 1.22–2.17, $p < 0.001$). Where as other studies reported no association between gender and vaccine hesitancy.^{18,19} Second most commonly reported

Table 3. Bivariate and multivariate regression analysis of participant characters associated with vaccine hesitancy.

Characteristics	Bivariate analysis		Multivariate analysis	
	OR (95% CI)	p-value	OR (95% CI)	p-value
• Gender				
Male	0.6 (0.41–0.92)	0.018	0.9 (0.57–1.65)	0.914
Female	Reference		Reference	
• Adequate information about vaccines				
Yes	0.38 (0.23–0.61)	<0.001	0.4 (0.23–0.83)	0.012
Neutral	0.8 (0.50–1.36)	0.466	0.5 (0.29–1.07)	0.083
No	Reference		Reference	
• COVID vaccination has a hidden agenda				
Strongly agree	2.5 (1.08–6.00)	0.032	0.6 (0.47–5.48)	0.440
Agree	3.7 (1.68–8.21)	0.001	2.8 (0.89–9.40)	0.077
Neutral	5.1 (2.33–11.4)	<0.001	2.6 (0.83–8.11)	0.099
Disagree	2.3 (1.02–5.20)	0.045	1.6 (0.51–5.44)	0.387
Strongly disagree	Reference		Reference	
• Fear of side effects				
Agree	4.7 (2.64–8.42)	<0.001	2.2 (1.05–4.85)	0.036
Neutral	3.7 (1.98–7.01)	<0.001	2.4 (1.07–5.58)	0.033
Disagree	Reference		Reference	
• Confidence in USA/UK vaccines				
Completely confident	0.04 (0.13–0.14)	<0.001	0.2 (0.049–1.04)	0.057
Confident	0.07 (0.02–0.21)	<0.001	0.2 (0.07–1.08)	0.065
Neutral	0.3 (0.12–0.97)	0.045	0.6 (0.17–2.37)	0.506
Not confident	0.7 (0.26–2.41)	0.685	1.2 (0.29–5.29)	0.763
Completely not confident	Reference		Reference	
• Confidence in Chinese vaccines				
Completely confident	0.04 (0.01–0.15)	<0.001	0.2 (0.04–1.06)	0.059
Confident	0.05 (0.01–0.16)	<0.001	0.1 (0.03–0.53)	0.004
Neutral	0.2 (0.09–0.75)	<0.012	0.4 (0.11–1.58)	0.203
Not confident	0.6 (0.23–1.98)	0.477	0.6 (0.16–2.78)	0.593
Completely not confident	Reference		Reference	
• Knowledge that vaccination reduces chances of infection				
Strongly agree	Reference		Reference	
Agree	2.9 (1.67–5.31)	<0.001	1.6 (0.72–3.57)	0.243
Neutral	11.4 (5.70–22.90)	<0.001	2.7 (0.99–7.51)	0.050
Disagree	23.8 (6.45–87.91)	<0.001	3.2 (0.51–20.00)	0.209
Strongly disagree	13.0 (1.37–123.08)	0.025	0.9 (0.03–28.08)	0.978
• Knowledge that vaccination reduces complications of infection				
Strongly agree	Reference		Reference	
Agree	2.3 (1.33–3.97)	0.003	1.2 (0.58–2.61)	0.574
Neutral	9.4 (4.43–20.10)	>0.001	2.7 (0.94–8.07)	0.063
Disagree	18.4 (5.85–58.02)	>0.001	7.9 (1.59–39.31)	0.011
Strongly disagree	10.1 (2.01–51.36)	0.005	11.8 (1.11–125.91)	0.04

barrier towards COVID-19 vaccine acceptance was lack of adequate knowledge about the vaccines. In our study lack of knowledge accounted for 62% more likelihood of vaccine hesitancy as compared to adequate knowledge (OR = 0.38, 95% CI 0.2–0.6, $p < 0.001$). In a study by Jain J et al.¹⁸ lack of awareness was found to be associated with COVID-19

vaccine hesitancy (OR = 4.08, 95% CI 1.97–8.45, $p < 0.001$). A study reported that among vaccine acceptance group, there were 45.9% of responders who rated their level of knowledge to be good, as compared to 31.8% who self-rated low level of knowledge ($p < 0.001$); whereas among vaccine hesitant group, 45.5% responders self-rated their

knowledge to be bad as compared to 23.8% who believed to have good knowledge about vaccines ($p < 0.001$).¹⁸

Medical and healthcare students are expected to be aware of the fact that the process of vaccination reduces chances of acquiring infection as it helps to build antibodies against the virus thus enhancing immunity. In this study there were 31.5% (125/398) students who were neutral or disagreed with the formerly stated fact, and 80% (100/125) of such students were found to be vaccine hesitant, demonstrating 10 folds higher risk of being hesitant (OR = 10.1, 95% CI 2.0–51.3, $p = 0.005$). Similarly, a study conducted in Italy reported comparable results, where the author reported similar hesitancy rates among medical and non-medical students ($p = 0.097$) when in reality they had expected different results because medical and allied health sciences students are supposed to have higher literacy of mechanism of vaccination process and other health-related issues.¹⁹ This might be due to the fact that not much emphasis is being given in medicine and health sciences curricula about importance and utility of vaccines in fight against infectious diseases.²²

Fear of side effects and vaccine efficacy is another important predictor highlighted in literature to have influence on vaccine hesitancy.²³ In present study, fear of vaccine side effects turned out to be a reason for vaccine hesitancy with an odds of 4.7 (95% CI 2.6–8.4, $p < 0.001$). The study conducted in France reported both the safety and efficacy of vaccines to be associated with vaccine acceptance and rejection. It was reported that medical and allied health sciences students who were confident about vaccine efficacy were less likely to be hesitant (OR = 0.61, 95% CI 0.58–0.65, $p < 0.001$), similarly students who were not afraid of vaccine side effects had a lower vaccine hesitancy (OR = 0.57, 95% CI 0.54–0.60, $p < 0.001$).²¹

Hidden motives behind free, mass vaccination campaigns are also found to be one of the predictor factors of vaccine hesitancy not only in developing but also in developed countries like united states.²⁴ In present study, fear of hidden motives and hidden agenda linked with COVID-19 vaccination was found among medical and allied health sciences students. Students with these perceptions were twice more likely to be vaccine hesitant as compared to those who did not perceive COVID-19 vaccination as a part of some hidden agenda (OR = 2.30, 95% CI 1.02–5.2, $p = 0.045$). The reason can be a general mistrust between general population and health organizations especially pharmaceutical companies who are doubted to be more profit-making than concerned with human health

generally. Other than that, increased spreading of vaccine misinformation via social media can also be a reason to build mistrust towards healthcare which is believed to be associated with vaccine hesitancy.²⁵ No other study, conducted on medical students, highlighted association between vaccine hesitancy and conspiracy beliefs but studies on general population reported significant relationship between negative attitude towards vaccines and skepticism or conspiracy beliefs.²⁶

Some of the study limitations include small sample size and low response rate, which might have incorporated selection and information bias. Positive attributes of the study include rich sampling frame from all over Peshawar and Khyber Pakhtunkhwa and no other local study was found to be conducted to address the current issue. A more robust study can be conducted in future to capture data from all over Pakistan which will help in getting a wider picture and understanding of COVID-19 vaccine hesitancy among medical/allied health sciences students.

In the end it is emphasized that medical and allied healthcare students can be a good target for vaccine educational campaigns as they are in training phase and are pen to change. It is very important to understand student's perceptions about vaccines so that they can be guided, supported and prepared for engagement in implementing strategies against vaccine hesitancy. It is reflected upon that in order to achieve better synergy between health care students/professionals and the general public it is required to improve medical education to students during education and training as there exists a gap between population health and preventive medicine in curricula of most of medical universities in developing countries.²⁷

5. Conclusion

A fairly high rate of vaccine hesitancy has been reported in this study. Important associated barriers with COVID-19 vaccine hesitancy included gender, lack of information, fear of side effects, lack of trust in imported and Chinese vaccines, and perception of hidden agenda behind COVID-19 vaccination.

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There is no conflict of interest to be reported for any author.

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