

Medical students in Karachi and COVID-19: Myths and facts

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Abstract

Objectives: COVID-19 pandemic brought mortalities, morbidities, fear, and financial despair among people around the world. As it advanced, misinformation and myths about it caught wildfire, contributing to misbelief among the already shocked population. Medical students are the building blocks of the medical community and can provide a pivotal role in combating COVID-19 misinformation by delivering correct knowledge and awareness to the non-medical population of the country. Hence, it is important to assess their knowledge and perception of COVID-19 myths. Therefore, this study evaluates medical student's knowledge regarding myths and misinformation related to COVID-19 infection and its vaccine. The study also assesses the belief of medical students on various conspiracy theories of COVID-19.

Methods: An online cross-sectional survey was conducted among 401 undergraduate medical students of Karachi in June–August 2021. A validated, structured, and self-administrated questionnaire was used for data collection. The data were entered on an open EPI version 3.01 and Statistical Package of Social Science version 26 for analysis. A chi-square test was performed to identify determinant factors. All p-values less than 0.05 were considered significant.

Results: Overall knowledge score of participants about myths and misinformation related to COVID-19 and its vaccine was as follows: 166 (28.9) participants possess good knowledge, while 167 (41.6) and 118 (29.4) had moderate to poor knowledge, respectively. Senior students, vaccinated, and participants infected by COVID-19 had good to moderate knowledge. Overall, 139 (34.7) participants strongly disagree and 103 (25.7) participants somewhat disagree with conspiracy theories related to COVID-19. Absence of belief in the conspiracies is associated with vaccinated participants.

Conclusion: The study shows that most medical students possess adequate knowledge of misinformation about COVID-19 and its vaccines, and have low belief in conspiracy theories of COVID-19.

Keywords

Medical students, conspiracy theories, misinformation, COVID-19, knowledge

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Introduction

Coronavirus also known as COVID-19 was first reported in Wuhan, city of China and then got spread all over the world.¹ It infected about 121 million people, and as per estimated figures, 2.5 million people have lost their lives due to COVID-19 to date.² Around 50,000 cases were reported in Pakistan by the end of April 2020, and the mortality rate was 1.4% among them.³ A developing country such as Pakistan faced significant economic, health, and social crises generated by the COVID-19-induced lockdown. The apparent increase in suicide cases was observed across the country due to lockdown-related economic recession.⁴ Furthermore, a high workload due to rising COVID-19 cases and

inadequate health resources produced burnout and anxiety among healthcare field workers.⁵ Control on the spread of disease is possible if reliable and authentic information

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from trusted sources is provided at public level.⁶ Misinformation on public health issues, usually as a result of unfounded stories, conspiracy theories, and pseudo sciences circulating on social media, misleads people.⁷ The general population pays three times more attention to fake information on social media rather than the verified one and considers it as an authentic source, which contributes to health-related rumors.⁸ Especially in Pakistan, where a low health literacy rate, lack of knowledge, poverty, and underdeveloped scientific thought of public sector strengthens these types of cultural misbelief rather than scientific evidence.⁹ Recently, the polio vaccine campaign received strict opposition by the religious extremists because of the conspiracy associated to vaccine, such as risk of castration and sterility, following vaccination.¹⁰ Consequently, despite the endless effort of the government, Pakistan is still not a polio-free country.¹⁰

Now, COVID-19 being a pandemic has become a subject of interest on the social media; therefore, there has been a significant increase in misinformation about it. Rising misinformation and conspiracies led the Director-General of the World Health Organization (WHO) to state that “We’re not just fighting an epidemic; we’re fighting an infodemic. Fake news spreads faster and more easily than this virus, and is just as dangerous.” Currently, widespread conspiracies regarding COVID-19 and its vaccine have emerged in Pakistan, some of which are that these vaccines are aimed to depolarize Muslims, the pandemic is bioengineered, or its God’s punishment.¹¹ Also, misinformation related to COVID-19 disease treatment, such as the use of garlic water, keeping the throat continuously moist, or use of hand dryer have been trending on different social media platforms in this region.¹¹ Belief in misinformation regarding COVID-19 negatively impacts the people’s perception about it. Evidence shows that a strong belief in these conspiracy theories among public is associated with less self-compliance on healthcare guidelines and unwillingness to get vaccinated.¹² A study conducted on young adult population in Pakistan narrates the deficit of awareness about COVID-19 severity in urban settings of the country, even though the majority of its population acknowledges the mode of transmission of COVID-19 and takes precautionary measures to avoid infection, half of the population perceives COVID-19 as a common flu.¹³

To counter this ripple effect, undergraduate medical students are the resources that can alleviate the burden of community; they can play a potentially active and impactful role in providing pertinent education about COVID-19 to the community and spread awareness.¹⁴ However, before taking above in account, it is mandatory to assess whether medical students possess adequate knowledge on COVID-19 or not. Therefore, the current study is designed to evaluate the understanding of medical students toward the myths and misinformation related to COVID-19. The study will also evaluate beliefs in conspiracy theories regarding COVID-19 among medical students.

Method

This is a cross-sectional online survey conducted among undergraduate medical students from different medical universities of Karachi, Pakistan from 26 June to 1 August 2021. A non-probability convenient sampling technique is used for the data collection process. The current study was conducted in accordance with the declaration of Helsinki. Ethical approval to perform the survey was granted by the United Medical and Dental College, Karachi. The study includes undergraduate medical students from all respective 5 years, enrolled in Bachelor of Medicine and Bachelor of Surgery (MBBS) program. Medical students enrolled other than the MBBS program and medical students volunteering in the COVID-19 centers of Karachi were excluded from the study. The sample size calculated on an open Epi calculator was 373 to achieve with the confidence of 95%, a margin error of 5%, response distribution 50%, and population size around 12,000 for the present entry. However, total of 410 medical students were reached and 401 complete responses were collected with a response rate of 97%.

Data collection procedure

COVID-19 pandemic has closed the doors of routine academic activities, movement restrictions, social distancing, and isolation. Thus, keeping in consideration of the current situation, the data were collected using an online questionnaire developed by means of Google Forms. However, to maintain the integrity of the study, each medical student individually got approached for the survey via WhatsApp, emails, and personal contact, which were obtained from medical colleges’ WhatsApp groups or from other platforms. A brief explanation of the motive of the study and directions to fill the survey were given, and a written informed consent on Google Forms was taken from all study participants prior to filling the questionnaire. The participation in this study was entirely voluntary, and each of the participants had the right to withdraw from the study in between if they were not willing to proceed.

Study instrument

The questionnaire is divided into four portions; (1) demography questions; (2) questions on belief in COVID-19, Vaccine willingness, and source for information regarding COVID-19; (3) statements on myths and misinformation related to COVID-19, and its vaccines (M1-11, V1-7); and (4) statements on conspiracy theories regarding COVID-19 (C1-5).

The questionnaire (M1–11, V1–7) that assesses knowledge and understanding on COVID-19’s associated myth and misinformation was designed according to already published literature, guidelines on COVID-19-related myths available on WHO, and myths related to vaccine on Hopkins Medicine platform.^{11,15,16} There are 18 statements on “myths

Table 1. Demography.

Variables	Frequency (n = 401)	%
Gender		
Male	105	26.2
Female	296	73.8
Academic year		
First	37	9.2
Second	132	32.9
Third	150	37.4
Fourth	41	10.2
Fifth	41	10.2
Current COVID-19 status		
Infected	18	4.5
Uninfected	306	76.3
Don't check	77	19.2
Current COVID-19 vaccine status		
Vaccinated	286	71.3
Not vaccinated	115	28.7

and misinformation related to COVID-19 and its vaccines” (M1–11, V1–7), and each has three options (TRUE/DON'T KNOW/FALSE). For each statement, participant scored one on the correct answer (*false*) and zero for the wrong answer (*doesn't know* or *true*). Knowledge of participants was categorized based on the modified blooms cut-off point into good ($\geq 75\%$: 18–13.5), moderate (74–50%: 13.4–9), and poor ($< 50\%$: < 8.9).¹⁷ To measure medical student belief on conspiracy, we presented five statements (C1–5) related to prevalent conspiracy theories on COVID-19 all around the world, that is, COVID-19 is bioweapon, released to create global surveillance state through vaccine program, etc.¹⁸ However, keeping in view that conspiracy may vary among communities under cultural and regional influence, the study also includes conspiracy theories on COVID-19 regulating in Pakistan.^{11,19} All conspiracy statements consisted of five-point Likert-type scale ranging from *strongly agree* = 1 to *strongly disagree* = 5. Overall belief on conspiracy theories was determined by computing the mean of all five statement's response of each participant and dividing the overall weighted mean into five categories (intervals), that is, *strongly agree* (1.00–1.79), *somewhat agree* (1.80–2.59), *neither agree nor disagree* (2.60–3.39), *somewhat disagree* (3.40–4.19), and *strongly disagree* (4.20–5.00).²⁰

Instrument reliability and validity

Two senior faculty members from the institute examined the questionnaire's content and constructed validity by reviewing it. Homogeneity in items was eliminated, items were rephrased to make them clear and easily comprehensible, double-barreled questions, any writing, and any grammatical error were removed. The pilot study was performed on 50 participants to test questionnaire reliability using the Cronbach's alpha test. The reliability obtained was $\alpha = 0.837$.

However, the reliability of conspiracy statements (C1–5) separately calculated is $\alpha = 0.833$.

Statistical analysis

The Statistical Package of Social Science (SPSS) version 26.0 (IBM Corporation, Armonk, NY, USA) was applied to analyze the data. Demographic characteristics of participants were presented by applying descriptive statistics. Frequency and percentage are computed for all categorical variables, and the mean and standard deviation of individual conspiracies is demonstrated. A chi-square test was performed to investigate the comparison between different categorical values. All p-values less than 0.05 were considered significant.

Results

In our study, a total of 401 undergraduate medical students were participated; around three-quarters, 296 (73.8%), of participants were female as illustrated in Table 1. Majority of the participants were from second (n = 132; 32.9%) and third (n = 150; 37.4%) academic year, and two-thirds, 286 (71.3%), of total participants were vaccinated against COVID-19. However, 18 (4.5%) participants out of the total were infected by the COVID-19 virus.

Social media (371 (92.5%)) and television (266 (66.3%)) are the most commonly stated platforms that deliver information regarding COVID-19. The least stated sources of information are medical colleges (153 (38.1)) and others (13 (3.2)) (Figure 1). Nearly, all of the participants (390 (97.2)) believe COVID-19 as a pandemic, 380 (94.8) admitted the existence of COVID-19 in Pakistan and majority (359 (89.5)) showed willingness to get vaccinated against COVID-19 (see Table 2). Those participants 41 (10.2) who did not intend

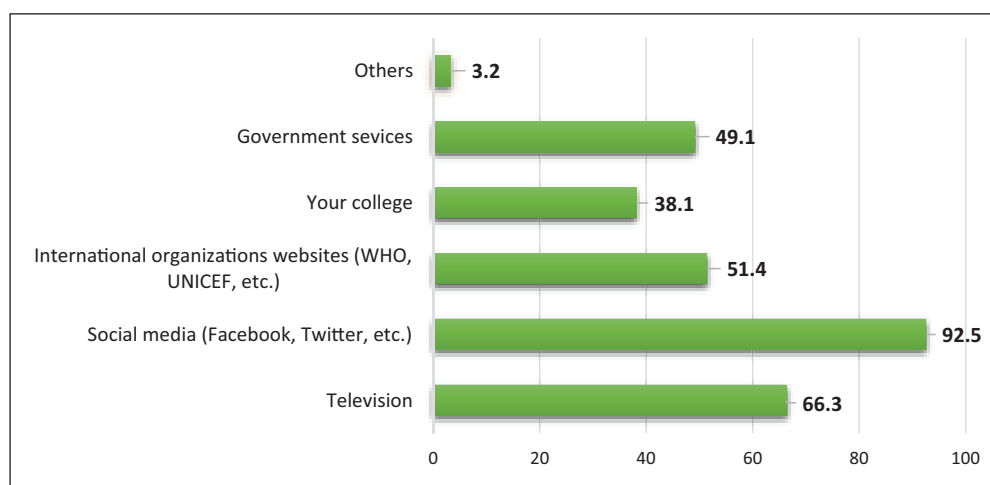


Figure 1. Source of information regarding COVID-19.

Table 2. Knowledge of participants on various misinformation related to COVID-19 and its vaccine.

No.	Statements	Frequency and percentage n (%)		
		Yes	Possibly	No
B.	Statement on believe in COVID-19 and willingness to get vaccinated	Yes	Possibly	No
1	Do you believe COVID-19 as pandemic?	390 (97.2)	10 (2.5)	1 (0.2)
2	Do you believe COVID-19 currently present in Pakistan?	380 (94.8)	19 (4.7)	2 (0.5)
3	Are you willing to get vaccinated?	359 (89.5)	11 (2.7)	30 (7.5)
M.	Statements on COVID-19 misinformation	True	Don't know	False
M1	A person will die as soon as this novel corona virus infects the person. (False)	29 (7.2)	25 (6.2)	347 (86.5)
M2	Adding hot spices to your meal can cure COVID-19 as its open nasal passage. (False)	25 (6.2)	116 (28.9)	260 (64.8)
M3	The number of COVID-19 cases being showed online is not accurate. (False)	155 (38.7)	152 (37.9)	94 (23.4)
M4	Consumption of herbal medicine can prevent infection or kill corona virus. (False)	41 (10.2)	165 (41.1)	195 (48.6)
M5	Corona virus only affects older people and cannot affect younger ones. (False)	17 (4.2)	18 (4.5)	366 (91.3)
M6	A hot shower can prevent and even stop the rapidly spreading corona virus disease. (False)	39 (9.7)	107 (26.7)	255 (63.6)
M7	The COVID-19 virus spreads faster in cold and is killed in hot and humid environment. (False)	87 (21.7)	97 (24.2)	217 (54.1)
M8	Hydroxychloroquine is a medicine that can be used to cure COVID-19. (False)	73 (18.2)	214 (53.4)	114 (28.4)
M9	Holding breath for 10s can be used to diagnose COVID-19. (False)	86 (21.4)	112 (27.9)	203 (50.6)
M10	Thermal scanners can detect the COVID-19. (False)	68 (17)	137 (34.2)	196 (48.9)
M11	COVID-19 is less dangerous than portrayed on media platforms. (False)	82 (20.4)	64 (16)	255 (63.6)
V.	Statement on COVID-19 vaccine misinformation	True	Don't know	False
V1	Researchers rush in developing the COVID-19 vaccine, so its safety and efficacy cannot be trusted. (False)	106 (26.4)	136 (34.7)	155 (38.7)
V2	If I've already had COVID-19, I don't need a vaccine. (False)	38 (9.5)	56 (14)	306 (76.3)
V3	Getting the COVID-19 vaccine mean stop taking COVID-19 precautionary measures. (False)	29 (16.5)	36 (29.4)	335 (53.9)
V4	The side effects of the COVID-19 vaccine are dangerous. (False)	66 (16.5)	118 (29.4)	216 (53.9)
V5	Vaccine enters into your cells and mutates your DNA (False)	44 (11)	132 (32.9)	224 (55.9)
V6	The COVID-19 vaccine can affect fertility. (False)	31 (7.7)	131 (32.7)	238 (59.4)
V7	Pneumonia vaccines can prevent the infection of this novel virus. (False)	25 (6.2)	137 (34.2)	238 (59.4)

to receive COVID-19 vaccine 30 (7.7), or were confused on vaccination decision 11 (2.7) shared a common reason that “I do not think this currently available vaccine is effective against COVID-19, hence waiting for higher efficacy vaccines” 22 (5.5), “I am afraid of vaccine that I may get sickness after vaccination” 15 (3.7); and “I think COVID-19 is not a severe disease, so it is better to develop natural immunity by using herbal medicine” 5 (1.2).

Overall knowledge score of participants about myths and misinformation related to COVID-19 and its vaccine revealed that 166 (28.9) participants possess good knowledge, while 167 (41.6) and 118 (29.4) had moderate to poor knowledge, respectively (see Figure 2). The mean knowledge score among all participants was 10.5 (SD=4.4, ranging 0–18), which is a moderate level of knowledge. About half of the participants know that consumption of herbal

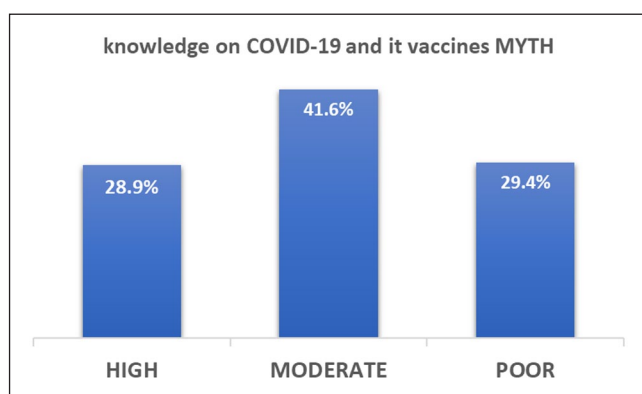


Figure 2. Overall knowledge of participants on myths and misinformation related to COVID and its vaccine.

medicine could not prevent COVID-19 (195 (48.6)), thermal scanner cannot detect COVID-19 (196 (48.9)), and holding breath for 10s cannot be used for the diagnosis of COVID-19 (203 (50.6)) (see Table 2). Only a quarter are aware of the fact that the number of the cases shown on media are accurate (94 (23.4)), and hydroxychloroquine medicine cannot cure COVID-19 (114 (28.4)). Similarly, about the COVID-19 vaccine, quarter of the study population think that the researcher rushes in developing the COVID-19 vaccine, so its safety and efficacy are trusted (106 (26.4)) (see Table 2). Participants from the fourth and fifth academic year and participants infected by COVID-19 were less likely to acquire poor level of knowledge than other participants. Similarly, vaccinated participants had good to moderate knowledge compared to non-vaccinated ones (see Table 3).

Overall belief score on conspiracy theories on COVID-19 among participants narrated that most participants did not believe in conspiracies regarding COVID-19, that is, 139 (34.7) participants strongly disagree and 103 (25.7) participants somewhat disagree with conspiracy theories. Whereas a few participants *somewhat agree* (59 (14.7)) and *strongly agree* (17 (4.2)) on it, 83 (20.7) participants showed a neutral response (see Figure 3). The mean conspiracy belief score among all participants was 3.52 (SD=1.02, ranging from 1 to 5); *somewhat disagree*. An individual question means range from 3.10 to 4.10 (SD=± 1.444–1.282) (see Table 4). Absence of belief on COVID-19 conspiracy theories strongly associated with vaccinated participants (see Table 5).

Discussions

In our study, we tried to evaluate the medical student’s knowledge about COVID-19 and whether they believed

Table 3. Comparison between knowledge on misinformation and different study variables.

Variable	Knowledge, n (%)			p value
	Poor	Moderate	High	
Gender				
Male	36 (34.3)	43 (41)	26 (24.8)	0.366 (NS)
Female	82 (27.7)	124 (41.3)	90 (30.4)	
Year of study				
First	10 (27)	19 (51.4)	8 (21.6)	0.014
Second	45 (34.1)	46 (34.8)	41 (31.1)	
Third	53 (35.3)	59 (39.3)	38 (25.3)	
Fourth	6 (14.6)	22 (53.7)	13 (31.7)	
Fifth	4 (9.8)	21 (51.0)	16 (39)	
Current COVID-19 status				
Infected	4 (22.4)	8 (44.4)	6 (33.3)	0.003
Not infected	81 (26.5)	124 (40.5)	101 (33)	
Didn’t check	33 (42.9)	35 (45.5)	9 (11.8)	
COVID-19 vaccine status				
Vaccinated	72 (25.2)	126 (44.1)	88 (30.8)	0.013
Not vaccinated	46 (40)	41 (35.7)	28 (24.8)	

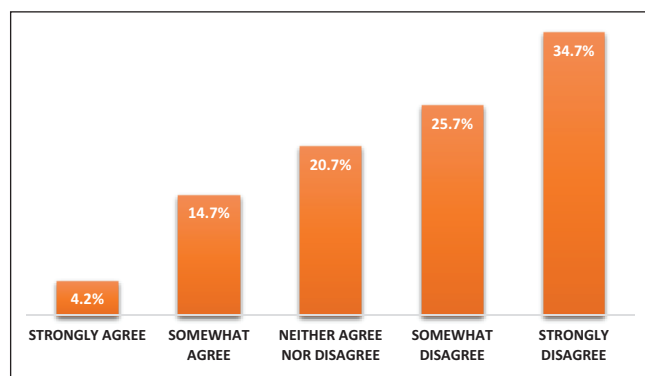


Figure 3. Overall belief of participants on different conspiracy theories of COVID-19.

these newsfeeds/social myths in our society. Medical students are at the beginner's level of medical fraternity, and non-medical people in a community tend to rely on these future doctors for health-related information. Thus, the thought process was to evaluate whether medical students, due to the influence of their medical background, possess adequate and correct knowledge regarding COVID-19 myth to intervene others about it or not. Our study reported that 92% of medical students used social media to learn about a pandemic rather than medical school teaching or other authenticated sources. Similarly, COVID-19 survey studies performed on medical students and the general public in Pakistan narrate social media and television as a substantial source for learning about COVID-19.^{13,21–23} Electronic media provide a knowledge platform for everyone and play an integral role in spreading awareness to control it. However, the downside of it often gives inappropriate and false information regarding COVID-19 infection and, similarly, accompanying false precautions.¹⁸

We believe that majority of our medical students have overall good knowledge regarding the myths and facts related to COVID-19 infection, which is relatively consistent with the result of different Knowledge, Attitude, and Practice (KAP) surveys of COVID-19 among undergraduate medical students of Pakistan.^{13,21,24} Furthermore, medical students have a higher level of knowledge in comparison with the general population of Pakistan.²⁵ However, most COVID-19-related KAP studies done in Pakistan focus on basic COVID-19 information that helps to guide individuals to practice COVID-19-related public health interventions (e.g. use of facemask, hand wash or sanitizer, etc.). The compliance on such intervention merely depends on the belief and perception of a person about that topic.¹² In contrast, our study shows susceptibility to misinformation and conspiracies among undergraduate medical students of Karachi, Pakistan. Regardless of overall good knowledge, 50% of study participants (medical students) consider some misconceptions as valid, such as thermal scanner can detect COVID-19, use of herbal therapies can cure infected patient, and holding your breath for 10 s can detect COVID-19 infection.

Table 4. Belief of study participants on different conspiracy theories of COVID-19.

No.(C)	Statement	Frequency (n) and percentage (%)					M	SD±
		Strongly agree, n (%)	Somewhat agree, n (%)	Neither agree nor disagree, n (%)	Somewhat disagree, n (%)	Strongly disagree, n (%)		
C1	Pakistani people have better immunity than Americans; that is why they are unaffected.	60 (15)	115 (28.7)	72 (18)	45 (11.2)	109 (27.2)	3.07	1.444
C2	World superpowers use it as cover to launch a vaccination program to facilitate a global surveillance regime and establish one world order.	47 (11.7)	106 (26.4)	106 (26.4)	45 (11.2)	97 (24.2)	3.10	1.345
C3	COVID-19 virus is a bioweapon released deliberately by the Chinese government to control the world's population.	25 (6.2)	81 (20.2)	110 (27.4)	65 (16.2)	120 (29.9)	3.43	1.277
C4	Pandemic is a hoax perpetrated by a global to diverge Muslim belief by shutting down mosques.	24 (6)	39 (9.7)	91 (22.7)	46 (11.5)	201 (50.1)	3.90	1.285
C5	COVID-19 has not come to Pakistan; the Pakistani Government shows fake number of COVID-19 patients to get the foreign funds.	27 (6.7)	27 (6.7)	61 (15.2)	33 (8.2)	253 (63.1)	4.14	1.282

Table 5. Comparison of overall belief in conspiracy theories and different study variables.

Variable	Belief in conspiracy theories regarding COVID-19					p value
	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	
Gender						
Male	6 (5.7)	18 (17.1)	24 (22.9)	28 (26.7)	29 (27.6)	0.44 (NS)
Female	11 (3.7)	41 (13.9)	59 (19.9)	75 (25.3)	110 (37.2)	
Year of study						
First	3 (8.1)	4 (10.8)	14 (37.8)	6 (16.2)	10 (27)	0.98 (NS)
Second	5 (3.8)	16 (12.1)	34 (25.8)	30 (22.7)	47 (35.6)	
Third	9 (6)	24 (16)	23 (15.3)	46 (30.7)	48 (32)	
Fourth	0 (0)	8 (19.5)	6 (14.6)	10 (24.4)	17 (41.5)	
Fifth	0 (0)	7 (17.1)	6 (14.6)	11 (26.8)	17 (41.5)	
Current COVID-19 status						
Infected	3 (16.7)	2 (11.1)	3 (16.7)	3 (16.7)	7 (38.9)	0.52 (NS)
Not infected	8 (2.6)	47 (15.4)	59 (19.3)	81 (26.5)	111 (36.3)	
Didn't check	6 (7.8)	10 (13)	21 (27.3)	19 (24.7)	21 (27.3)	
COVID-19 vaccine status						
Vaccinated	9 (3.1)	37 (12.9)	52 (18.2)	80 (28)	108 (37.8)	0.012
Not vaccinated	8 (7)	22 (19.1)	31 (27)	23 (20)	31 (27)	

Relying on misinformation like these could negatively impact controlling COVID-19, such as inadequate detection of the virus among the population due to avoidance of getting tested for COVID-19 and not seeking treatment if infected.

Only 7.7% of our study participants exhibited non-willingness toward COVID-19 vaccination. The anti-vaccine behavior of the general population of Pakistan reported by Arshad et al.²² is comparatively six times higher than the medical students. Surprisingly, regardless of these figures, both ours and Arshad et al.'s studies notice the same prevalent misinformation among study population for their anti-vaccine behavior. The non-willingness toward COVID-19 vaccination reported among Indian and Egyptian medical students is almost equivalent to non-willingness observed in our study.^{26,27}

Even though 89% of study participants show vaccine willingness, 28% are still not vaccinated. Despite that, the government of Pakistan initially launched a COVID-19 vaccination program only for healthcare professionals and elderly population in early 2021, and by the end of July 2021, around 18.2% of total population of a country got vaccinated.²⁸ In our study, a higher prevalence of misinformation and conspiracies was observed in non-vaccinated individuals. Moreover, 26.4% of participants believe that the vaccines are a part of a large-scale pharmaceutical monopoly. These results support the fact that regardless of the majority showing willingness toward a vaccine, participants hesitate to get vaccinated. A relatively similar aspect is reported in another cross-sectional survey of healthcare professionals by Kashif et al. where around one-third of the study population wanted to delay their vaccination against COVID-19.²⁹ However, it is worth getting the first available

COVID-19 vaccine, as a higher vaccine coverage rate even by a low-efficacy vaccine will significantly reduce the spread of infection.³⁰

Pakistan is a country that is quite vulnerable to such a conspiracy narrative. In consequence of these conspiracy theories, the Pakistani government is still struggling to eradicate polio from the country.¹⁰ According to our study, the overall belief in COVID-19 conspiracies was low among medical students. Favorably, the misinformation related to polio vaccines in the past, such as infertility following vaccination and its use to decline the Muslim population, is not so ubiquitous among medical students, even in the general population of Pakistan.²² However, conspiracy “world super-power wants to create global surveillance state through vaccine program of COVID-19” and “Pakistani people have better immunity than others” are somewhat agreed by our one-fourth of the study population with the higher predominance in non-vaccinated participants. These types of conspiracies regarding COVID-19 lead to less self-compliance and ultimately careless attitudes toward precautions against it and a carefree approach to COVID-19 vaccination.¹²

The study results suggest that belief in misinformation of COVID-19 is influenced by the medical background and year of medical school. However, the belief in conspiracies is not influenced by student's level of health background, but probably by other reported sociodemographic, motivational, political, and psychological factors that inflamed these theories and encouraged individuals to believe in them.^{31,32} Ejaz et al.³³ study highlighted some additional factors—higher risk perception, lack of a shared sense of national identity, faint belief in traditional media and government—that are responsible for strong belief in conspiracy theories related to COVID-19 in Pakistan. All of these factors are not analyzed

by our study, as our research aims to assess the prevalence of COVID-19 myths among medical students and their association with their medical background. Not just the general public but also medical students and healthcare professionals seem to struggle to keep up with recent advances and updates. An effective strategy would be to introduce a multidisciplinary curriculum of COVID-19 and its vaccines, and also covering scientific evidence that narrates the falsity in COVID-19 myths and misinformation. The primary responsibility of media is to neutralize this misleading information by delivering an evidence-based education regarding COVID-19 and its safety and efficacy of vaccine.¹⁹ An ethical and most sensible approach to addressing these myths is to involve healthcare personnel and enlighten religious scholars by having regular discussions with them. Pakistan Electronic Media Regulatory Authority (PEMRA) should issue guidelines on statements regarding COVID-19 pandemic, and law enforcement agencies should take action against individuals spreading these unfounded theories without evidence.¹⁹ Furthermore, medical students could play a pivotal role in combating COVID-19 misinformation by delivering correct knowledge and awareness to non-medical population of the country, as they can be a reliable source for information acquisition on COVID-19.

Limitations

The survey is done on undergraduate medical (MBBS) students from all medical colleges of Karachi, Pakistan. However, there are some limitations to our study. The survey is conducted online that may create the possibility of bias as some students with Internet connectivity issues may not be able to take part in the study. Also, the study did not approach the medical students from cities other than Karachi, which can create a probability of selection bias. Another limitation is the type of study participants, as this study is limited to medical students only.

Conclusion

Generally, most medical students have good and moderate knowledge of misinformation related to COVID-19 and its vaccine and have low belief in conspiracy theories. The majority of these were senior year students, vaccinated participants, and participants infected with COVID-19. Social media and television were the most cited sources used to gain knowledge about COVID-19.

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Author contributions

O.B.K.J.: conceptualization, supervision, final draft, and discussion writing; M.M.: conceptualization, literature search, introduction

writing, statistical analysis, and study design; M.A.A.: data collection, data interpretation, statistical analysis, and writing results; A.M.A.: data collection, data interpretation, proof reading, and writing charts and table; H.H.K.: data collection and proof reading; N.Y.K.: data collection and proof reading.

Declaration of conflicting interests

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Ethical approval

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Informed consent

Written informed consent was obtained from all subjects before the study on Google Forms, and filling consent form is mandatory.

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Supplemental material

Supplemental material for this article is available online.

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