COVID-19 vaccine hesitancy among medical students in India

Authors and affiliations: Jyoti Jain¹, Suman Saurabh²*, Prashant Kumar³, Mahendra Kumar Verma⁴, Akhil Dhanesh Goel⁵, Manoj Kumar Gupta⁶, Pankaj Bhardwaj⁷, Pankaja Ravi Raghav⁸

* Corresponding author

¹ Medical student, All India Institute of Medical Sciences (AIIMS), Jodhpur, Rajasthan 342005, India, Mobile: +91 7742263987, E-mail: dr.jyotijain23@gmail.com

² Assistant Professor, Department of Community Medicine and Family Medicine, All India Institute of Medical Sciences (AIIMS), Basni, Jodhpur, Rajasthan 342005, India, Mobile: +91 7766906623, E-mail: drsumansaurabh@gmail.com / saurabhs@aiimsjodhpur.edu.in

³ Senior Resident, Department of Community Medicine, All India Institute of Medical Sciences (AIIMS), Phulwari Sharif, Patna, Bihar 801507, India, Mobile: +91 7296815939, E-mail: pras.sing39@gmail.com

⁴ Assistant Professor, Department of Community Medicine, Institute of Medical Sciences and Research Centre, Jaipur National University, Jagatpura, Jaipur, Rajasthan 302017, India, Mobile: +91 9462823592, E-mail: verma.udr@gmail.com

⁵ Associate Professor, Department of Community Medicine and Family Medicine, All India Institute of Medical Sciences (AIIMS), Basni, Jodhpur, Rajasthan 342005, India, Mobile: +91 9643158274, E-mail: doc.akhilgoel@gmail.com

This is an Open Access article, distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives licence (http://creativecommons.org/licenses/by-nc-nd/4.0/), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is unaltered and is properly cited. The written permission of Cambridge University Press must be obtained for commercial re-use or in order to create a derivative work.
COVID-19 vaccine hesitancy among medical students

Summary

COVID-19 vaccine was launched in India on 16 January 2021, prioritizing health care workers which included medical students. We aimed to assess vaccine hesitancy and factors related to it among medical students in India. An online questionnaire was filled by 1068 medical students across 22 states and union territories of India from 2 February – 7 March 2021. Vaccine hesitancy was found among 10.6%. Concern regarding vaccine safety and efficacy, hurried testing of vaccines prior to launch and lack of trust in government agencies predicted COVID-19 vaccine hesitancy. Presence of risk perception of oneself regarding contracting COVID-19 reduced vaccine hesitancy as well as hesitation in participating in COVID-19 vaccine trials. Vaccine hesitant students were more likely to derive information from social media and less likely from teachers at medical college. Choosing between the two available vaccines (Covishield and Covaxin) was considered important by medical students both for themselves and for their future patients. Covishield was preferred to Covaxin by students. Majority of those willing to take the COVID-19 vaccine felt that it was important for them to resume their clinical posting, face-to-face
classes and get their personal life back on track. Around three-fourths medical students viewed that COVID-19 vaccine should be made mandatory for both health care workers and international travellers. Prior adult vaccination didn’t have an effect upon COVID-19 vaccine hesitancy. Targeted awareness campaigns, regulatory oversight of vaccine trials and public release of safety and efficacy data and trust building activities could further reduce COVID-19 vaccine hesitancy among medical students.

KEY WORDS
COVID-19, vaccine hesitancy, Covishield, Covaxin, medical students

MAIN TEXT

INTRODUCTION:

COVID-19 has emerged as a global pandemic with 157 million confirmed cases and 3.3 million deaths worldwide, as on 11 May 2021.¹ As a part of control measures against COVID-19, vaccines have been launched in India from 16 January 2021, which has been subsequently scaled up in response to the surge of cases starting in April 2021.² The second wave of pandemic in India has triggered a massive humanitarian crisis with unprecedented number of hospitalizations and deaths.³ Mass vaccination against COVID-19 has emerged as a key preventive strategy.⁴

In the first phase, health care workers including medical students were targeted for vaccination with either of the two vaccines approved for restricted emergency use - Covishield or Covaxin. Covishield is manufactured by Serum Institute of India under license from Astra Zeneca (adenovirus vectored ChAdOx1 nCoV-19 vaccine - AZD1222)⁴,⁵ whereas the inactivated SARS-CoV-2 vaccine Covaxin (BBV152) is manufactured in India by Bharat Biotech in collaboration with Indian Council of Medical Research.⁵,⁶ From 1 March 2021, COVID-19 vaccination has been extended to those aged more than 60 years
and those with comorbidities from 45-59 years of age. Subsequently, starting 1 April 2021 and 1 May 2021, all individuals in India aged 45-59 years and 18-44 years have become eligible to receive vaccination, respectively. The process of registration for the vaccination is done online through the COVID-19 Vaccine Intelligence Network (CO-WIN) portal which is developed with the support of United Nations Development Programme (UNDP). It is also configured to track enlisted beneficiaries, issue short messaging service (SMS) reminders and vaccination certificates for users.

Vaccine hesitancy has been frequently studied among health care workers and especially medical students. The COVID-19 pandemic spurred the rapid development of vaccines with their prominent coverage in news and social media. Recent studies highlighted the concerns regarding adverse events, unduly rapid vaccine development and poor vaccine efficacy as some of the possible reasons for vaccine hesitancy among medical students. In the Indian situation, out of the two vaccines, the safety and phase 3 efficacy data was publicly released for Covishield through a scientific publication of the parent Astra Zeneca vaccine. For Covaxin, the safety and immunogenicity data of phase 1 trial is available. An announcement of 81% efficacy has been made on 3 March 2021, while its peer-reviewed scientific publication is awaited.

Although provided free of charge, there had been no option for the health workers to choose between the two vaccines, since allocation of vaccines to health facilities had been centrally determined owing to limited supply in the initial phase. High vaccination converge among medical students is needed not only because of their role as future physicians but also because they are expected to provide COVID-19 care in high burden situations. Therefore, considering the recent surge in COVID-19 cases in India, the study of vaccine hesitancy among medical students is all the more important. The present study aims to assess the awareness and sources of vaccine information, attitudes and possible
determinants of COVID-19 vaccine hesitancy among medical students enrolled in MBBS course in India.

METHODS

A cross-sectional study was conducted among the cohort of medical students in India for a period of around 5 weeks from 2 February – 7 March 2021.

Sample size was calculated pertaining to the prevalence of COVID-19 vaccine hesitancy or refusal among medical or nursing students from previous reports which ranged from 6% in Egypt, 13.9% in Italy and 23% in USA.\textsuperscript{12,18,19} This yielded a sample size of 962 individuals corresponding to the lowest prevalence, relative precision of 25% and alpha value of 5%.

An anonymous online structured questionnaire (Supplementary file 1) was prepared using evidence from prior studies on vaccine hesitancy in general\textsuperscript{20,21} and COVID-19 vaccine hesitancy among medical students.\textsuperscript{12} The questionnaire was prepared in English language which could be understood by medical students as it is the medium of instruction of medical course throughout India. It was designed to collect information regarding basic demographic details, awareness and sources of information regarding COVID-19 vaccine, attitudes regarding the vaccine and prior vaccination experience. This questionnaire was deployed online using google forms. Its link was shared by the student investigator within the social media network of medical students – both individually and mainly through the WhatsApp groups which included students of a particular batch studying in the medical colleges. The students further circulated it among their acquaintances within the same medical college.

Respondent-driven sampling strategy was used to target all medical students consenting and willing to spare the time to fill the survey. No financial or in-kind reward was offered to students who completed the survey.

Upon completion of the survey, data was downloaded in comma-separated values format and data analysis was conducted using SPSS software v23.0 and EpilInfo™ v7.2.4.
Categorical variables related to the survey items were tabulated and odds ratio for vaccine hesitancy was calculated using univariate approach. Subsequently, multivariate logistic regression was conducted to test for plausible determinants of vaccine hesitancy while adjusting for gender, type of medical college, being in pre-clinical or clinical part of course and lack of prior vaccine experience. Similar analysis was repeated for exploring the determinants of hesitancy of joining COVID-19 vaccine trial. A p-value of less than 0.05 was taken as significant.

The study has been approved by the Institutional Ethics Committee of All India Institute of Medical Sciences (AIIMS) - Jodhpur, India (Ref: AIIMS/IEC/2021/3438). Data collection was completely anonymous with no individual level identifying information such as name, email or mobile number of student or name of medical colleges being collected (Supplementary file 1).

**Results**

A total of 1068 students from 22 states and union territories of India participated in the online survey (Fig 1). Around two-fifths of students were from Rajasthan state (Table 1). Gender of students were almost equally distributed (48.6% females). Nearly one-fourths of students were studying in the clinical part of the MBBS course (Table 1). The consolidated data of the study is included in Supplementary file 2.

In response to the statement ‘I am willing to take the COVID-19 vaccine when offered’, 43 (4.0%) ‘disagreed’ and 70 (6.6%) were ‘not sure’. Therefore, vaccine hesitancy was found among 113 students (10.6%). Among those who agreed, 689 (64.5%) had already taken the vaccine and 266 (24.9%) were yet to receive the vaccine at the time of responding to the survey. Cumulative vaccine hesitancy based on the online responses showed a significant declining trend \( p = 0.00164 \) from 15.5% at the end of the first week of the survey to 10.6% at the end of the fifth week (Fig 2). Internet, social media and teachers at
medical college were the most common source of information regarding COVID-19 vaccine for both the vaccine hesitance and acceptance groups (Fig 3). Further, we found that larger proportion of vaccine hesitant students obtained vaccine-related information from social media, as compared to those accepting vaccines (Fig 3). On the other hand, lesser vaccine hesitant students had teachers at college as their source of information (Fig 3). Concern regarding safety of COVID-19 vaccine followed by concern regarding its efficacy was the most common reason cited by those hesitant to take the vaccine (Fig 4).

Upon conducting logistic regression, lack of awareness of medical students regarding their COVID-19 vaccine eligibility, concern regarding vaccine safety and efficacy and lack of trust in public health authorities were associated with COVID-19 vaccine hesitancy (Table 2). Hesitation in joining COVID-19 vaccine trial was predicted by lack of trust in government or public health authorities (Table 3). Conversely, presence of risk perception among students regarding COVID-19 was associated with lesser hesitancy in receiving COVID-19 vaccine as well as for participating in COVID-19 vaccine trials (Table 2, Table 3).

Comments by medical students were arranged in four themes – ‘confidence in vaccine’, ‘concern regarding vaccine’, ‘practical considerations’ and ‘need for better education’ (Table 4).

Discussion

Awareness of COVID-19 vaccine and sources of information

COVID-19 vaccination provides a renewed opportunity to closely study the dynamics of health behaviour change in a well-informed young adult population. We found that better awareness regarding the COVID-19 vaccine was associated with reduced hesitancy, similar to study conducted earlier. COVID-19 vaccine hesitancy reduced over time in our study, which has also been observed earlier. COVID-19 vaccine uptake, especially among young college students has been explained through diffusion of innovation theory through
openness to experience and adoption of descriptive norm. Innovators and early adopters of COVID-19 vaccination could play a role in facilitating its wider acceptance in the medical student community.

The views of students should also be seen in relation to the matrix of multiple sources of information available to them. Our findings support that the role of internet and social media as an information source of health behaviours has been increasingly important for medical students. Any future intervention to reduce vaccine hesitancy among the student population should take into account this realignment of sources of information. Contribution of social media as a source of information was significantly greater among vaccine hesitant students, which could be explained by unverified and potentially misleading information promoted by anti-vaccination groups. Therefore we recommend countering this by systematic promotion of more reliable sources of information such as through peers, teachers and official websites.

**Determinants of vaccine hesitancy**

Adoption of vaccination practices by healthcare workers plays a key role in motivating the general population through setting of example. Concerns regarding COVID-19 vaccine adverse events as a possible reason for hesitancy has been highlighted by most studies concerning university students, health care workers and in the general population. Further, concerns regarding vaccine efficacy were also seen to limit the adoption of the COVID-19 vaccine. The real concern regarding adverse events appeared to be from the possible ‘long term’ effect of the vaccine. This was coupled with the apprehension that the vaccines had not been tested rigorously enough to determine all possible adverse events and efficacy in a proper manner. The short-term adverse events were also inconveniencing the students owing to vaccination sessions held close to their examinations. The concern regarding vaccine adverse events and efficacy were further
elaborated by the comments provided by students. Additionally, concern of lack of consent for provision of data for registration of COVID-19 vaccine by medical students was also observed.

Our findings also seemed to match with the health belief model\textsuperscript{24} wherein the perceived susceptibility to COVID-19 and perceived benefits of vaccination had a role in reducing the hesitancy for COVID-19 vaccination. We also found that a sizeable proportion of students had indeed received the vaccination despite having concerns which indicated that acceptance of vaccination was not purely voluntary. It appears unlikely that this coercion could be entirely driven by the pressure of college authorities. Within this framework, COVID-19 vaccine acceptance could have been a subjective norm and pressure of social conformity could have influenced some hesitant students to finally get vaccinated. Further, majority of those choosing to be vaccinated were motivated by desire for resumption of clinical and face-to-face classes and by the prospect of getting their personal lives back on track. Therefore, COVID-19 vaccination was also seen a confidence building measure which could help the students ease their restricted life during COVID-19 pandemic.

Confidence regarding the vaccine was also expressed by the students through free comments. On the other hand, those hesitating were much less likely to believe in this enabling effect of COVID-19 vaccination.

\textit{Hesitancy for participation in COVID-19 vaccine trials}

Concern for adverse events didn’t deter medical students to participate in vaccine trials unlike their counterparts in the United States of America.\textsuperscript{12} Risk perception of self-regarding COVID-19 increased the students’ willingness to participate in COVID-19 vaccine trial. On the other hand, lack of trust in government or public health authorities deterred them from participating in vaccine trials, similar to what was observed in previous studies.\textsuperscript{12,29,30}

\textit{Attitudes regarding COVID-19 vaccine mandates}
Overall, more than three-fourths medical students viewed that COVID-19 vaccine should be made mandatory for both health care workers and international travellers. However, those hesitating to take COVID-19 vaccination were also less convinced about the various aspects of usefulness of the vaccine for the community such as its potential in reducing the spread of infection or severe COVID-19 disease. They were also much less likely to have it mandated for health care workers and domestic and international travellers. Majority of even those hesitating displayed a sense of responsibility in their role as future physicians to keep up to date regarding the upcoming vaccines and their importance in keeping themselves healthy. This suggests that hesitation regarding COVID-19 vaccination could be related to issues specific to it rather than due to apathy towards vaccines in general. Therefore, targeted education and trust building by regulatory agencies and medical colleges could help reduce COVID-19 vaccine hesitancy among medical students considerably.

Choice of vaccines and previous vaccination

Students considered it important to choose between the available COVID-19 vaccines both for themselves and for their future patients. Between the two available vaccines, Covishield was preferred whereas a considerable proportion also felt that they didn’t have enough information to choose. Acceptance of Covaxin was found to be less in general and was even lesser among those hesitating to take the vaccine. This situation might change in future with more information on safety and efficacy of vaccines being available.

Experience of prior vaccination has been found to have a role in increasing the acceptance of COVID-19 vaccine. However, this was not replicated in the present study. This could be mainly because in the present setting, Hepatitis-B was the vaccine taken by majority of the students unlike the studies from outside India in which annual Influenza vaccination had been considered. Since the importance of Hepatitis B vaccine is well-accepted for
healthcare professionals, its uptake might be more related to medical colleges’ policy of offering vaccination to medical students during their course rather than vaccine hesitancy *per se*.

**Limitations**

Our survey had the limitation that it was conducted after COVID-19 vaccination had started in some of the medical colleges. Therefore, it could have underestimated the initial vaccine hesitancy of those who subsequently converted to the vaccine acceptance group and were ultimately vaccinated. Since participation in this survey was based on peer-to-peer communication through social media networks, the denominator for calculation of response rate could not be determined. Due to the non-probability sampling approach in the study, the generalizability of vaccine hesitancy among medical students across India would need to be further informed by the local context. We also didn’t specifically ask about scientific journals as a source of vaccine information. Although we captured students’ responses through open comments, the online mode of data collection often fails to capture the depth of information which could have otherwise been possible through qualitative methods applied in face-to-face settings.

**Conclusions**

COVID-19 vaccine hesitancy was found in one out of every ten medical students. Lack of awareness regarding vaccination eligibility, concern regarding adverse events and efficacy of the vaccine and lack of trust in government were independently predictive of vaccine hesitancy. Heightened risk perception regarding COVID-19 seemed to reduce vaccine hesitancy. Concerns regarding lack of vaccine-related information and launch of vaccine prior to release of safety and efficacy data were noted. Although vaccine hesitancy showed a diminishing trend over time, health education programmes tailored to boost awareness regarding vaccine and improve trust in government agencies would be helpful. Focus
should be on promoting official sources of information to counter apprehension generated through social media use. Taking due informed consent for registration of personal information in vaccine portal and ensuring that vaccination sessions are not held just before examinations could further improve acceptance of newly launched vaccines. As future health care providers, concerns of medical students should be addressed on priority.

DECLARATIONS

Authors’ contributions – JJ conceived the idea of the study. JJ and SS designed the data collection format with inputs from MKG, PB. JJ, PK, MKV and SS conducted data collection. SS wrote the manuscript with inputs from JJ, MKG, PB, AG and PRR. All authors approved the final manuscript.

Acknowledgement – We acknowledge the help of medical students who participated in the study.

Funding – The authors declare that no funding was received from any source for the study and preparation of this article.

Conflict of interest- The authors declare that there are no conflicts interests for publication of this article. The views expressed in this article are those of the authors alone and do not necessarily represent the views of their organizations.

Ethical approval – The study has been approved by the Institutional Ethics Committee of All India Institute of Medical Sciences (AIIMS) – Jodhpur, India (Ref: AIIMS/IEC/2021/3438).

Data availability statement – Data file upon which the study findings are based is included as Supplementary file 2.

REFERENCES
1. WHO. Weekly epidemiological update for COVID-19 – 11 May 2021. World Health Organization, Geneva; 2021. Available at: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20210511_weekly_epi_update_39.pdf?sfvrsn=b66ba70d_11 (accessed May 2021).

2. MoHFW. Frequently asked questions: COVID-19 vaccination. Ministry of Health and Family Welfare, Government of India, New Delhi; 2021. Available at: https://www.mohfw.gov.in/covid_vaccination/vaccination/index.html (accessed May 2021).

3. Mallapaty S. India’s massive COVID surge puzzles scientists. Nature. 2021;592(7856):667–8.

4. Kumar VM, Pandi-Perumal SR, Trakht I, Thyagarajan SP. Strategy for COVID-19 vaccination in India: the country with the second highest population and number of cases. NPJ Vaccines. 2021;6(1):60.

5. Padma TV. India’s COVID-vaccine woes - by the numbers. Nature. 2021;592(7855):500–1.

6. Bharat Biotech Announces Phase 3 Results of COVAXIN®: India’s First COVID-19 Vaccine Demonstrates Interim Clinical Efficacy of 81%. Bharat Biotech International Ltd., Hyderabad; 2021. Available at: https://www.bharatbiotech.com/images/press/covaxin-phase3-efficacy-results.pdf (accessed May 2021).

7. MoHFW. COVID-19 vaccination - operational guidelines (updated 20 December 2020). Ministry of Health and Family Welfare, Government of India, New Delhi; 2021. Available at: https://www.mohfw.gov.in/pdf/COVID19VaccineOG111Chapter16.pdf (accessed May 2021).

8. Paterson P, Meurice F, Stanberry LR, Glismann S, Rosenthal SL, Larson HJ. Vaccine hesitancy and healthcare providers. Vaccine. 2016;34(52):6700–6.

9. Kashte S, Gulbake A, El-Amin lii SF, Gupta A. COVID-19 vaccines: rapid development, implications, challenges and future prospects. Human Cell. 2021;34(3):711-733.

10. Manning ML, Gerolamo AM, Marino MA, Hanson-Zalot ME, Pogorzelska-Maziarz M. COVID-19 vaccination readiness among nurse faculty and student nurses. Nursing Outlook. 2021;S0029-6554(21)00023-3. doi: 10.1016/j.outlook.2021.01.019.

11. Taylor S, Landry CA, Paluszek MM, Groenewoud R, Racho GS, Asmundson GJG. A Proactive Approach for Managing COVID-19: The Importance of Understanding the Motivational Roots of Vaccination Hesitancy for SARS-CoV2. Frontiers in Psychology. 2020;11:575950.

12. Lucia VC, Kelekar A, Afonso NM. COVID-19 vaccine hesitancy among medical students. Journal of Public Health (Oxf). 2020 Dec 26:fdaa230. doi: 10.1093/pubmed/fdaa230.

13. Qiao S, Friedman DB, Tam CC, Zeng C, Li X. Vaccine acceptance among college students in South Carolina: Do information sources and trust in information make a
difference? medRxiv [Preprint]. 2020 Dec 4:2020.12.02.20242982. doi: 10.1101/2020.12.02.20242982.

14. Voysey M, Clemens SAC, Madhi SA, Weckx LY, Folegatti PM, Aley PK, et al. Safety and efficacy of the ChAdOx1 nCoV-19 vaccine (AZD1222) against SARS-CoV-2: an interim analysis of four randomised controlled trials in Brazil, South Africa, and the UK. Lancet. 2021;397(10269):99–111.

15. Bhuyan A. India begins COVID-19 vaccination amid trial allegations. Lancet. 2021;397(10271):264.

16. Ella R, Vadrevu KM, Jogdand H, Prasad S, Reddy S, Sarangi V, et al. Safety and immunogenicity of an inactivated SARS-CoV-2 vaccine, BBV152: a double-blind, randomised, phase 1 trial. Lancet Infectious Diseases. 2021;21(5):637-646. doi: 10.1016/S1473-3099(20)30942-7.

17. Wallen J. Medical students to be sent to Covid frontlines as India’s hospitals face collapse. The Telegraph [newspaper on the Internet]. 2021 May 4 [cited 2021 May 18]; Available from: https://www.telegraph.co.uk/global-health/science-and-disease/medical-students-sent-covid-frontlines-indias-hospitals-face/.

18. Saied SM, Saied EM, Kabbash IA, Abdo SAE. Vaccine hesitancy: Beliefs and barriers associated with COVID-19 vaccination among Egyptian medical students. Journal of Medical Virology. 2021;10.1002/jmv.26910. doi: 10.1002/jmv.26910.

19. Barelo S, Nania T, Dellafiore F, Graffigna G, Caruso R. “Vaccine hesitancy” among university students in Italy during the COVID-19 pandemic. European Journal of Epidemiology. 2020;35(8):781–3.

20. Afonso NM, Kavanagh MJ, Swanberg SM, Schulte JM, Wunderlich T, Lucia VC. Will they lead by example? Assessment of vaccination rates and attitudes to human papilloma virus in millennial medical students. BMC Public Health. 2017;17(1):35.

21. Kernéis S, Jacquet C, Bannay A, May T, Launay O, Verger P, et al. Vaccine Education of Medical Students: A Nationwide Cross-sectional Survey. American Journal of Preventive Medicine. 2017;53(3):e97–104.

22. Mo PK, Luo S, Wang S, Zhao J, Zhang G, Li L, Li L, Xie L, Lau JTF. Intention to Receive the COVID-19 Vaccination in China: Application of the Diffusion of Innovations Theory and the Moderating Role of Openness to Experience. Vaccines (Basel). 2021;9(2):129. doi: 10.3390/vaccines9020129.

23. Nguyen KH, Srivastav A, Razzaghi H, Williams W, Lindley MC, Jorgensen C, et al. COVID-19 Vaccination Intent, Perceptions, and Reasons for Not Vaccinating Among Groups Prioritized for Early Vaccination - United States, September and December 2020. Morbidity Mortality Weekly Report (MMWR). 2021;70(6):217–22.

24. WHO. Health education: theoretical concepts, effective strategies and core competencies: a foundation document to guide capacity development of health educators. World Health Organization - EMRO, Cairo; 2012. Available at: https://apps.who.int/iris/handle/10665/119953 (accessed May 2021).
25. Wilson SL, Wiysonge C. Social media and vaccine hesitancy. BMJ Global Health. 2020;5(10):e004206. doi: 10.1136/bmjgh-2020-004206.

26. Hotez P. COVID vaccines: time to confront anti-vax aggression. Nature. 2021;592(7856):661.

27. Szmyd B, Bartoszek A, Karuga FF, Staniecka K, Błaszczyk M, Radek M. Medical Students and SARS-CoV-2 Vaccination: Attitude and Behaviors. Vaccines (Basel). 2021;9(2):128. doi: 10.3390/vaccines9020128.

28. Shekhar R, Sheikh AB, Upadhyay S, Singh M, Kottewar S, Mir H, Barrett E, Pal S. COVID-19 Vaccine Acceptance among Health Care Workers in the United States. Vaccines (Basel). 2021;9(2):119. doi: 10.3390/vaccines9020119.

29. Fisher KA, Bloomstone SJ, Walder J, Crawford S, Fouayzi H, Mazor KM. Attitudes Toward a Potential SARS-CoV-2 Vaccine: A Survey of U.S. Adults. Annals of Internal Medicine. 2020;173(12):964–73.

30. Sun S, Lin D, Operario D. Interest in COVID-19 vaccine trials participation among young adults in China: Willingness, reasons for hesitancy, and demographic and psychosocial determinants. Preventive Medicine Reports. 2021;22:101350. doi: 10.1016/j.pmedr.2021.101350.

31. Pastorino R, Villani L, Mariani M, Ricciardi W, Graffigna G, Boccia S. Impact of COVID-19 Pandemic on Flu and COVID-19 Vaccination Intentions among University Students. Vaccines (Basel). 2021;9(2):70. doi: 10.3390/vaccines9020070.
Figure 1: State/Union territory-wise participation of medical students in the COVID-19 vaccine survey in India (n = 1068)
Figure 2: Week-wise trend of cumulative COVID-19 vaccine hesitancy among surveyed medical students
Figure 3: Sources of information regarding COVID-19 vaccine for the medical students belonging to vaccine hesitance and vaccine acceptance groups (n = 1068)
Figure 4: Reasons for COVID-19 vaccine hesitancy among the medical students (n = 113)
Table 1. Responses of medical students belonging to vaccine acceptance and hesitance groups (N = 1068)

| Survey items | All students (N = 1068) | Vaccine acceptance group (N = 955) | Vaccine hesitancy group (N = 113) | Odds ratio (95% CI) | p value |
|--------------|--------------------------|-----------------------------------|-----------------------------------|---------------------|---------|
| Demographic details | | | | | |
| Government medical college | 938 87.8 | 843 88.3 | 95 84.1 | 0.70 (0.41 – 1.20) | 0.207 |
| Location of medical college in Rajasthan | 433 40.5 | 399 41.8 | 34 30.1 | 0.60 (0.39 – 0.91) | 0.016 |
| Students in clinical years (3rd yr, 4th yr and interns) | 255 23.9 | 227 23.8 | 28 24.8 | 1.06 (0.67 – 1.66) | 0.802 |
| Female gender | 519 48.6 | 467 48.9 | 52 46.0 | 0.89 (0.60 – 1.32) | 0.565 |
| Awareness and overall attitude regarding vaccine acceptance | | | | | |
| Aware that MBBS students are eligible for COVID-19 vaccination | 1011 94.7 | 922 96.5 | 89 78.8 | 0.13 (0.08 – 0.23) | < 0.001 |
| Awareness of the correct number of COVID-19 vaccines (two) available in the country | 802 75.1 | 724 75.8 | 78 69.0 | 0.71 (0.46 – 1.09) | 0.122 |
| ‘I will take the COVID-19 vaccine only if it is made mandatory for me by government authorities or college and not on my own.’ | 396 37.1 | 308 32.3 | 88 77.9 | 7.39 (4.65 – 11.77) | < 0.001 |
| ‘I will be willing to take part in a COVID-19 vaccine trial in future.’ | 524 49.1 | 509 53.3 | 15 13.3 | 0.13 (0.08 – 0.23) | < 0.001 |
| ‘I will be willing to motivate my fellow students to take the COVID-19 vaccine.’ | 871 81.6 | 844 88.4 | 27 23.9 | 0.04 (0.03 – 0.07) | < 0.001 |
| Perception of vulnerability to COVID-19 and personal attitude regarding usefulness of vaccine | | | | | |
| ‘I am likely to get COVID-19 in course of my duties as a medical student.’ | 859 80.4 | 805 84.3 | 54 47.8 | 0.17 (0.11 – 0.26) | < 0.001 |
| ‘Getting the appropriate vaccines are important for me to stay healthy as a future physician.’ | 1022 95.7 | 934 97.8 | 88 77.9 | 0.08 (0.04 – 0.15) | < 0.001 |
Keeping up to date about the upcoming vaccines is important for my role as a future physician.

COVID-19 vaccination is important to me in order to resume my clinical posting and face-to-face classes.

‘COVID-19 vaccination is important to me to get my personal life back on track.’

| General views regarding usefulness of COVID-19 vaccine for community |
|---------------------------------------------------------------|
| ‘COVID-19 vaccine can reduce the spread of the disease in the community.’ | 907 | 84.9 | 840 | 88.0 | 67 | 59.3 | 0.20 (0.13 – 0.31) | < 0.001 |
| ‘COVID-19 vaccine can help reduce severe COVID-19 disease.’ | 906 | 84.8 | 839 | 87.9 | 67 | 59.3 | 0.20 (0.13 – 0.31) | < 0.001 |
| ‘COVID-19 vaccine should be made mandatory for the healthcare workers.’ | 800 | 74.9 | 764 | 80.0 | 36 | 31.9 | 0.12 (0.08 – 0.18) | < 0.001 |
| ‘COVID-19 vaccine should be made mandatory for those travelling abroad.’ | 853 | 79.9 | 804 | 84.2 | 49 | 43.4 | 0.14 (0.10 – 0.22) | < 0.001 |
| ‘COVID-19 vaccine should be made mandatory for domestic inter-state travellers’ | 705 | 66.0 | 678 | 71.0 | 27 | 23.9 | 0.13 (0.08 – 0.20) | < 0.001 |

Concern regarding COVID-19 vaccines and trust of official information

I am concerned that the present COVID-19 vaccines may not be effective enough.

‘I am concerned about the serious adverse events from the currently available COVID-19 vaccines’

‘I am concerned about the present COVID-19 vaccines might not have been tested rigorously prior to launch’

‘I trust the information I am receiving about the COVID-19 vaccine from the government or public health experts.’

Choice of vaccines

I consider it important to choose between the different available

| | 800 | 74.9 | 724 | 75.8 | 76 | 67.3 | 0.66 (0.43 – 1.00) | 0.053 |
COVID-19 vaccines for myself.  
I consider it important to choose between the different available COVID-19 vaccines for my patients in future.

If provided an option, which of the following vaccines would you choose for yourself?

| Vaccine                  | N   | Mean | Median | SD   | P-value (95% CI) | p-value |
|--------------------------|-----|------|--------|------|----------------|---------|
| Covaxin                  | 213 | 19.9 | 20.5   | 8.7  | 0.17 (0.08 – 0.37) | < 0.001 |
| Covishield               | 483 | 45.2 | 44.6   | 37   | 0.36 (0.23 – 0.57) | < 0.001 |
| No preference for either | 86  | 8.1  | 7.4    | 0.36 | 0.93 (0.49 – 1.75) | 0.834   |
| Don't have enough info   | 286 | 26.8 | 23.3   | 53   | 1 (reference)    | -       |

Prior vaccination experience

Have you received any other vaccine(s) after joining as a medical student (apart from COVID-19 vaccine)?

| Type of vaccine          | N = 414 | N = 376 | N = 38 |
|--------------------------|---------|---------|--------|
| Hepatitis B              | 325     | 293     | 32     |
| Tetanus                  | 116     | 108     | 8      |
| Hepatitis A              | 23      | 19      | 4      |
| Hepatitis C              | 17      | 16      | 1      |
| Varicella                | 15      | 14      | 1      |
| Human Papilloma Virus    | 10      | 9       | 1      |
| Herpes                   | 2       | 0.5     | 1      |
| Other vaccines           | 91      | 22.0    | 0      |
Table 2. Multivariable logistic regression for plausible determinants of COVID-19 vaccine hesitancy (N = 1068)

| Variables                                                      | Odds ratio (95% CI) | p value |
|---------------------------------------------------------------|--------------------|---------|
| Studying in government medical college                       | 1.32 (0.82 – 2.13) | 0.243   |
| Studying in clinical year                                     | 0.99 (0.57 – 1.72) | 0.966   |
| Male gender                                                    | 1.33 (0.82 – 2.13) | 0.244   |
| Lack of awareness regarding eligibility of medical students for COVID-19 vaccination | 4.08 (1.97 – 8.45) | < 0.001 |
| Presence of risk perception regarding COVID-19                | 0.18 (0.11 – 0.30) | < 0.001 |
| Prior vaccination experience present                          | 0.97 (0.59 – 1.60) | 0.908   |
| Concern regarding adverse effect of vaccine                   | 3.63 (1.86 – 7.07) | < 0.001 |
| Concern regarding efficacy of vaccine                         | 2.23 (1.30 – 3.84) | 0.004   |
| Lack of trust in govt. or public health authorities            | 5.93 (3.68 – 9.56) | < 0.001 |

Model parameters: Log likelihood = - 247.59, Minus 2 log likelihood difference vs. intercept = 226.05, df = 9, p < 0.0001. Pseudo R-square = 0.3134
| Variables                                                      | Odds ratio (95% CI) | p value |
|---------------------------------------------------------------|---------------------|---------|
| Studying in government medical college                        | 1.14 (0.77 – 1.70)  | 0.513   |
| Studying in clinical year                                     | 1.43 (1.05 – 1.95)  | 0.024   |
| Male gender                                                   | 0.91 (0.71 – 1.17)  | 0.478   |
| Lack of awareness regarding eligibility of medical students for COVID-19 vaccination | 1.45 (0.79 – 2.66)  | 0.234   |
| Presence of risk perception regarding COVID-19                | 0.34 (0.24 – 0.49)  | < 0.001 |
| Prior vaccination experience present                          | 1.14 (0.88 – 1.49)  | 0.320   |
| Concern regarding adverse effect of vaccine                   | 0.95 (0.71 – 1.27)  | 0.713   |
| Concern regarding efficacy of vaccine                         | 1.18 (0.88 – 1.58)  | 0.264   |
| Lack of trust in govt. or public health authorities           | 2.33 (1.71 – 3.17)  | < 0.001 |

Model parameters: Log likelihood = - 691.08, Minus 2 log likelihood difference vs. intercept = 98.03, df = 9, p < 0.0001. Pseudo R-square = 0.0662
| Theme (total number of comments) | Representative Quotes |
|---------------------------------|------------------------|
| Concerns regarding vaccine      | ‘Adverse effects of vaccine are too much.’  
  ‘We still don’t know the long-term effect of this vaccine so the people who are in low covid prone area can avoid taking the vaccine until clinical trial ends & rest who are at high risk of exposure to COVID-19 should take the vaccine. In this way it won’t affect the entire population’  
  ‘Vaccine is being administered without consent especially to the medical students, which is not ethically correct, given the unavailability of adequate data regarding its safety. My registration was done by the college authorities without my prior knowledge and without asking about my medical background e.g., if I have any coexisting diseases which could probably be related to increased risk of any adverse effects of the vaccine. Nor were we warned about the expected side effects like fever and injection site pain.’  
  ‘I just wanted that Govt of India makes sure that these vaccines have gone through complete and proper testing/trial before they start being used widely.’  
  ‘It’s efficacy and side effects should be mentioned properly, updated information.’  
  ‘Heard, Covishield is fully tested vaccine till last phase and is a formula from Oxford, but I’m concerned about Covaxin, which they didn’t complete the last phase of trial (rumour) and is manufactured in India and is being given.’  
  ‘It should not be mandatory for any one’ |
‘I am worried about the side effects of the vaccine’
‘I doubt its potential’
‘There are some questions which can be answered rather than this or that. I mean to express our own thoughts and.. I am bit concerned of the vaccines as they are not properly tested under the trials but I don't mind if it causes minute problems. And I am ready for the trials if wanted.’
‘The socioethical condition, family condition of student must be considered and Side effects must be taken into account.’
‘It would be very good if this vaccination trail is transparent and the data and efficacy should be approved by WHO and then given trials on people…hoping for a better tomorrow with COVID-19 free world’
‘Govt and medical officials failed to provide proper info to common folks about mechanism of action of vaccines.’
‘I hope it works.’

Confidence in vaccine

‘I think to control the spread of this disease, vaccination is must and everyone should participate in it’
‘Vaccine should be made available for the general public as soon as possible.’
‘Vaccination is must. Only believe the experts and not the fake media or social influencers. Side effects are just as same as other vaccination like fever, body pain, etc which is quite normal. Be mentally strong before vaccination as being mentally strong is very important for your health. And being a medical student, it is your duty to get vaccinated.’
‘Just go for it’
‘We as health care professionals should avoid rumours about COVID-19 vaccine...hoping for a better tomorrow with COVID-19 free world’
as they don't have any proper base and should believe in our researchers, doctors and government'
'It's awesome, thanks for the adventure'
'Do it as fast as possible'
'We medical students should encourage everyone to being vaccinated'
'Vaccination is important to all the country.'
'Proud to say that it's our own.'

| Practical considerations regarding vaccination |
|-----------------------------------------------|
| 'Those below 20 should not be given vaccine according to me!!' |
| 'Don't be vaccinated during exam because it may cause variable side effect' |
| 'There should be certain blood parameters to determine if the vaccine has generated certain immune response or not' |
| 'I think it would be better to have a test done for each one regarding the vaccine. Because the vaccine can act differently in different persons. And if he has already immunised himself by his body defence system. I think no need to take vaccine then...' |
| 'Our vaccination is yet pending' |
| 'Colleges should take better part in organising vaccines, and assigning authority for management and information on where to receive vaccines as many days vaccination site is not created in college itself, so management should take into consideration students' comfort as classes are already without significant social distancing' |
| 'Because of Covid Vaccine our exams are being started in hurry. So much less preparation' |
| Need for better education regarding vaccine | "The medical institutions should inform about the dos and don’ts after putting vaccine."
  | 'All the effects after virus should be informed. So that people don't consider them as side effects and advise against it'
  | 'I think data analysis should be made clearer. Or it might be possible that I am not going to the right articles?'
  | 'Which vaccine is best right now?'
  | 'Because of less awareness about vaccination, number of vaccinated people are less so we should create awareness about COVID-19 vaccination, its benefits and its effect on our country. '
  | 'Please make this type of forms for spreading awareness of different types of vaccines, basic differences, plus points, minus points.' |