

 Open access • Posted Content • DOI:10.1101/2021.03.12.21253444

COVID-19 vaccine hesitancy among undergraduate medical students: results from a nationwide survey in India — [Source link](#)

Jyoti Jain, Suman Saurabh, Akhil Dhanesh Goel, Manoj Kumar Gupta ...+2 more authors

Institutions: All India Institute of Medical Sciences

Published on: 12 Mar 2021 - medRxiv (Cold Spring Harbor Laboratory Press)

Topics: Vaccination

Share this paper:    

View more about this paper here: <https://typeset.io/papers/covid-19-vaccine-hesitancy-among-undergraduate-medical-2io177nkk7>

1 **TITLE PAGE**

2 **Title: COVID-19 vaccine hesitancy among undergraduate medical students: results**
3 **from a nationwide survey in India**

4 **Authors and affiliations:** Jyoti Jain¹, Suman Saurabh^{2*}, Akhil Dhanesh Goel³, Manoj
5 Kumar Gupta⁴, Pankaj Bhardwaj⁵, Pankaja Ravi Raghav⁶

6 * Corresponding author

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

9 ² Assistant Professor, Department of Community Medicine and Family Medicine, All India
10 Institute of Medical Sciences (AIIMS), Basni, Jodhpur, Rajasthan 342005, India, Mobile:
11 +91 7766906623, E-mail: drsumansaurabh@gmail.com / saurabhs@aiimsjodhpur.edu.in

12 ³ Associate Professor, Department of Community Medicine and Family Medicine, All India
13 Institute of Medical Sciences (AIIMS), Basni, Jodhpur, Rajasthan 342005, India, Mobile:
14 +91 9643158274, E-mail: doc.akhilgoel@gmail.com

15 ⁴ Associate Professor, Department of Community Medicine and Family Medicine, All India
16 Institute of Medical Sciences (AIIMS), Basni, Jodhpur, Rajasthan 342005, India, Mobile:
17 +91 8003996087, E-mail: drmkgbhu@gmail.com

18 ⁵ Additional Professor, Department of Community Medicine and Family Medicine, All India
19 Institute of Medical Sciences (AIIMS), Basni, Jodhpur, Rajasthan 342005, India, Mobile:
20 +91 8003996903, E-mail: pankajbhardwajdr@gmail.com

21 ⁶ Professor and Head, Department of Community Medicine and Family Medicine, All India
22 Institute of Medical Sciences (AIIMS), Basni, Jodhpur, Rajasthan 342005, India, Mobile:
23 +91 8003996874, E-mail: drpankajaraghav@gmail.com

24 **Running title:** COVID-19 vaccine hesitancy among medical students

25 **Summary**

26 COVID-19 vaccine was launched in India on 16 January 2021, prioritizing health care
27 workers which included medical students. We aimed to assess vaccine hesitancy and
28 factors related to it among undergraduate medical students in India. An online
29 questionnaire was filled by 1068 medical students across 22 states and union territories of
30 India from 2 February – 7 March 2021. Vaccine hesitancy was found among 10.6%.
31 Concern regarding vaccine safety and efficacy, hurried testing of vaccines prior to launch
32 and lack of trust in government agencies predicted COVID-19 vaccine hesitancy. Risk
33 perception regarding contracting COVID-19 vaccine reduced COVID-19 vaccine hesitancy
34 as well as hesitation in participating in COVID-19 vaccine trials. Choosing between the two
35 available vaccines (Covishield and Covaxin) was considered important by medical
36 students both for themselves and their future patients. Covishield was preferred to
37 Covaxin by students. Majority of those willing to take the COVID-19 vaccine felt that it was
38 important for them to resume their clinical posting, face-to-face classes and get their
39 personal life back on track. Around three-fourths medical students viewed that COVID-19
40 vaccine should be made mandatory for both health care workers and international
41 travellers. Prior adult vaccination didn't have an effect upon COVID-19 vaccine hesitancy.
42 Targeted awareness campaigns, regulatory oversight of vaccine trials and public release
43 of safety and efficacy data and trust building activities could further reduce COVID-19
44 vaccine hesitancy among medical students.

45 **KEY WORDS**

46 COVID-19, vaccine hesitancy, Covishield, Covaxin, medical students

47

48 **MAIN TEXT**

49 **INTRODUCTION:**

50 COVID-19 has emerged as a global pandemic with 113 million confirmed cases and 2.5
51 million deaths worldwide, as on 2 March 2021.¹ As a part of control measures against
52 COVID-19, vaccines have been launched in India from 16 January 2021.²

53 In the first phase, health care workers including medical students are targeted for
54 vaccination with either of the two vaccines approved for restricted emergency use -
55 Covishield or Covaxin. Covishield is manufactured by Serum Institute of India under
56 license from Astra Zeneca (adenovirus vectored ChAdOx1 nCoV-19 vaccine - AZD1222)³
57 whereas the inactivated SARS-CoV-2 vaccine Covaxin (BBV152) is manufactured in India
58 by Bharat Biotech in collaboration with Indian Council of Medical Research.⁴

59 Subsequently, from March 1 2021, COVID-19 vaccination has been extended to those
60 aged more than 60 years and those with comorbidities from 45-59 years of age.² The
61 process of registration for the vaccination is done online through the COVID-19 Vaccine
62 Intelligence Network (CO-WIN) portal which is developed with the support of UNDP.⁵ It is
63 also configured to track enlisted beneficiaries, issue SMS reminders and vaccination
64 certificates for users.⁵

65 Vaccine hesitancy has been frequently studied among health care workers and especially
66 medical students.⁶ The COVID-19 pandemic spurred the rapid development of COVID-19
67 vaccines with their prominent coverage in news and social media.⁷ Recent studies
68 highlighted the concerns regarding adverse events, unduly rapid vaccine development and
69 poor vaccine efficacy as some of the possible reasons for vaccine hesitancy among
70 medical students.⁸⁻¹² In the Indian situation, out of the two vaccines, the safety and phase
71 3 efficacy data was publicly released only for Covishield through a scientific publication of

72 the parent Astra Zeneca vaccine.^{13,14} For Covaxin, only the safety and immunogenicity
73 data of phase 1 trial is available.¹⁵ An announcement of 81% efficacy has only been
74 recently made on 3 March 2021⁴, while its scientific publication is awaited. Although
75 provided free of charge, there has been no option for the health workers to choose
76 between the two vaccines since allocation of vaccines to health facilities had been
77 centrally determined owing to limited supply. Therefore, considering the rapidly evolving
78 situation, the study of vaccine hesitancy among medical students is important. The
79 present study aims to assess the awareness and sources of vaccine information, attitudes
80 and possible determinants of COVID-19 vaccine hesitancy among medical students
81 enrolled in MBBS course in India.

82 **METHODS**

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

85 Sample size was calculated pertaining to the prevalence of COVID-19 vaccine hesitancy
86 or refusal among medical or nursing students from previous reports which ranged from 6%
87 in Egypt, 13.9% in Italy, 23% in USA, 30.5 in Malta.^{9,16-18} This yielded a sample size of
88 962 individuals corresponding to the lowest prevalence, relative precision of 25% and
89 alpha error of 5%.

90 An anonymous online structured questionnaire was prepared using evidence from prior
91 studies on vaccine hesitancy in general^{19,20} and COVID-19 vaccine hesitancy in medical
92 students.¹¹ The questionnaire consisted of three main sections – first section with basic
93 demographic details and assessment of awareness and source of information regarding
94 COVID-19 vaccine, second section with assessment of attitudes regarding the vaccine
95 and the third section relating to prior vaccination experience. This questionnaire was

96 deployed online using google forms. The link for the survey form was exclusively shared
97 with the social network of undergraduate medical students – both individually and through
98 their social media groups. Non-probability sampling strategy was used to target all medical
99 students consenting and willing to spare the time to fill the survey.

100 Upon completion of the survey, data was downloaded in comma-separated values format
101 and data analysis was conducted using SPSS software version 23.0. Categorical variables
102 related to the survey items were tabulated and odds ratio for vaccine hesitancy was
103 calculated using univariate approach. Subsequently, multivariate logistic regression was
104 conducted to test for plausible determinants of vaccine hesitancy while adjusting for
105 gender, type of medical college, being in pre-clinical or clinical part of course and lack of
106 prior vaccine experience. Similar analysis was repeated for exploring the determinants of
107 hesitancy of joining COVID-19 vaccine trial. A p-value of less than 0.05 was taken as
108 significant. Data analysis was done using STATA v11 and EpiInfo™ v7.2.4.

109 The study has been approved by the Institutional Ethics Committee of All India Institute of
110 Medical Sciences (AIIMS) - Jodhpur, India (Ref: AIIMS/IEC/2021/3438). Data collection
111 was completely anonymous with no individual level information or name of medical college
112 being collected.

113 **Results**

114 A total of 1068 students from 22 states and union territories of India participated in the
115 online survey (Fig 1). Around four-fifths of students were from Rajasthan state (Table 1).
116 Gender of students were almost equally distributed (48.6% females). Nearly one-fourths of
117 students were studying in the clinical part of the MBBS course (Table 1).

118 In response to the statement 'I am willing to take the COVID-19 vaccine when offered', 43
119 (4.0%) 'disagreed' and 70 (6.6%) were 'not sure'. Therefore, vaccine hesitancy was found

120 among 113 students (10.6%). Among those who agreed, 689 (64.5%) had already taken
121 the vaccine and 266 (24.9%) were yet to receive the vaccine at the time of responding to
122 the survey. Cumulative vaccine hesitancy based on the online responses showed a
123 significant declining trend ($p = 0.00164$) from 15.5% at the end of the first week of the
124 survey to 10.6% at the end of the fifth week (Fig 2). Internet, social media and teachers at
125 medical college were the most common source of information regarding COVID-19
126 vaccine for both the vaccine hesitance and acceptance groups (Fig 3). Further, we found
127 no significant difference between the sources of vaccine-related information between the
128 vaccine acceptance and hesitance groups (Fig 3). Concern regarding safety of COVID-19
129 vaccine followed by concern regarding its efficacy was the most common reason cited by
130 those hesitant to take the vaccine (Fig 4).

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

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

141 **Discussion**

142 *Awareness of COVID-19 vaccine and sources of information*

143 COVID-19 vaccination provides a renewed opportunity to closely study the dynamics of
144 health behaviour change in a well-informed young adult population. We found that better
145 awareness regarding the COVID-19 vaccine was associated with reduced hesitancy,
146 similar to study conducted earlier.⁶ It is important to note that vaccine hesitancy for newly
147 launched vaccines reduced over time in our study, which has also been observed
148 earlier.^{21,22} COVID-19 vaccine uptake, especially among young college students has been
149 explained through diffusion of innovation theory through openness to experience and
150 adoption of descriptive norm.²¹ Innovators and early adopters of COVID-19 vaccination
151 could play a role in facilitating its wider acceptance in the medical student community.²³
152 The views of students should also be seen in the matrix of multiple sources of information
153 available to them. Our findings support that the role of internet and social media as an
154 information source of health behaviours has been increasingly important for medical
155 students.¹⁹ Any future intervention to reduce vaccine hesitancy among the student
156 population should take into account this realignment of sources of information. Since the
157 sources of vaccine information were not different among the vaccine acceptance and
158 hesitance groups, we don't recommend promoting or restricting any particular information
159 channel to tackle vaccine hesitance among medical students.

160 *Determinants of vaccine hesitancy*

161 Adoption of vaccination practices by healthcare workers plays a key role in motivating the
162 general population through setting of example.^{8,24} Concerns regarding COVID-19 vaccine
163 adverse events as a possible reason for hesitancy has been highlighted by most studies
164 concerning both university students and general population.^{8-12,17} Further, concerns
165 regarding vaccine efficacy seen to play a role in adoption of the COVID-19 vaccine.^{8,10,17}
166 The real concern regarding adverse events appeared to be from the possible 'long term'
167 effect of the vaccine. This was coupled with the apprehension that the vaccines had not

168 been tested rigorously enough to determine all possible adverse events and efficacy in a
169 proper manner. The short-term adverse events were also inconveniencing the students
170 owing to vaccination sessions held close to their examinations. The concern regarding
171 vaccine adverse events and efficacy were further elaborated by the comments provided by
172 students. Additionally, concern of lack of consent for provision of data for registration of
173 COVID-19 vaccine by medical students was also observed.

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

186 Our findings also seemed to match with the health belief model²³ wherein the perceived
187 susceptibility to COVID-19 and perceived benefits of vaccination had a role in lessening
188 the hesitancy for COVID-19 vaccination. We also found that a sizeable proportion of
189 students had indeed received the vaccination despite having concerns which indicated
190 that acceptance of vaccination was not purely voluntary. It appears unlikely that this
191 coercion could be entirely driven by the pressure of college authorities. Within this
192 framework, COVID-19 vaccine acceptance could have been a subjective norm and

193 pressure of social conformity could have influenced some hesitant students to finally get
194 vaccinated. Further, majority of those choosing to be vaccinated were motivated by desire
195 for resumption of clinical and face-to-face classes by the prospect of getting their personal
196 lives back on track. Therefore, COVID-19 vaccination was also seen a confidence building
197 measure which could help the students ease their restricted life during COVID-19
198 pandemic. Confidence regarding the vaccine was also expressed by the students as free
199 comments. On the other hand, those hesitating were much less likely to believe in this
200 enabling effect of COVID-19 vaccination.

201 Concern for adverse events didn't deter medical students to participate in vaccine trials
202 unlike their counterparts in the United States of America.¹¹ Risk perception of self-
203 regarding COVID-19 increased the students' willingness to participate in COVID-19
204 vaccine trial. On the other hand, lack of trust in government or public health authorities
205 deterred them from participating in vaccine trials, similar to what was observed in previous
206 studies.^{11,25,26}

207 *Choice of vaccines and previous vaccination*

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

214 Experience of prior vaccination has been found to have a role in increasing the
215 acceptance of COVID-19 vaccine.^{9,25,27} However, this was not replicated in the present
216 study. This could be mainly because in the present setting, Hepatitis-B was the vaccine

217 taken by majority of the students unlike the studies from outside India in which annual
218 Influenza vaccination had been considered.^{9,25,27} Since the importance of Hepatitis B
219 vaccine is well-accepted for healthcare professionals, its uptake might be more related to
220 medical colleges' policy of offering vaccination to medical students during their course
221 rather than vaccine hesitancy *per se*.

222 *Implication of findings for general population*

223 Care needs to be taken while extrapolating the findings among health care workers and
224 medical and nursing students to the general population. This is since acceptance of
225 vaccine might be more among medical students as compared to non-medical students
226 and general population.²⁴ It was also found that conspiracy theories don't tend to affect
227 medical students as compared to non-medical students.²⁴ On the other hand, a study
228 conducted in Italy found no difference between hesitancy among medical and non-medical
229 students.¹⁸ Therefore, transferability of findings among medical students to the community
230 appears to be context-specific. Challenges faced in the community may be more regarding
231 provision of accurate information and tackling vaccine hesitancy in general whereas
232 among health workers and medical students it would be mainly related to safety and
233 efficacy issues specific to the newly launched vaccines.

234 *Limitations*

235 Our survey had the limitation that it was conducted after COVID-19 vaccination had
236 started in some of the medical colleges. Therefore, it could have underestimated the initial
237 vaccine hesitancy for those who were vaccinated and would have subsequently converted
238 to the vaccine acceptance group. Although we captured students' responses through open
239 comments, the online mode of data collection often fails to capture the depth of

240 information which could have otherwise been possible through qualitative methods applied
241 in face-to-face settings.

242 **Conclusions**

243 COVID-19 vaccine hesitancy was found in one out of every ten medical students. Lack of
244 awareness regarding vaccination eligibility, concern regarding adverse events and efficacy
245 of the vaccine and lack of trust in government were independently predictive of vaccine
246 hesitancy. Heightened risk perception regarding COVID-19 reduced vaccine hesitancy.
247 Concerns regarding lack of vaccine-related information and launch of vaccine prior to
248 release of safety and efficacy data were noted. Although vaccine hesitancy showed a
249 diminishing trend over time, health education programmes tailored to boost awareness
250 regarding vaccine and improve trust in government agencies would be helpful. Taking due
251 informed consent for registration of personal information in vaccine portal and ensuring
252 that vaccination sessions are not held just before examinations could further improve
253 acceptance of newly launched vaccines. As future health care providers, concerns of
254 medical students should be addressed on priority basis.

255 **DECLARATIONS**

256 **Authors' contributions** – JJ conceived the idea of the study. JJ and SS designed the
257 data collection format with inputs from MKG, PB. JJ conducted data collection. SS wrote
258 the manuscript with inputs from JJ, MKG, PB, AG and PRR. All authors approved the final
259 manuscript.

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

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

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

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

270 **Data availability statement** – Data upon which the study findings are based will be
271 included in Supplementary file 1, along with the article upon acceptance for publication.

272 REFERENCES

- 273 1. WHO. Weekly epidemiological update for COVID-19 – 2 March 2021. World Health
274 Organization, Geneva; 2021. Available at: [https://www.who.int/docs/default-](https://www.who.int/docs/default-source/coronaviruse/situation-reports/20210302_weekly_epi_update_29.pdf?sfvrsn=91306c8c_5)
275 [source/coronaviruse/situation-](https://www.who.int/docs/default-source/coronaviruse/situation-reports/20210302_weekly_epi_update_29.pdf?sfvrsn=91306c8c_5)
276 [reports/20210302_weekly_epi_update_29.pdf?sfvrsn=91306c8c_5](https://www.who.int/docs/default-source/coronaviruse/situation-reports/20210302_weekly_epi_update_29.pdf?sfvrsn=91306c8c_5) (accessed March
277 2021).
- 278 2. MoHFW. Frequently asked questions: COVID-19 vaccination. Ministry of Health and
279 Family Welfare, Government of India, New Delhi; 2021. Available at:
280 https://www.mohfw.gov.in/covid_vaccination/vaccination/index.html (accessed March
281 2021).
- 282 3. Sah R, Shrestha S, Mehta R, Sah SK, Rabaan AA, Dhama K, et al. AZD1222
283 (Covishield) vaccination for COVID-19: Experiences, challenges, and solutions in
284 Nepal. *Travel Med Infect Dis.* 2021 Feb 10;40:101989.
- 285 4. Bharat Biotech Announces Phase 3 Results of COVAXIN®: India's First COVID-19
286 Vaccine Demonstrates Interim Clinical Efficacy of 81%. Bharat Biotech International
287 Ltd., Hyderabad; 2021. Available at:
288 <https://www.bharatbiotech.com/images/press/covaxin-phase3-efficacy-results.pdf>
289 (accessed March 2021).
- 290 5. MoHFW. COVID-19 vaccination - operational guidelines (updated 20 December 2020).
291 Ministry of Health and Family Welfare, Government of India, New Delhi; 2021.
292 Available at: <https://www.mohfw.gov.in/pdf/COVID19VaccineOG111Chapter16.pdf>
293 (accessed March 2021).
- 294 6. Paterson P, Meurice F, Stanberry LR, Glismann S, Rosenthal SL, Larson HJ. Vaccine
295 hesitancy and healthcare providers. *Vaccine.* 2016 Dec 20;34(52):6700–6.
- 296 7. Kashte S, Gulbake A, El-Amin Iii SF, Gupta A. COVID-19 vaccines: rapid
297 development, implications, challenges and future prospects. *Hum Cell.* 2021 Mar 7:1–
298 23. doi: 10.1007/s13577-021-00512-4.

- 299 8. Manning ML, Gerolamo AM, Marino MA, Hanson-Zalot ME, Pogorzelska-Maziarz M.
300 COVID-19 vaccination readiness among nurse faculty and student nurses. *Nurs*
301 *Outlook*. 2021 Feb 5:S0029-6554(21)00023-3. doi: 10.1016/j.outlook.2021.01.019.
302 Epub ahead of print.
- 303 9. Grech V, Gauci C. Vaccine hesitancy in the University of Malta Faculties of Health
304 Sciences, Dentistry and Medicine vis-à-vis influenza and novel COVID-19 vaccination.
305 *Early Hum Dev*. 2020 Nov 12;105258.
- 306 10. Taylor S, Landry CA, Paluszek MM, Groenewoud R, Rachor GS, Asmundson GJG. A
307 Proactive Approach for Managing COVID-19: The Importance of Understanding the
308 Motivational Roots of Vaccination Hesitancy for SARS-CoV2. *Front Psychol*.
309 2020;11:575950.
- 310 11. Lucia VC, Kelekar A, Afonso NM. COVID-19 vaccine hesitancy among medical
311 students. *J Public Health (Oxf)*. 2020 Dec 26:fdaa230. doi: 10.1093/pubmed/fdaa230.
- 312 12. Qiao S, Friedman DB, Tam CC, Zeng C, Li X. Vaccine acceptance among college
313 students in South Carolina: Do information sources and trust in information make a
314 difference? *medRxiv [Preprint]*. 2020 Dec 4:2020.12.02.20242982. doi:
315 10.1101/2020.12.02.20242982.
- 316 13. Voysey M, Clemens SAC, Madhi SA, Weckx LY, Folegatti PM, Aley PK, et al. Safety
317 and efficacy of the ChAdOx1 nCoV-19 vaccine (AZD1222) against SARS-CoV-2: an
318 interim analysis of four randomised controlled trials in Brazil, South Africa, and the UK.
319 *Lancet*. 2021 Jan 9;397(10269):99–111.
- 320 14. Bhuyan A. India begins COVID-19 vaccination amid trial allegations. *Lancet*. 2021 Jan
321 23;397(10271):264.
- 322 15. Ella R, Vadrevu KM, Jogdand H, Prasad S, Reddy S, Sarangi V, et al. Safety and
323 immunogenicity of an inactivated SARS-CoV-2 vaccine, BBV152: a double-blind,
324 randomised, phase 1 trial. *Lancet Infect Dis*. 2021 Jan 21:S1473-3099(20)30942-7.
325 doi: 10.1016/S1473-3099(20)30942-7.
- 326 16. Lucia VC, Kelekar A, Afonso NM. COVID-19 vaccine hesitancy among medical
327 students. *Journal of Public Health [Internet]*. 2020 Dec 26 [cited 2021 Feb 1];(fdaa230).
328 Available from: <https://doi.org/10.1093/pubmed/fdaa230>
- 329 17. Saied SM, Saied EM, Kabbash IA, Abdo SAE. Vaccine Hesitancy: Beliefs and Barriers
330 Associated with COVID-19 Vaccination among Egyptian Medical Students. *J Med*
331 *Viro*. 2021 Feb 28. doi: 10.1002/jmv.26910. Epub ahead of print.
- 332 18. Barello S, Nania T, Dellafiore F, Graffigna G, Caruso R. “Vaccine hesitancy” among
333 university students in Italy during the COVID-19 pandemic. *Eur J Epidemiol*. 2020
334 Aug;35(8):781–3.
- 335 19. Afonso NM, Kavanagh MJ, Swanberg SM, Schulte JM, Wunderlich T, Lucia VC. Will
336 they lead by example? Assessment of vaccination rates and attitudes to human
337 papilloma virus in millennial medical students. *BMC Public Health*. 2017 Jan
338 6;17(1):35.

- 339 20. Kernéis S, Jacquet C, Bannay A, May T, Launay O, Verger P, et al. Vaccine Education
340 of Medical Students: A Nationwide Cross-sectional Survey. *American Journal of*
341 *Preventive Medicine*. 2017 Sep 1;53(3):e97–104.
- 342 21. Mo PK, Luo S, Wang S, Zhao J, Zhang G, Li L, Li L, Xie L, Lau JTF. Intention to
343 Receive the COVID-19 Vaccination in China: Application of the Diffusion of Innovations
344 Theory and the Moderating Role of Openness to Experience. *Vaccines (Basel)*. 2021
345 Feb 5;9(2):129. doi: 10.3390/vaccines9020129.
- 346 22. Nguyen KH, Srivastav A, Razzaghi H, Williams W, Lindley MC, Jorgensen C, et al.
347 COVID-19 Vaccination Intent, Perceptions, and Reasons for Not Vaccinating Among
348 Groups Prioritized for Early Vaccination - United States, September and December
349 2020. *MMWR Morb Mortal Wkly Rep*. 2021 Feb 12;70(6):217–22.
- 350 23. WHO. Health education: theoretical concepts, effective strategies and core
351 competencies: a foundation document to guide capacity development of health
352 educators. World Health Organization - EMRO, Cairo; 2012. Available at:
353 <https://apps.who.int/iris/handle/10665/119953> (accessed December 2020).
- 354 24. Szymd B, Bartoszek A, Karuga FF, Staniecka K, Błaszczuk M, Radek M. Medical
355 Students and SARS-CoV-2 Vaccination: Attitude and Behaviors. *Vaccines (Basel)*.
356 2021 Feb 5;9(2):128. doi: 10.3390/vaccines9020128.
- 357 25. Fisher KA, Bloomstone SJ, Walder J, Crawford S, Fouayzi H, Mazor KM. Attitudes
358 Toward a Potential SARS-CoV-2 Vaccine □: A Survey of U.S. Adults. *Ann Intern Med*.
359 2020 Dec 15;173(12):964–73.
- 360 26. Sun S, Lin D, Operario D. Interest in COVID-19 vaccine trials participation among
361 young adults in China: Willingness, reasons for hesitancy, and demographic and
362 psychosocial determinants. *medRxiv [Preprint]*. 2020 Jul 14:2020.07.13.20152678. doi:
363 10.1101/2020.07.13.20152678.
- 364 27. Pastorino R, Villani L, Mariani M, Ricciardi W, Graffigna G, Boccia S. Impact of
365 COVID-19 Pandemic on Flu and COVID-19 Vaccination Intentions among University
366 Students. *Vaccines (Basel)*. 2021 Jan 20;9(2):70. doi: 10.3390/vaccines9020070.

367 **FIGURES**

368 **Figure 1: State/Union territory-wise participation of medical students in the COVID-**
369 **19 vaccine survey (n = 1068)**

370 **Figure 2: Week-wise trend of cumulative COVID-19 vaccine hesitancy among**
371 **surveyed medical students**

372 **Figure 3: Sources of information regarding COVID-19 vaccine for the medical**
373 **students (n = 1068)**

374 **Figure 4: Reasons for COVID-19 vaccine hesitancy among the medical students (n =**
375 **113)**

376 **TABLES**

377 **Table 1. Responses of medical students belonging to vaccine acceptance and**
 378 **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
	n	%	n	%	n	%		
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 (3 rd year, 4 th year 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'	1042	97.6	939	98.3	103	91.2	0.18 (0.08 – 0.40)	< 0.001
COVID-19 vaccination is important to me in order to resume my clinical posting and	899	84.2	865	90.6	34	30.1	0.04 (0.03 – 0.07)	< 0.001

face-to-face classes.									
'COVID-19 vaccination is important to me to get my personal life back on track.'	776	72.7	746	78.1	30	26.5	0.053 (0.03 – 0.08)	< 0.001	
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 health care 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.	468	43.8	385	40.3	83	73.5	4.10 (2.65 – 6.34)	< 0.001	
'I am concerned about the serious adverse events from the currently available COVID-19 vaccines'	621	58.1	523	54.8	98	86.7	5.40 (3.09 – 9.43)	< 0.001	
'I am concerned about the present COVID-19 vaccines might not have been tested rigorously prior to launch'	502	47.0	419	43.9	83	73.5	3.54 (2.29 – 5.48)	< 0.001	
'I trust the information I am receiving about the COVID-19 vaccine from the government or public health experts.'	799	74.8	765	80.1	34	30.1	0.11 (0.07 – 0.16)	< 0.001	
Choice of vaccines									
I consider it important to choose between the different available COVID-19 vaccines for myself.	800	74.9	724	75.8	76	67.3	0.66 (0.43 – 1.00)	0.053	
I consider it important to choose between the different available COVID-19 vaccines for my patients in future.	907	84.9	819	85.8	88	77.9	0.58 (0.36 – 0.94)	0.034	
If provided an option, which of the following vaccines would you choose for yourself?									
Covaxin	213	19.9	205	21.5	8	7.1	0.17 (0.08 – 0.37)	< 0.001	
Covishield	483	45.2	446	46.7	37	32.7	0.36 (0.23 – 0.57)	< 0.001	
No preference for either of them	86	8.1	71	7.4	15	13.3	0.93 (0.49 – 1.75)	0.834	
Don't have enough information to choose	286	26.8	233	24.4	53	46.9	1 (reference)	-	
Prior vaccination experience									

Have you received any other vaccine(s) after joining as a medical student (apart from COVID-19 vaccine)	414	38.8	376	39.4	38	33.6	0.78 (0.52 – 1.18)	0.237
Type of vaccine	N = 414		N = 376		N = 38			
Hepatitis B	325	78.5	293	77.9	32	84.2	0.68 (0.30 – 1.52)	0.352
Tetanus	116	28.0	108	28.7	8	21.1	1 (reference)	-
Hepatitis A	23	5.6	19	5.1	4	10.5	0.352 (0.10 – 1.29)	0.142
Hepatitis C	17	4.1	16	4.3	1	2.6	1.19 (0.14 – 10.11)	0.957
Varicella	15	3.6	14	3.7	1	2.6	1.04 (0.12 – 8.92)	0.952
Human Papilloma Virus	10	2.4	9	2.4	1	2.6	0.67 (0.07 – 5.94)	0.688
Herpes	2	0.5	1	0.3	1	2.6	0.07 (0.004 – 1.30)	0.153
Other vaccines	91	22.0	91	24.2	0	0	-	-

379

380 **Table 2. Multivariable logistic regression for plausible determinants of COVID-19**
 381 **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

382

383 **Table 3. Multivariable logistic regression for plausible determinants of hesitancy**
 384 **regarding participation in COVID-19 vaccine trials (N = 1068)**

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

385

386 **Table 4: Comments provided by medical students regarding COVID-19 vaccine**

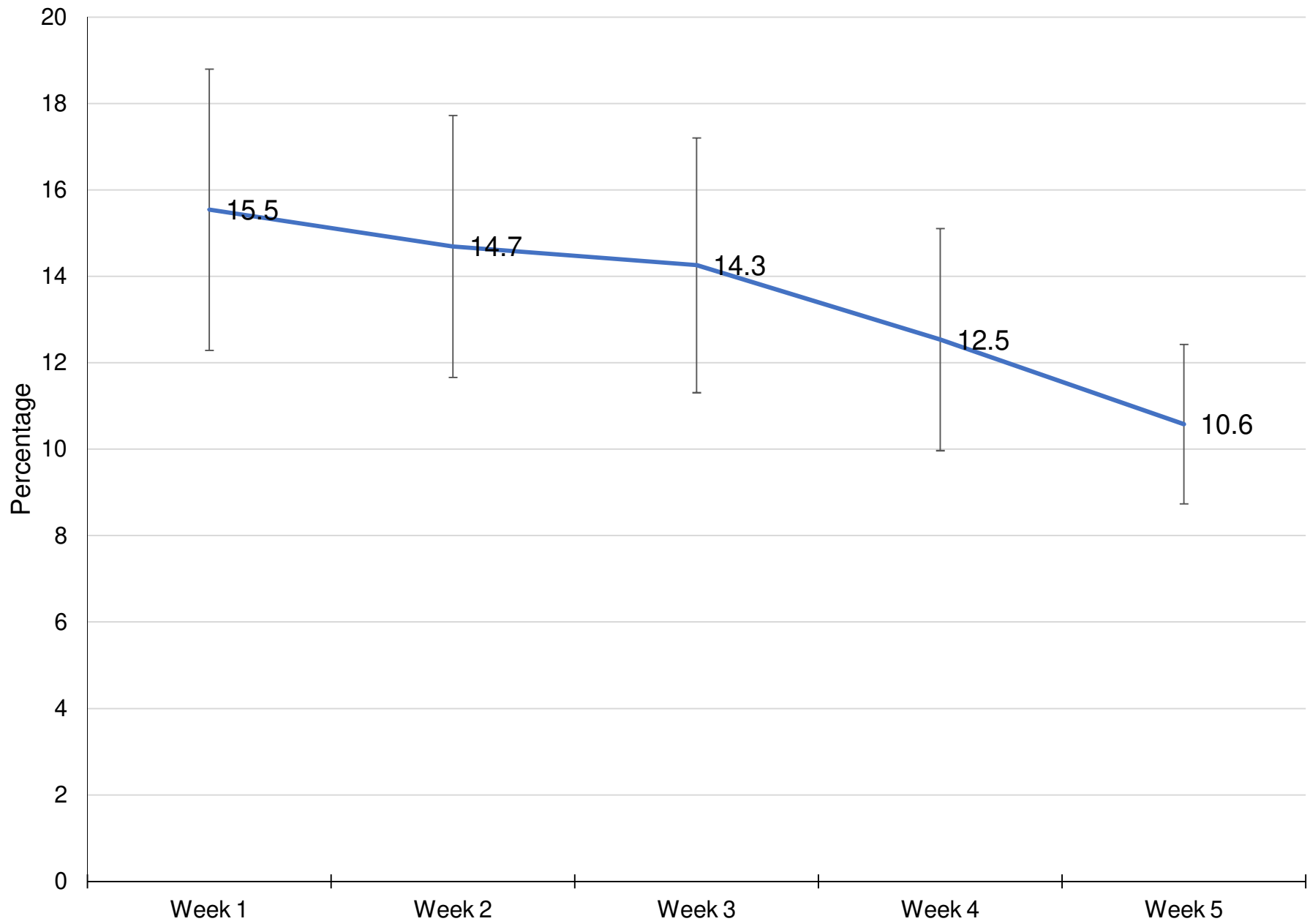
Theme (total number of comments)	Representative Quotes
Concerns regarding vaccine	'Adverse effects of vaccine are too much.' 'We still don't know the long-term effect of this vaccine so the people who are in low covid prone area can avoid taking the vaccine until clinical trial ends & rest who are at 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

	<p>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.'</p> <p>'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.'</p> <p>'It's efficacy and side effects should be mentioned properly, updated information.'</p> <p>'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.'</p> <p>'It should not be mandatory for any one'</p> <p>'I am worried about the side effects of the vaccine'</p> <p>'I doubt Its potential'</p> <p>'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.'</p> <p>'The socioethical condition, family condition of student must be considered and Side effects must be taken into account.'</p> <p>'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'</p> <p>'Govt and medical officials failed to provide proper info to common folks about mechanism of action of vaccines.'</p> <p>'I hope it works.'</p>
<p>Confidence in vaccine</p>	<p>'I think to control the spread of this disease, vaccination is must and everyone should participate in it'</p> <p>'Vaccine should be made available for the general public as soon as possible.'</p> <p>'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.'</p> <p>'Just go for it'</p> <p>'We as health care professionals should avoid rumours about COVID-19 vaccine as they don't have any proper base and should believe in our researchers, doctors and government'</p>

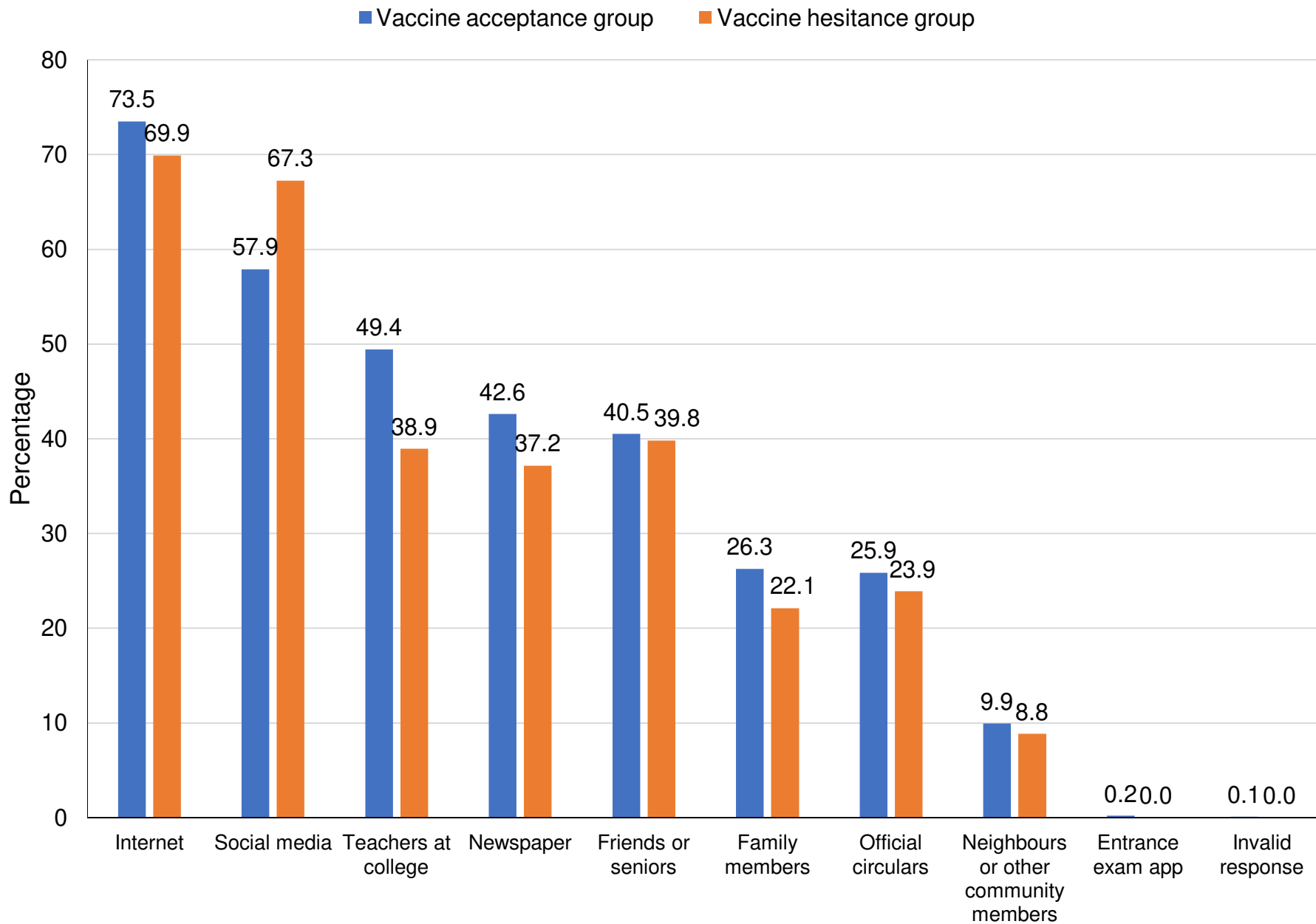
	<p>'It's awesome, thanks for the adventure'</p> <p>'Do it as fast as possible'</p> <p>'We medical students should encourage everyone to being vaccinated'</p> <p>'Vaccination is important to all the country.'</p> <p>'Proud to say that it's our own.'</p>
Practical considerations regarding vaccinations	<p>'Those below 20 should not be given vaccine according to me!!'</p> <p>'Don't be vaccinated during exam because it may cause variable side effect'</p> <p>'There should be certain blood parameters to determine if the vaccine has generated certain immune response or not'</p> <p>'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... '</p> <p>'Our vaccination is yet pending'</p> <p>'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'</p> <p>'Because of Covid Vaccine our exams are being started in hurry. So much less preparation'</p>
Need for better education regarding vaccine	<p>'The medical institutions should inform about the dos and don'ts after putting vaccine.'</p> <p>'All the effects after virus should be informed. So that people don't consider them as side effects and advise against it'</p> <p>'I think data analysis should be made clearer. Or it might be possible that I am not going to the right articles?'</p> <p>'Which vaccine is best right now?'</p> <p>'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.'</p> <p>'Please make this type of forms for spreading awareness of different types of vaccines, basic differences, plus points, minus points.'</p>

387 **Supplementary file**

388 **Supplementary file 1: Data for 'Determinants of COVID-19 vaccine hesitancy among**
 389 **undergraduate medical students: results from a nationwide survey in India'**



(Chi-square for linear trend = 9.91, $df = 1$, $p = 0.00164$)



Odds ratio 95%CI	1.07 (0.54- 2.14)	1.31 (0.65 – 2.61)	0.89 (0.43 – 1.82)	0.98 (0.47 – 2.02)	1.11 (0.54 – 2.27)	0.95 (0.44 – 2.04)	1.04 (0.48 – 2.28)	1 (Reference)	NA	NA
---------------------	----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	------------------	----	----

