Original Article

COVID-19 vaccine hesitancy and its determinants among health-care workers and non-health-care workers: An online survey in India

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Abstract

Background: India has already witnessed two COVID-19 waves, and in midst of it, India was not far behind in rolling out COVID-19 vaccination. However, considering the novelty of the disease and very short duration invested in developing the vaccine, hesitancy to take the vaccine was expected.

Methods: This cross-sectional study was conducted by using validated, multi-lingual, self-administered online questionnaires designed separately for the health-care workers (HCWs) and non-HCWs. Adult subjects willing to participate in our study by filling the online questionnaire were included. First 1000 responses were selected for the analysis.

Results: On Likert scale, 45% HCWs and 51.2% non-HCWs were hesitant about vaccination. Binary logistic regression predicted the factors of hesitancy as follows. for HCWs (female-gender [odds ratio (OR) = 0.518, 95% confidence intervals (95% CI) 0.368–0.728, $P < 0.001$], middle-age [26–35 years (OR = 1.78, 95% CI 1.644–8.062), $P = 0.001$], 35–55 years [OR = 2.51, 95% CI 1.279–4.925, $P = 0.007$], doubtful vaccine efficacy [OR = 2.262, 95% CI 1.283–3.989, $P = 0.005$]); for non-HCWs [{no past medical illness (OR = 1.672, 95% CI 1.019–2.906, $P = 0.048$)], doubtful vaccine efficacy [(OR = 2.442, 95% CI 1.022–5.834, $P = 0.048$)].

Conclusions: Our observations suggest that the vaccine hesitancy can be a major hindrance to achieve desired vaccination coverage in India. This hesitancy is safety, quality control, novelty of the disease and vaccine, efficacy and false belief of herd immunity among the community.

Keywords: COVID-19 vaccine hesitancy, vaccine acceptance, vaccine efficacy, vaccine perception, vaccine safety

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INTRODUCTION

Human species very well knows survival through pandemics. It took less than a year after the first reported case of severe acute respiratory syndrome coronavirus

2 (SARS-COV-2) to roll out the first vaccination campaign in the United Kingdom and Europe.[1] Enormous efforts and money have been put into the vaccine development within a very short time.[2] The entire world is aware that

Access this article online

Quick Response Code:

Website:
www.jcsr.co.in

DOI:
10.4103/jcsr.jcsr_38_21

How to cite this article: Bhondve AS, Ingawale SM, Rajapurkar ND. COVID-19 vaccine hesitancy and its determinants among health-care workers and non-health-care workers: An online survey in India. J Clin Sci Res 2021;10:212-20.

the threat is on-going, as several locally mutated variants have been identified. The disease burden is still increasing, and the new variants have been found to demonstrate high virulence and severity.[3] In the absence of definitive therapeutic measures, health promotion measures such as use of face masks, social distancing and hand washing and specific protection measures such as vaccine prophylaxis are the only options to halt the transmission.[4,5] India has already witnessed two COVID-19 waves and in midst of it, India was not far behind in rolling out the world's largest COVID-19 vaccination programme on 16th January 2021. In India, vaccination drive was flagged off with vaccination of health-care workers (HCWs) and currently to all adults. Numerous vaccines cropped up across the globe with Oxford/AstraZeneca-CoviShield, Covaxin, Gamaleya-Sputnik, Moderna and BioNTech/Pfizer, being few of the leading ones. Currently, India has approved three vaccines, Oxford/AstraZeneca-CoviShield, Covaxin and Gamaleya-Sputnik-V.[6] All the vaccines have shown 80%–95% efficacy in various studies.[7-10] The Government of India is making extensive efforts to bring more COVID-19 vaccines to tackle the new and more aggressive wave of COVID-19.

However, to achieve the desired coverage, vaccine acceptance is crucial. Considering the novelty of the disease and very short duration invested in vaccine development, vaccine hesitancy was expected. Vaccine hesitancy, an old social phenomenon, defined by the WHO as the delay in acceptance or refusal of vaccination despite availability of vaccination services. The phenomenon is widely prevalent in all groups of population including HCWs.[11] General population wants the vaccine to be effective and safe. The vaccine hesitancy is a very complex, dynamic, and multi-dimensional phenomenon. It might not always correlate with the current vaccine availability and disease rate. It's not just determined by the medical literature but also by social media and peer influence.[11-14] Previous studies on hesitancy have pointed out that certain factors such as disease severity, previous vaccination history, lack of belief in health-care services, route of vaccine administration, economic and educational status, recommendations from doctors, and cost of vaccine also determine the acceptance of vaccines. In addition, multiple pseudo-scientific conspiracy theories have flooded social media. Similarly, vaccine hesitancy may become an important challenge in the COVID-19 immunization campaign.[15]

Several studies have assessed the hesitancy among HCWs and non-HCWs separately.[16-19] However, our survey has studied the hesitancy among both the groups together and tried to analyse the differences towards acceptance of the vaccine. Earlier, the general population used

to rely on HCWs' recommendations to guide their decisions. However, social-media is playing a pivotal role in dissemination of information to the general population to take independent decisions. Hence, it is crucial to assess these two groups' attitude towards the vaccination at the same time in the same survey.

In this cross-sectional, nationwide, multilingual two questionnaires-based online study, we analysed the various sociodemographic variables, knowledge and understanding, perception, beliefs and barriers that determine the hesitancy towards vaccination among both HCWs and non-HCWs.

MATERIAL AND METHODS

This is a cross-sectional study conducted by using validated, multi-lingual, self-administered online questionnaires through Google forms. Given their differences in knowledge and understanding of the medical field, two separate questionnaires were designed for the medical fraternity (having or pursuing a medical course namely medical teachers, students, general-practitioners, AYUSH fraternity, nursing and paramedics) and for the rest of the population. Convenient sampling technique was used. The sample size was calculated based on the prevalence of vaccine acceptance from our pilot study. Out of 100 study participants, 30% showed acceptance. Hence, considering 30% prevalence, at 95% level of confidence, 10% relative precision, 10% attrition and by formula $n = Z^2P\ (1-P)/d^2$ the sample size was calculated as 1000. Institutional Ethics Committee approval was sought (Ref No: EC/OA-51/2021). The Google forms were distributed through WhatsApp. Adult (age >18 years) Indian citizens consenting to participate in the study were included. First 1000 responses were selected for the analysis.

Two different pre-validated questionnaires for HCWs and non-HCWs were translated and back translated and revalidated from experts of either profession. Some close-ended questions were two item responses 'Yes/No' or '5-item Likert type Scale' indicative of the degree of agreement (Definitely/Probably/Possibly/Probably Not/Definitely not).

It had three sections: (i). First section: Included Informed consent, resident and citizen status and separated HCWs from non-HCWs ensuring that the participants would receive the questionnaire intended to them as per the profession; (ii). Second section: Included demographic details, comorbidity, history of COVID-19 infection and COVID (15 questions); and (iii). Third section:

Questions pertaining to knowledge and understanding about COVID-19 vaccine, its usage and acceptance (25 questions).

Statistical analysis

The data were automatically obtained in Spreadsheet form as an output of Google form, cleaned and downloaded in Microsoft Excel (2010) and analysed using the Statistical Package for the Social Sciences (SPSS), Version 21.0 for Microsoft Windows (IBM Corp, Armonk, NY, USA). The quantitative data such as age, duration of experience in practice is presented using median and interquartile range (IQR). Qualitative data such as demographics, age groups, gender, comorbidities, etc., were presented with frequency and percentage tables. Association among two or more groups was assessed with the help of Chi-square or Fisher's exact test wherever appropriate. Binary logistic regression was applied to predict the determinants of vaccine hesitancy differently among both the groups. Multivariate analysis was done with two models. In the first model, the factors related to study participants such as age groups, gender, comorbidity, living status, and nature of work were considered. Whereas in the second model factors related to perceived information about vaccine, posology, efficacy, safety and source of information about the vaccine determining the hesitancy towards vaccine were considered for the analysis. Level of significance was considered at 95% confidence interval ($P < 0.05$).

RESULTS

As per ethics committee approval, analysis was conducted among the first 1000 participants. Out of 1000 participants, 853 belonged to Maharashtra and rest were from 20 other states. Out of 1000 participants, 637 were related to medical professionals (HCWs): Medical-Practitioners (Allopathy, Ayush, etc.,) ($n = 371$, 58.2%), medical students ($n = 242$, 38%) and paramedics ($n = 24$, 33.8%) and 363 were not related to the medical profession (non-HCWs). Among

HCWs and non-HCWs 51.5% and 56.7% were males respectively. The median age of HCWs was 26 (IQR 24) years and median age of non-HCWs was 43 (IQR 26) years. Among HCWs 23.1% and 26.2% non-HCWs responded that they had any one of the comorbidities. Of the total participants (n=116) 11.6% were infected with COVID-19, of which 67.2% were HCWs (Table 1).

Questions about the willingness to get vaccinated (on Likert scale) yielded that 52.1% HCWs and 45.7% non-HCWs were definitely going to get vaccinated and almost same proportion of participants will definitely recommend it their family. Overall only 2.9% of total participants (HCWs 2.8% and non-HCWs 3%) responded that they definitely would not take the vaccine. 105% of HCWs, who responded that they would definitely take the vaccine, also responded that they would recommend it to others. Five per cent HCWs and 9.1% non-HCWs think that they could stop wearing the masks after vaccination. Around 10% participants from both the groups opined that India has gained herd immunity. 30%–35% from both groups responded that they might opt for vaccine tourism if needed (Table 2 and Figure 1).

In the third section, questions about the various vaccine types, posology, safety, efficacy, cost, etc., were asked. 50.1% HCWs did not have any vaccine brand preference, whereas 54% non-HCWs had a specific brand preference which was statistically significant ($P = 0.003$).

Only 46% HCWs and 54% non-HCWs responded that they would get vaccinated if they are first one to get vaccinated at the workplace among others. Similar proportions (HCWs = 45.5%, non-HCWs = 53.7%, $P = 0.003$) were noted in response to the question whether vaccination should be made compulsory for all. Almost 80% from both the groups responded that even if they would have had COVID-19 illness they should be taking

Table 1: Baseline characteristics

Variable	HCWs	Non-HCWs	Total
Age (years)†	26 (24)	43 (26)	32(27)
Male*	328 (51.5)	206 (56.7)	534 (53.4)
Married/engaged*	267 (41.9)	243 (66.9)	510 (51.0)
At least 1 comorbidity*	147 (23.1)	95 (26.2)	242 (24.2)
DM*	13 (2.0)	15 (4.1)	28 (2.8)
DM with HTN*	9 (1.4)	16 (4.4)	25 (2.5)
HTN*	67 (10.5)	33 (9.1)	100 (10.0)
Were COVID-19 infected*	78 (12.2)	38 (10.5)	116 (11.6)
Close relatives were COVID-19 infected*	303 (47.6)	168 (46.3)	471 (47.1)

*Data are presented as No. (%)
†Data are presented as median (interquartile range)
HCWs=Healthcare workers; IQR=Interquartile range; DM=Diabetes mellitus; HTN=Hypertension

the vaccine. Almost 45% HCWs and 39% non-HCWs opined that the vaccine would be effective on new strains (*P* = 0.09). Twenty-three per cent HCWs and 13% non-HCWs thought that drinking alcohol would influence on COVID-19 vaccine efficacy.

Respondents were asked 'Which of the following would be your biggest concern, if you intend to take the vaccine?'. Both the groups responded that side effects (HCW [46%], non-HCW [55.1%]) is the most common concern, followed by quality control of the vaccine (HCW [19%],

Table 2: Detailed perception/acceptance about the vaccination

|	Definitely No. (%)	Probably No. (%)	Possibly No. (%)	Probably not No. (%)	Definitely not No. (%)	Total No. (%)	P-value
Willingness to get vaccinated							
HCW	332 (52.1)	148 (23.2)	76 (11.9)	63 (9.9)	18 (2.8)	637 (100.0)	0.372
Non-HCW	166 (45.7)	90 (24.8)	53 (14.6)	43 (11.8)	11 (3.0)	363 (100.0)	
Recommended to family members							
HCW	331 (52.0)	150 (23.5)	82 (12.9)	55 (8.6)	19 (3.0)	637 (100.0)	0.486
Non-HCW	174 (47.9)	84 (23.1)	56 (15.4)	40 (11.0)	9 (2.5)	363 (100.0)	
Recommended to patients (for HCWs only)	349 (54.8)	148 (23.2)	97 (15.2)	30 (4.7)	13 (2.0)	637 (100.0)	0.392
Do you think that getting yourself vaccinated may cause adverse effects for yourself?							
HCW	47 (7.4)	168 (26.4)	241 (37.8)	159 (25.0)	615 (96.5)	637 (100.0)	<0.001
Non-HCW	29 (8.0)	114 (31.4)	126 (34.7)	85 (23.4)	354 (97.5)	363 (100.0)	
In your opinion could people stop wearing masks if they get themselves vaccinated?							
HCW	32 (5.0)	168 (26.4)	139 (21.8)	215 (33.8)	83 (13.0)	637 (100.0)	0.204
Non-HCW	33 (9.1)	129 (35.5)	106 (29.2)	75 (20.7)	20 (5.5)	363 (100.0)	
In your opinion has India has gained herd immunity against COVID-19?							
HCW	55 (8.6)	179 (28.1)	181 (28.4)	157 (24.6)	65 (10.2)	637 (100.0)	0.204
Non-HCW	40 (11.0)	114 (31.4)	108 (29.8)	72 (19.8)	29 (8.0)	363 (100.0)	
If yes, do you think it will have an negative impact on COVID-19 vaccination drive?							
HCW	35 (5.5)	129 (20.3)	159 (25.0)	235 (36.9)	79 (12.4)	637 (100.0)	0.534
Non-HCW	21 (5.8)	80 (22.0)	97 (26.7)	114 (31.4)	51 (14.0)	363 (100.0)	
Are you likely to opt for vaccine tourism if the vaccine is delayed in India?							
HCW	34 (5.3)	75 (11.8)	107 (16.8)	207 (32.5)	214 (33.6)	637 (100.0)	0.977
Non-HCW	21 (5.8)	45 (12.4)	63 (17.4)	119 (32.8)	115 (31.7)	363 (100.0)	

HCWs = Healthcare workers
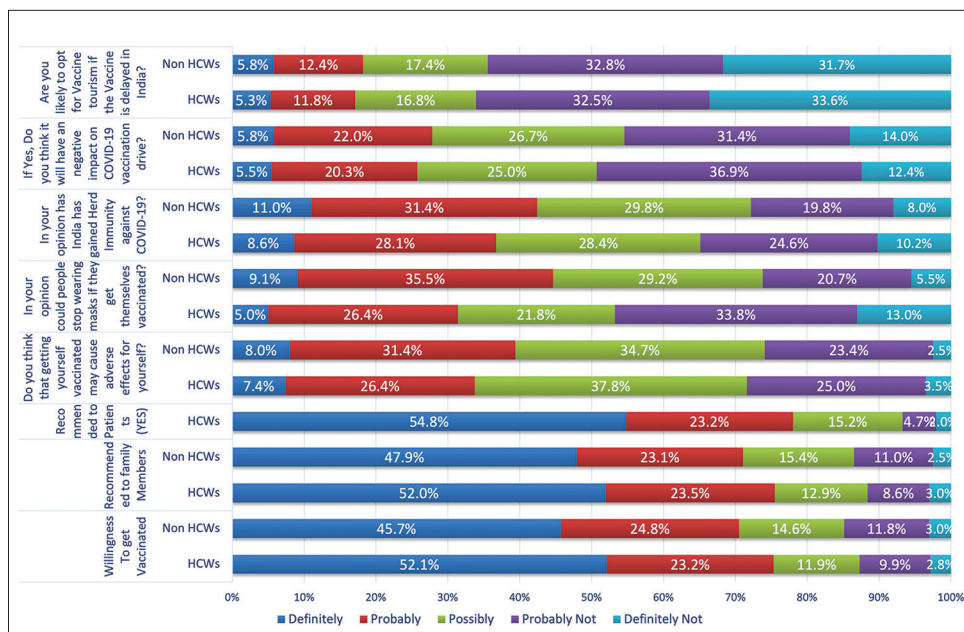
Figure 1: Opinions/attitudes about the common questions of COVID-19 Vaccines

Bhondve, *et al.*: COVID-19 vaccine hesitancy and its determinants

Table 3: Which of the following would be your biggest concern, if you intend to take the vaccine?'

Variable	HCWs No. (%)	Non-HCWs No. (%)	Total No. (%)	*P*-value
Associated COVID-19 illness	23 (3.6)	7 (1.9)	30 (3.0)	0.133
COVID-19 symptoms are mostly mild	5 (0.8)	6 (1.7)	11 (1.1)	0.206
Doubted efficiency of the vaccine	71 (11.1)	34 (9.4)	105 (10.5)	0.377
Herd immunity is better	26 (4.1)	13 (3.6)	39 (3.9)	0.694
Novelty of the disease and vaccine	79 (12.4)	28 (7.7)	107 (10.7)	0.021
Physiological immunity is better	10 (1.6)	13 (3.6)	23 (2.3)	0.041
Pregnancy	9 (1.4)	3 (0.8)	12 (1.2)	0.412
Quality control	121 (19.0)	59 (16.3)	180 (18.0)	0.279
Side effects	293 (46.0)	200 (55.1)	493 (49.3)	0.005
Total	637 (100.0)	363 (100.0)	1000 (100.0)	

HCWs=Healthcare workers

non-HCW [16.3%]). Of these, both the groups were statistically different on concerns such as physiological immunity, novelty of the disease and the vaccine and vaccine side effects (Table 3).

Statistical significant associations were found for the question 'Which of the following have influenced your acceptance/avoidance of COVID-19 vaccine?' The most common sources for vaccine information for HCWs were medical-literature (64.7%) followed by social-media (27.6%). Whereas for non-HCWs were news-channels (39.7%), social-media (34.7%), medical-literature (27.3%) (Table 4).

Table 4: Which of the following have influenced your acceptance/avoidance of COVID-19 vaccine?

Mode of Influence	HCWs No. (%)	Non-HCWs No. (%)	Total No. (%)	*P*-value
Friends	13 (2.0)	14 (3.9)	27 (2.7)	0.088
Medical literature	412 (64.7)	99 (27.3)	511 (51.1)	<0.0001
News channels	165 (25.9)	144 (39.7)	309 (30.9)	<0.0001
Newspaper	116 (18.2)	96 (26.4)	212 (21.2)	0.002
No definite source	78 (12.2)	65 (17.9)	143 (14.3)	0.013
Social media	176 (27.6)	126 (34.7)	302 (30.2)	0.019
Other media	73 (11.5)	50 (13.8)	123 (12.3)	0.285
Total	637 (100.0)	363 (100.0)	1000 (100.0)	

HCW=Healthcare worker

Binary logistic regression was used to predict the factors of hesitancy among both groups. Among the HCW, male gender (odds ratio [OR] = 0.518, 95% CI = 0.368–0.728, *P* < 0.001), middle age (26–35 years OR = 1.78, 1.644–8.062, 95% CI = *P* = 0.001), 35–55 years (OR = 2.51, 95% CI = 1.279–4.925, *P* = 0.007) were demographic predictors of hesitancy. While, doubtful vaccine efficacy (OR = 2.262, 95% CI = 1.283–3.989, *P* = 0.005), medical literature as source of vaccine information, (OR = 0.531, 95% CI = 0.348–0.811, *P* = 0.003), belief in herd immunity (OR = 1.902, 95% CI = 1.231–2.939, *P* = 0.004) and belief that COVID-infected patients need not take vaccines (OR = 1.995,

95% CI = 1.213–3.281, *P* = 0.007) were the non-demographic predictors of hesitancy (Table 5).

Among non-HCWs those who did not have any medical illness (OR = 1.672, 95% CI = 1.019–2.906, *P* = 0.048) were hesitant to get vaccinated, while doubtful vaccine efficacy (OR = 2.442, 95% CI = 1.022–5.834, *P* = 0.048) and belief that COVID-infected patients need not take vaccines (OR = 2.268, 95% CI = 1.019–5.224, *P* = 0.045) predicted the hesitancy toward COVID-19 vaccine.

DISCUSSION

Vaccination drive in India was flagged off on 16th January 2021 with vaccination of HCWs. After that several surveys have gauged the public perception and acceptance of the vaccine among HCWs and general population as separate cohorts.[20-24] To achieve maximum vaccination, institutions and policy-makers need to design the strategies to identify and allay the hesitancy by targeting specific population subgroups. This study has analysed both the populations subgroups together.

There are the reports of non-acceptance of vaccines among HCWs and non-HCWs worldwide.[20-24] The principal concerns identified by our study were safety and quality control of the vaccine. This could be because the vaccine is developed within a very short duration. Similar attitude was also observed towards the H1N1 influenza vaccine; however, there are fewer publications which document the same.[25]

In our study, only 49.8% of the total participants responded that they will definitely get vaccinated. The proportion was just higher among HCWs (52.1%) and non-HCWs (45.7%). 45.1% HCWs and 51.2% non-HCWs were hesitant to get vaccinated. The proportion of acceptance is far below than required to halt the current pandemic. In a simulation

Table 5: Binary logistic regression to predict hesitancy of vaccine amongst HCWs and non-HCWs

Predictors of hesitancy of vaccine amongst medical profession				Predictors of hesitancy of vaccine amongst non-medical profession			
Variable	Adjusted OR	P-value	95% CI	Variable	Adjusted OR	P-value	95% CI
Male	0.518	<0.001	0.368–0.728	Male	0.795	0.32	0.506–1.25
Age group [>55 years (reference)]		0.003		Age group >55 years (reference)		0.149	
<25	1.785	0.147	0.815–3.907	<25	1.048	0.912	0.455–2.414
26–35	3.64	0.001	1.644–8.062	26–35	0.985	0.974	0.394–2.463
36–55	2.51	0.007	1.279–4.925	36–55	1.739	0.141	0.833–3.63
Staying with family (yes)	0.756	0.242	0.474–1.208	Staying with family	1.71	0.258	0.675–4.335
HCWs (doctor) reference		0.734		Post-graduate		0.515	
HCWs (medical student)	0.876	0.657	0.488–1.572	Graduate	1.396	0.385	0.658–2.963
HCWs (paramedics)	1.277	0.578	0.54–3.017	HSC	1.497	0.249	0.754–2.972
Medical illness (yes)	0.826	0.403	0.528–1.292	Medical illness (no)	1.672	0.048	1.019–2.906
COVID positive self	0.844	0.517	0.505–1.411	COVID positive self	0.567	0.148	0.262–1.223
COVID positive (family)	1.55	0.011	1.107–2.17	COVID positive (family)	1.156	0.535	0.731–1.826
COVID ward duty [>1 month (reference)]		0.2		Working as usual		0.351	
COVID ward duty (not done)	0.681	0.127	0.415–1.116	Temporary unemployed	0.675	0.508	0.211–2.159
COVID ward duty (<1 month)	0.969	0.917	0.542–1.734	Loss of job	1.432	0.228	0.798–2.57
				Work from home		0.545	
				Work involves exposure	1.157	0.649	0.617–2.168
				No exposure but have to work	0.807	0.413	0.483–1.348
Mild disease	0.947	0.937	0.249–3.605	Mild disease	1.722	0.48	0.381–7.793
Safety	0	1		Safety	0	1.000	
Positive	1.058	0.928	0.308–3.635	Positive	5.159	0.168	0.502–53.066
Efficiency	2.262	0.005	1.283–3.989	Efficiency	2.442	0.044	1.022–5.834
Side effects	9×10^8	1.000		Side effects	9×10^8	1.000	
Don't believe vaccine	4×10^8	0.999		Don't believe vaccine	9×10^8	0.999	
Don't believe illness	4×10^8	0.999		Don't believe illness	1×10^9	0.999	
Friends	3.365	0.066	0.922–12.277	Friends	1.34	0.657	0.368–4.883
Medical literature	0.531	0.003	0.348–0.811	Medical literature	0.966	0.909	0.533–1.75
News channels	0.748	0.259	0.452–1.238	News channels	0.983	0.952	0.558–1.732
Newspaper	0.909	0.739	0.518–1.595	Newspaper	0.798	0.496	0.416–1.529
Social media	1.514	0.084	0.946–2.422	Social media	1.068	0.818	0.608–1.877
Cost (free) (reference)		0.691		Cost (free) (reference)		0.038	
Cost (>500 Rs.)	0.798	0.42	0.462–1.379	Cost (>500 Rs.)	0.54	0.118	0.25–1.168
Cost (<500 Rs.)	0.819	0.456	0.485–1.383	Cost (<500 Rs.)	1.231	0.547	0.627–2.417
Herd immunity is spread in India	1.902	0.004	1.231–2.939	Herd immunity is spread in India	1.219	0.502	0.683–2.177
Ineffective against new strain	0.826	0.356	0.551–1.239	Ineffective against new strain	1.026	0.928	0.585–1.8
Not necessary to take vaccine in case of past history of COVID	1.995	0.007	1.213–3.281	Not necessary to take vaccine in case of past history of COVID	2.268	0.045	1.019–5.224
Constant	0.269	0		Constant	0.37	0.025	

HCWs=Healthcare workers; HSC = Higher secondary school certificate; OR=Odds ratio; CI=Confidence intervals

model developed by Tata Institute of Fundamental Research and Indian Institute of Science, it is projected that the R_0 of India has progressed to more than 4 during the second wave. Therefore, at least 75% $(1-[1/R_0] \times 100\%)$ of the population is needed to be vaccinated.[26] To achieve desired coverage, >75% of the population should be willing to get vaccinated. Similar results were also found in the studies done worldwide. Nevertheless, in our study, the proportion of acceptance among HCWs was lower than their international counterparts.[18,20,27] Various studies including ours have pointed out the fact that the HCWs who got vaccinated are likely to recommend it to their family, friends and patients.[28-31] Hence, to convert the acceptance of vaccination from 50% to required 75%, we will have to formulate the strategies. Strategies such as targeted sensitisation of specific groups of the population showing unwillingness is necessary. Special educational

campaigns will help demystify the doubts regarding the vaccination.

The reasons for hesitancy in India could be an overall nonchalant attitude towards adult vaccination in India. Hence, to propagate adult vaccination in India, we will have to create the awareness among HCWs about the adult vaccination and then propagate the same to the general population. COVID vaccination drive is a good opportunity to promote the other adult vaccination programmes nationwide.

Sixty-percent of the participants were also reluctant to get vaccinated even if their employer provided it to them as one of the firsts to receive the vaccines at workplace. They also responded that they would like to wait for a few others to get vaccinated. In a study[32] it was reported

that HCWs in the USA will wait for 3–6 months for safety data of the vaccine to get published.

We studied the determinants of vaccine acceptance among HCWs and non-HCWs differently by univariate analysis. The variables such as presence of any comorbidity, lower age, past history of SARS-COV2, relatives affected with SARS-COV2 in the past, did not affect the decision of acceptance or non-acceptance of COVID vaccine among both HCWs and non-HCWs. The participants who perceived that the vaccine will be effective against newer strains had a higher percentage of acceptance. Among the HCWs, female gender, paramedical workers and medical professionals who did not do any COVID ward duties exhibited non-acceptance.

The source of information about the vaccine also plays a major role while deciding on acceptance of vaccination. While majority non-HCWs responded that social media, news channels, and newspapers were the sources of vaccine information, medical literature was the single most common source of information for most HCWs.[33]

The common concern of HCWs which was significantly different from non-HCWs was novelty of the vaccine and disease. Whereas the common concern among non-HCWs which was always significantly different from the HCWs was side effects to the vaccine.

In our study, we observed that only 2.9% of overall participants responded that they will definitely not get vaccinated. Forty-five per cent HCWs and 52% non-HCWs were hesitant to get vaccinated. Hence, the major concern demonstrated by this study is the hesitancy about the vaccination. This is the target population which can definitely be converted from hesitancy to willingness to get vaccinated. Hence, further analysis to demonstrate the predictors of hesitancy was done.

Similar to the results evidenced by most of the studies, female-HCWs are more hesitant to take the vaccine than males. HCWs on either ends of the age groups, i.e., young (<25 years) and old (>55 years) were more sure about taking the vaccine. This can be explained by the fact the old HCWs have perceived higher risk of severe form of COVID-19 disease and younger HCWs look at the vaccination drive as a mode to halt the disease and normalise the situation. They might be as well inclined to the vaccination as to indirectly protect the older non-HCWs in the family as most of the Indians stay in joint families.

The reasons for vaccine hesitancy were very similar among HCWs and non-HCWs. Among all the participants who doubt about the vaccine efficacy, and who think that vaccines are not necessary after COVID infection are hesitant to take vaccines. Various studies have reported differences in vaccine efficacy ranging from 80% to 95%.[8,9,34,35] These studies have been misquoted differently on various social media platforms. The 'anti-vax' groups have been spreading the rumours about less efficacy of the vaccines. Nevertheless, we also have seen that the HCWs who have gained the knowledge from medical literature are less hesitant. Hence, to achieve high vaccine coverage, the correct information about the vaccine supported by medical references should be made available to the general public. Most of this medical literature has paid access which might be a hindrance for vaccine knowledge. Besides medical literature, social-media platforms are a great source of information and have wide reach. These platforms with the use of machine learning can filter the misinformation on efficacy and only the correct information which is in favour of vaccines can be percolated.[33] Similarly, as the guidelines for interval between COVID-19 infection and vaccination have changed; this might have brought more confusion about taking the vaccine after COVID infection.

While almost half of the population is hesitant to get vaccinated, most of them will certainly get vaccinated over the period of time. This population group is definitely amenable, provided correct information is percolated and misleading information is selectively filtered out. Most of the non-HCW, which is almost 80% got the knowledge from news channels and social media as well; nevertheless, it was also found that 27% of the non-HCWs also got their knowledge from the medical literature.

This study can be concluded with a finding that the vaccine hesitancy can be a major hindrance to achieve desired vaccination coverage in India. This hesitancy is safety, quality control, novelty of the disease and vaccine, efficacy and false belief of herd immunity among the community. Nevertheless, this hesitancy is definitely an opportunity to convert into acceptance as more than half of the population belonged to this group. Currently, the country has opened the vaccine for all the indicated age groups. Studies are being conducted for vaccination of paediatric age groups. However, our study has shown hesitancy amongst middle age population (25–55 years). With the impending third wave of COVID-19, it is prudent to improve vaccine confidence amongst the parents. Hence, to achieve wide coverage the waves of misinfodemics need to be envisaged and to be strategically dealt with. Moreover, from this study, this is evident that providing information on the safety and

efficacy of the new vaccines and promoting positive peer influence could be key in addressing the major concerns of the population who are hesitant to be vaccinated.

The study was conducted on Google forms hence only the literate participants with smartphones could participate so might not represent the population. The questionnaire was presented before the second wave of COVID-19; hence, there is a possibility that hesitancy might decrease after the second wave. Majority HCW respondents were medical students, and hence, age groups were not uniform. The co-morbidites were self-reported possibly causing reporting bias. The response rate of the study is doubtful as the unwilling persons might have chosen not to participate. The study design might not be suitable to assess the causal relationship. Despite the limitations, the study is crucial to assess baseline hesitancy and identify determinants of hesitancy allowing to design future strategies to alleviate it.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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