Original Research Article

A cross-sectional study to assess COVID-19 vaccine hesitancy among health care providers in a tertiary care centre, Tamil Nadu

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ABSTRACT

Background: The only way to reduce a person's likelihood of contracting COVID-19 infection, hospitalization, and death from it is to get vaccinated. Healthcare providers are indefinitely exposed to the virus and are also a source of knowledge about the sickness and vaccination. However hesitancy towards vaccination among healthcare providers persists. To estimate the prevalence of COVID-19 vaccine hesitancy among healthcare providers and to assess its predictors.
Methods: This cross-sectional study was conducted using an interviewer administered pretested semi-structured questionnaire adapting 5C vaccine acceptance/hesitancy questionnaire among 310 healthcare providers like doctors, nurses, multipurpose workers, support and paramedical staffs and students in a Tertiary care centre in Tamil Nadu selected by multistage random sampling from March to April of 2021. The collected data was analyzed by using Statistical package for social sciences (SPSS) version 16.
Results: The results showed that overall, 29.35% (n=91) of healthcare providers had hesitancy towards vaccination. 48.7% of the total respondents were not vaccinated against COVID-19 (n=151) and 24.5% of them were unwilling to be vaccinated. The mean of 5C questionnaire score was taken as cut off and the psychological antecedents of COVID-19 vaccination were compared between those vaccinated and not vaccinated. Among those vaccinated, it was observed that they had high confidence in vaccination, collective responsibility and calculation.
Conclusions: To battle misinformation and poor vaccination rates in future COVID-19 vaccination program, interventional educational efforts focusing on mitigating the constraints and complacence is urgently needed.

Keywords: COVID-19, Healthcare providers, Vaccination, Vaccine hesitancy, 5C questionnaire

INTRODUCTION

In December 2019, the coronavirus disease 2019 (COVID-19) outbreak caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was first detected in Wuhan, China.[1] Since then, the lethal virus has spread rapidly across the globe, prompting the World Health Organization (WHO) to proclaim a worldwide pandemic on March 11, 2020.[2] By the end of July 2021, the cumulative numbers had reached over 194 million reported cases and over 4 million deaths globally since the start of the pandemic.[3]

In the beginning, before the vaccine against COVID-19 was developed, the best methods for controlling the spread of the virus included social distancing, mask-wearing, frequent hand washing and geographical lockdowns.[4] The multi-faceted catastrophic consequences caused among the panic-stricken citizens intensified global efforts in developing an effective prevention method to keep outbreaks under control. This grueling

challenge thereby led to several candidate vaccines in different stages of development since the beginning of 2020.[5,6]

Vaccines play a vital role in mitigating the spread and communicability of infectious diseases, severity of the disease, hospitalization and deaths caused by infectious diseases.[7] Emerging data on effectiveness indicates that licensed COVID-19 vaccines are contributing to controlling the spread of the disease.[8,9] Almost 21 different vaccines are currently used globally with different country preferring one over other while several different vaccines are still under final stages of development phase.[10,11] The Government of India launched the biggest-ever mass vaccination program nationwide to vaccinate all adults above 18 years in the country (Total population 1.380 billion, Census 2021) with the COVID-19 vaccines in various stages based on the guidance from The National Expert Group on Vaccine Administration for COVID-19 (NEGVAC).[12,13] The Covishield vaccine developed by AstraZeneca/Oxford and manufactured by the Serum Institute of India and SK Bio respectively was given Emergency Use Authorization (EUA) on 16 February 2021 and the COVAXIN, by Bharat Biotech is developed in collaboration with the Indian Council of Medical Research (ICMR) - National Institute of Virology (NIV) are widely used in India. Sputnik-V developed by the Gamaleya Research Institute of Epidemiology and Microbiology in Russia was approved by the Drugs Controller General of India (DCGI) on 12 April, for emergency use in India.[14]

COVID-19 vaccine was introduced in a phased manner with first phase focusing on health care providers and frontline workers. The prioritization of groups was based upon the disease incidence and prevailing pandemic situation. The Phase-1 of vaccination was implemented to vaccinate nearly 30 million Health Care Providers (HCPs) in Public and Private health care settings, including ICDS workers.[13,15] Despite priority being given to health care providers, the number of beneficiaries vaccinated were lesser than expected (9.3 million) as on 02.03.2021.[16]

At this point, the next major hurdle to controlling the pandemic is the public hesitancy towards vaccination. The term vaccine hesitancy comprises refusal to vaccinate, delaying vaccines, accepting vaccines but remaining uncertain about their use, or using certain vaccines but not others.[17,18] In general, vaccine hesitancy has risen so substantially that it is considered by WHO as one of the major threats to Global Health. Vaccine hesitancy is not a novel concept. It has existed ever since the notion of vaccination against infectious diseases began.[19,20]

Healthcare workers play a significant role in the battle against COVID-19 both as frontline warriors and as role-models to the general public. They have wide knowledge on the effectiveness of the vaccines against COVID-19 and their adverse effects following vaccination.[21] HCPs have easy access to the vaccination site, timing for vaccination as the sites are in their workplace and the knowledge on the eligibility criteria.[8,9,22] Only a few studies have looked into healthcare providers' willingness to vaccinate against COVID-19. Thus, the present study was conducted to assess the prevalence of the COVID-19 vaccine hesitancy and its associated factors among healthcare providers in a tertiary health care center in Tamil Nadu.

METHODS

Study design and population

A cross-sectional study was conducted to estimate the prevalence of vaccine hesitancy among the healthcare providers in a tertiary care center in Tamil Nadu between March to April 2021 using an interviewer-administered questionnaire. The sample size was calculated based on the prevalence of vaccine hesitancy of 23.1% from previous study conducted by Paris et al with an absolute precision of 5% and applying 10% non-response rate.[23] The final sample size derived was 310. The participants were selected by multistage random sampling. A tertiary care center was chosen randomly by random number generator. The list of all the healthcare providers was obtained and they were categorized as students, paramedical staff, nurses, doctors and support personnel. Proportionate sampling was done among each category based on the sample size (Figure 1).

Inclusion criteria

All adult healthcare providers working in the tertiary care centre and its affiliated institutions during the COVID-19 pandemic in various departments.

Exclusion criteria

Healthcare providers who did not give consent to participate in the study.

Survey instrument

The questionnaire was designed with three components comprising of the demographic profile of the participants, intention to vaccinate against COVID-19 and the 5C scale by Betsch et al.[24] The following demographic variables were included as the independent variables of this study: age, sex, religion, marital status, type of family, educational attainment, place of residence, occupation, income and history of previous COVID-19 infection. Two questions were used to measure COVID-19 vaccine hesitancy. The respondents were asked, "Have you received the COVID-19 vaccine?" The responses to this question were: Yes, or No. Those who responded 'No' will be directed to the next question; "If not vaccinated earlier, are you willing to get vaccinated against COVID-19 in the near future?" And the responses were: Yes, No, and Unsure.
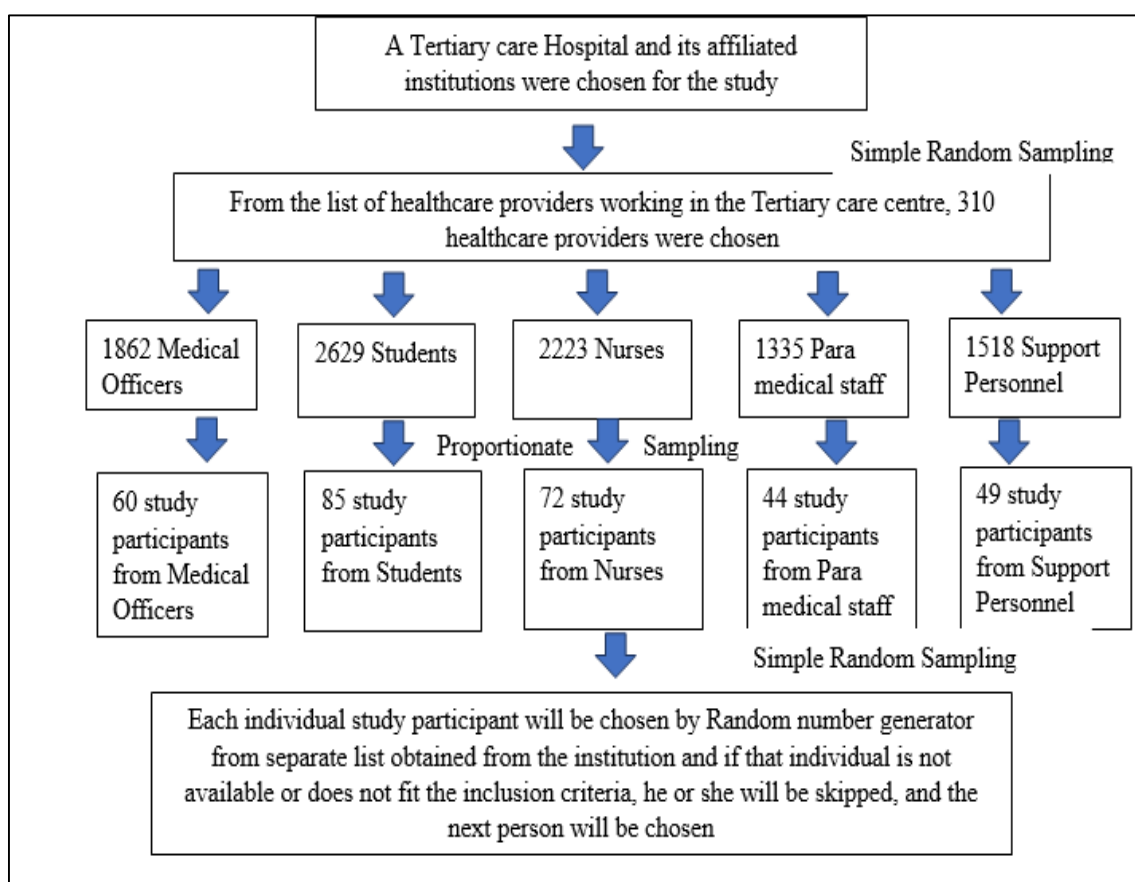
Figure 1: Sampling method: multistage random sampling.

The 5C scale was used to assess five psychological antecedents of vaccination and gives insights into individual perceptions, attitudes and behavioural tendencies that are influenced by their immediate environment (nonspecific for any one vaccination.[24,25] The 15-item 5C scale was previously validated with sensitivity of 66% and specificity of 63.4%. It comprises of the following determinants: confidence in the safety and efficacy of vaccines, as well as trust in the providers of the service, such as policymakers and healthcare providers ; complacency, which is defined by a low perception of disease risk; constraints, which include physical and psychological barriers that make vaccination inconvenient; calculation, which entails active engagement in searching for information about the vaccine and its utility; collective responsibility, defined by the extent of willingness to benefit others by receiving vaccination to help in achieving herd immunity. The survey was assessed for clarity and minor edits were made to the wording to correct any potential misinterpretations. The questionnaire responses were based on a four-point Likert scale scoring from 1 to 4. The higher the 5C score (the closer to 4), the more likely the respondent is to accept vaccination. The inverted score will more likely represent the vaccine hesitancy.[24,25] For the interpretation, the mean scores were calculated for hesitancy and across each item of the 5C antecedents were measured independently and analyzed.

For each 5C antecedent and validation construct, Cronbach's alpha was calculated to assess the scale's internal consistency. To assess the reliability of the scale, the Cronbach's alpha value should be above 0.70 for each 5C antecedent. Assuming that $\alpha \geq 0.70$, the mean values are calculated per antecedent. Three four-point Likert scale questions were used to measure the Confidence towards vaccination ($\alpha=0.722$) against COVID-19, three for Complacency towards COVID-19 vaccination which had an α of 0.556, three for Constraints against COVID-19 vaccination ($\alpha=0.702$), three for Calculation towards COVID-19 vaccination ($\alpha=0.725$) and three for Collective responsibility towards vaccination which had an α of 0.605.

The selected participants were contacted individually and were explained on the purpose of the study and the respondents who completed the survey received a note thanking them for their participation in the study. The questionnaire was developed in English and was then translated into Tamil. Back translation was done to know the quality of translation through experts. Questions were presented bilingually in both English and Tamil language depending on the preference of the study participants. Prior to the administration of the questionnaire, local experts validated the content of the questionnaire and the questionnaire was pilot tested among the peers and

experts from the institute. After final approval the study was conducted among the participants.

Statistical analysis

We analyzed the data using the Statistical Package for Social Sciences (SPSS) software, version 16. The results are presented as means and standard deviations for normally distributed data, or as percentages for categorical data. Continuous variables were compared using t-test. Chi-square test was used to analyze the determinants. For all the analysis, p≤0.05 was assumed to be statistically significant.

RESULTS

Demographic characteristics

Overall, 310 HCPs had completed the survey (Table 1). The average age of the respondents was 33.61 years, with an SD of 12.88.

The highest proportion of respondents were between the age group of 18 to 45 years 247 (79.7%). About 67.4% of

the respondents were women, while most of the respondents (75.2%) were Hindus. Nearly half of the respondents (58.4%) were married, and 12.3% of the respondents had less than a secondary education level and 58.7% had some form of under-graduate educational qualification. About two-thirds of the respondents (70%) were living a nuclear family, while 27.4% were students from the tertiary care centre. Among the study population, 84.8% had no co-morbidity and are not on any form of medication. The mean household income was Rs.29108 excluding the students.

About 10.6% of the respondents reported that they were tested positive for COVID-19 infection during the pandemic, which was confirmed by standard laboratory investigation. 39.3% of the laboratory confirmed COVID-19 patients utilized Government hospitals for treatment while 33.3% were on home isolation for the same. 17.4% of the respondents had history of family members infected by COVID-19 and 20.4% among them had lost someone in the family due to the infection during pandemic.

Table 1: Determinants of health care providers' vaccination behavior (n=310).

Characteristics	Features	Vaccinated (n=159) N (%)	Not vaccinated (n=151) N (%)	P value
Age (years)	18 to 45	131 (82.4)	116 (76.8)	0.082
	45 to 60	25 (15.7)	29 (19.2)	
	>60	3 (1.9)	6 (4.0)	
Gender	Male	57 (35.8)	44 (29.1)	0.176
	Female	102 (64.2)	107 (70.9)	
Occupation	Doctor	34 (21.4)	26 (17.2)	0.001*
	Nurse	47 (29.6)	25 (16.6)	
	Paramedical	10 (6.3)	36 (23.8)	
	Support	11 (6.9)	36 (23.8)	
	Student	57 (35.8)	28 (18.6)	
Salary	<Rs 30,000	95 (59.7)	101 (66.9)	0.435
	≥Rs 30,000	64 (40.3)	50 (33.1)	
Religion	Hindu	117 (73.6)	116 (76.8)	0.204
	Christian	32 (20.1)	25 (16.6)	
	Muslim	10 (6.3)	10 (6.6)	
Marital status	Married	87 (54.7)	94 (62.3)	0.0001*
	Single	72 (45.3)	57 (37.7)	
Family	Nuclear family	118 (74.2)	99 (65.6)	0.487
	Non-nuclear family	72 (25.8)	52 (34.4)	
Comorbidity	Yes	13 (8.2)	31 (20.5)	0.062
	No	146 (91.8)	120 (79.5)	
History of COVID-19	Yes	20 (12.6)	13 (8.6)	0.364
	No	139 (87.4)	138 (91.4)	
Family members infected by COVID-19	Yes	26 (16.4)	28 (18.5)	0.184
	No	133 (83.6)	123 (81.5)	
Lost Family members to COVID-19	Yes	6 (3.8)	11 (7.3)	0.997
	No	153 (96.2)	140 (92.7)	

* p value significant <0.05.

Table 2: Intention of HCPs to get vaccinated (among unvaccinated HCPs) n=151.

	Frequency	Percentage (%)
Willing to vaccinate	80	53
Not willing to vaccinate	37	24.5
Not sure about vaccination	34	22.5

Table 3: Psychological antecedent of vaccination using 5C Questionnaire (n=310).

	Vaccinated (n=159)	Not vaccinated (n=151)	Inference	
Characteristics	Mean (SD)	Mean (SD)	t test	P value
Confidence	3.101 (0.367)	2.166 (0.511)	18.416	<0.001*
Complacence	2.104 (0.567)	1.792 (0.509)	-8.327	<0.001*
Constraints	1.792 (0.553)	2.773 (0.574)	-15.325	<0.001*
Calculative	3.055 (0.434)	1.962 (0.600)	18.300	<0.001*
Collective	3.222 (0.503)	1.962 (0.495)	22.212	<0.001*

*p value significant <0.05

Table 4: Mean survey scores based on demographic characteristics and vaccination acceptancy/hesitancy n=310.

Characteristics	Features	Vaccinated (n=159) Mean 5C (SD)	Not vaccinated (n=151) Mean 5C (SD)	Inference t Test	P value
Age (years)	18 to 45	2.509 (0.258)	2.214 (0.242)	9.236	<0.001*
	45 to 60	2.667 (0.230)	2.255 (0.248)	6.289	<0.001*
	>60	2.600 (0.174)	2.054 (0.149)	4.987	0.002*
Gender	Male	2.462 (0.248)	2.179 (0.254)	5.621	<0.001*
	Female	2.577 (0.256)	2.230 (0.236)	10.176	<0.001*
Occupation	Doctor	2.377 (0.243)	2.232 (0.161)	2.778	0.007*
	Nurse	2.704 (0.213)	2.232 (0.212)	8.963	<0.001*
	Paramedical	2.646 (0.164)	2.167 (0.249)	5.712	<0.001*
	Support	2.462 (0.192)	2.246 (0.250)	2.624	0.012*
	Student	2.486 (0.245)	2.208 (0.307)	4.514	<0.001*
Salary	<Rs 30,000	2.132 (0.231)	2.216 (0.261)	-2.394	0.018*
	≥Rs 30,000	2.150 (0.222)	2.214 (0.199)	-1.603	0.112
Religion	Hindu	2.155 (0.229)	2.219 (0.242)	-2.084	0.038*
	Christian	2.084 (0.220)	2.199 (0.223)	-1.948	0.057
	Muslim	2.133 (0.19)	2.218 (0.306)	-0.710	0.487
Marital status	Married	2.107 (0.221)	2.200 (0.226)	-2.807	0.006*
	Single	2.178 (0.229)	2.241 (0.266)	-1.439	0.153
Family	Nuclear family	2.141 (0.228)	2.212 (0.231)	-2.258	0.025*
	Non-Nuclear	2.134 (0.224)	2.223 (0.263)	-1.731	0.087
Comorbidity	Yes	2.564 (0.235)	2.302 (0.183)	3.964	<0.001*
	No	2.533 (0.261)	2.193 (0.251)	10.774	<0.001*
History of COVID-19	Yes	2.653 (0.246)	2.236 (0.148)	5.483	<0.001*
	No	2.519 (0.256)	2.214 (0.249)	10.046	<0.001*
Family members infected by COVID-19	Yes	2.476 (0.290)	2.257 (0.166)	3.363	0.002*
	No	2.547 (0.251)	2.206 (0.256)	10.776	<0.001*
Lost Family members to COVID-19	Yes	2.592 (0.208)	2.217 (0.209)	3.547	0.003*
	No	2.534 (0.260)	2.216 (0.245)	10.745	<0.001*

*p value significant <0.05.

Intention of vaccination against COVID-19

The results showed that overall, 29.35% (n=91) of healthcare providers had hesitancy towards vaccination.

48.7% of the total respondents were not vaccinated against COVID-19 (n=151) (Table 2) and 24.5% of them were unwilling to be vaccinated. 53% of them were willing to vaccinate in the future and 22.5% were not sure

about vaccination. 9.2% of the respondents were apprehensive regarding the side effects and the underlying medical conditions as the reason for not yet vaccinated.

51.3% of participants were already vaccinated against COVID-19 infection (n=159). Among those who took vaccine against COVID-19 infection, 27.7% responded that it was mandatory at work place to take the COVID-19 vaccine, 6% knew how it helps in preventing the infection, 7% knew how important the vaccination is to protect others and 19.2% believed it will help in protection against the infection. Majority of the participants 40.1% responded with more than one of the above options. Overall majority 57.2% preferred vaccination as its mandatory for their job rather than knowing its importance.

5C antecedents of vaccination

The mean of 5C questionnaire score was taken as cut off and the psychological antecedents of COVID-19 vaccination were compared (Table 3) between those vaccinated and not vaccinated (n=151). The mean of 5C questionnaire among those not vaccinated to calculate the antecedents of vaccine hesitancy was calculated as 2.132 with mean of confidence 2.166, complacence 1.792, constraints 2.772, calculative behaviour 1.962 and collective attitude 1.962. Based on the interpretation 45% were not confident about the vaccine while 35.1% had poor complacence towards vaccination and 48.3% had poor constraints towards vaccination. On the other hand, 66.9% did not assess different calculation for receiving COVID-19 vaccine and 63.6% of the respondents had lack of (absence of) collective responsibility. On the other hand, the mean of antecedents to vaccinate was calculated among those vaccinated with mean 5C score of 2.523 with high mean confidence value of 3.101, calculative measure of 3.055 and collective responsibility of 3.222. The mean score of complacence and constraints were low with 2.104 and 1.792 which shows high vaccine acceptance among those vaccinated compared to hesitancy among those not vaccinated.

DISCUSSION

This study confirms the strong differences in COVID-19 vaccine intention among healthcare providers. In the present study, the overall vaccine hesitancy among the HCWs was 29.35%. Of note, the proportion of unvaccinated healthcare providers declaring that they would receive the COVID-19 vaccine was lesser among those unvaccinated when compared to the study by Paris et al and Hossain et al. There was no striking difference across occupations in regards to vaccination as the predictors of vaccination hesitancy among them wasn't much varied when compared to study by Paris et al, where there was significant variation in regards to type of job among the healthcare providers.[26] Among the unvaccinated healthcare professionals, a higher vaccine hesitancy was observed among the blue-collar workers or support personnel than the doctors and nurses. This is contradictory to the study by Paris et al. 'COVID-19 vaccine hesitancy among healthcare workers' where a lower vaccine hesitancy was observed among the cleaners. Only a few people in our study said they had been personally infected with COVID-19 or had observed a family member or friend being affected by the disease. Few respondents from the study have already lost someone during the COVID-19 pandemic. At the same time, only a small percentage of respondents regarded their odds of contracting COVID-19 as "very likely" or were unduly concerned about the disease's consequences if infected. Several studies were conducted during the 2021 COVID-19 pandemic to first assess the desire to accept the COVID-19 vaccination, and then to study the actual uptake among healthcare providers.[27-30] In a study conducted in France, by Paris et al. 23.1% categorized themselves as 'hesitant', and 3.9% as 'against' the COVID-19 vaccine.[23]

In our study, the age group of 45-60 years showed having the maximum vaccine hesitancy among HCPs. Further analysis (Table 4) showed that certain variables were associated with a lower intent to receive COVID-19 vaccines among HCPs in India. These variables included female sex, lower educational qualification, a lower income group, being single and living in a non-nuclear family. A higher degree of vaccine hesitancy among females appears to be a recurring pattern that has been observed in a variety of research from diverse time periods and geographical areas.[31] Significance in regard to vaccine acceptance and history of COVID-19 infection to self and family could be due to the burden of the disease observed and provided insight towards vaccination to mitigate further burden. Whereas salary, religion, marital status and type of family were not significantly associated which has to be further analyzed in the upcoming studies. Another interesting finding in our study was the increased hesitancy among people with comorbidities. This usually is due to the unknown side effects which may exacerbate the comorbidity or initiate a new complication. Lack of information regarding this aspect demands increased research in this field.

Healthcare providers' vaccination behaviors are associated with various psychological determinants and additional barriers and drivers. In our study subjects, 51.3% of healthcare providers were vaccinated and a majority actively recommended vaccination to their contacts. In general, lower levels of confidence and collective responsibility and higher levels of complacency, constraints, and calculation is associated with significant hesitancy of COVID-19 vaccines. Healthcare providers' own vaccination status is significantly associated with them recommending vaccines to their contacts, which suggests that Healthcare providers are a stronger leverage to promote vaccination if they generally accept vaccinations themselves.

In our study, using the 5C questionnaire to calculate the antecedents of vaccine hesitancy and vaccine acceptancy among the healthcare providers, confidence and collective responsibility in the safety of vaccines was identified as an issue of special importance. Since it was associated with both own vaccination and recommendation behavior, the safety and effectiveness of vaccines should be a major topic to be addressed in communication activities targeting healthcare providers. However, activities aiming at healthcare providers own vaccination and recommendation behavior should go beyond confidence in vaccination, since other psychological determinants such as stressful environment, inconvenience to vaccination, over confidence in one's own immune system and visiting vaccination centers were negatively associated with own vaccination status.

The overall tendency for acceptance of a vaccine was high among those not vaccinated, with more than half (53%) of the participants expressing a definite intention to take the COVID-19 vaccine and 22.5% declared that they are not sure of vaccination. 24.5% were not willing to take the COVID-19 vaccine which is much higher than the study conducted in Bangladesh as 14% by Hossain et al. When enquired on the delay in vaccination among those willing for vaccination, 16.8% replied upcoming university exams were the delay in vaccination while 13.6% were on treatment for medical condition as delay in vaccination and 10% replied fear of side effects as delay in vaccination following controversies over vaccine tolerance similar to study by Paris et al. Of note, intervention is needed for COVID-19 vaccine refusals as well as healthcare providers with possible and probable intention to ensure high actual vaccination uptake.

Limitations

The timing of the study is one of its major limitations. It was carried out before the onset of the second wave of COVID-19 in India. Due to the extreme difference in mortality and morbidity rates, acceptance and hesitancy among health care providers and the general public must have improved during the second wave of COVID-19. Additionally, the 5C subscales' internal consistency could have been improved by adding more items, particularly for the complacence and collective responsibility antecedents. Furthermore, the cross-sectional character of this study should not be neglected, as vaccine hesitancy is context-dependent, particularly in terms of the location and timing of any survey.

CONCLUSION

Overall, 29.35% (n=91) of the total HCPs had hesitancy towards vaccination of which 40.65% (n=37) were not willing for vaccination due to high constraints and complacence. Healthcare workers play a significant role in the battle against COVID-19 both as frontline warriors and as role-models to the general public. They are regarded as the ambassadors for vaccine acceptance among the general population. However, if they themselves are vaccine-hesitant, the patients who look up to them cannot be rid of their doubt and uncertainty. Hence, the findings in this study may be used by policy makers to implement promotion campaigns in the future to increase vaccine acceptance among the people. Interventions targeting constraints and complacence could be effective in increasing the uptake of the vaccine. To battle misinformation and avoid poor vaccination rates, interventional educational efforts like focused group discussions on vaccine hesitancy and acceptance, seminars on effects of vaccination including the benefits of vaccination and adverse effects following vaccination and collective responsibilities targeting health workers at risk of vaccine hesitancy are urgently needed. To eliminate any potential hurdles to a future COVID-19 vaccination program, swift action to mitigate even a small number of healthcare providers with vaccine hesitancy is crucial as general public rely on healthcare workers for their decision before vaccination.

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