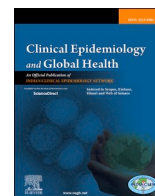




Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



## Community health workers willingness to participate in COVID-19 vaccine trials and intention to vaccinate: A cross-sectional survey in India

Kapil Goel<sup>a</sup>, Arunima Sen<sup>a</sup>, Parul Goel<sup>b</sup>, Prakasini Satapathy<sup>c,n</sup>, Lovely Jain<sup>a</sup>, Jatina Vij<sup>a</sup>, Binod Kumar Patro<sup>d</sup>, Sitanshu Sekhar Kar<sup>e</sup>, Venkatesan Chakrapani<sup>f</sup>, Ritesh Singh<sup>g</sup>, Star Pala<sup>h</sup>, Lalit Sankhe<sup>i</sup>, Bhavesh Modi<sup>j</sup>, Surya Bali<sup>k</sup>, Neeti Rustagi<sup>l</sup>, Anuradha Nadda<sup>m</sup>, Vineeth Rajagopal<sup>a</sup>, Tanvi Kiran<sup>a</sup>, Arun Kumar Aggarwal<sup>a</sup>, Madhu Gupta<sup>a</sup>, Bijaya Kumar Padhi<sup>a,\*</sup>

<sup>a</sup> Department of Community Medicine and School of Public Health, Post Graduate Institute of Medical Education & Research (PGIMER), Chandigarh, India

<sup>b</sup> Department of Biochemistry, Shri Atal Bihari Vajpayee Government Medical College Chhainsa, Faridabad, Haryana, India

<sup>c</sup> Department of Public Health, Utkal University, Bhubaneswar, Odisha, India

<sup>d</sup> Department of Community and Family Medicine, All India Institute of Medical Sciences (AIIMS), Bhubaneswar, Odisha, India

<sup>e</sup> Department of Preventive and Social Medicine, Jawaharlal Institute of Postgraduate Medical Education & Research (JIPMER), Puducherry, 605006, India

<sup>f</sup> Centre for Sexuality and Health Research and Policy (C-SHaRP), Chennai, India

<sup>g</sup> Department of Community and Family Medicine, All India Institute of Medical Sciences (AIIMS), Kalyani, West Bengal, India

<sup>h</sup> Department of Community Medicine, North Eastern Indira Gandhi Regional Institute of Health & Medical Sciences, (NEIGRIHMS), Mawdiangiang, Shillong, 793018, Meghalaya, India

<sup>i</sup> Grant Medical College & JJ Hospital, Mumbai, Maharashtra, India

<sup>j</sup> Department of Community and Family Medicine, All India Institute of Medical Sciences (AIIMS), Rajkot, India

<sup>k</sup> Department of Community and Family Medicine, All India Institute of Medical Sciences (AIIMS), Bhopal, MP, 462024, India

<sup>l</sup> Department of Community Medicine & Family Medicine, AIIMS, Jodhpur, 342005, India

<sup>m</sup> Department of Community Medicine, Dr B R Ambedkar Institute of Medical Sciences (AIMS), Mohali, Punjab, India

<sup>n</sup> Regional Virus Research & Diagnostic Lab, Department of Virology, Post Graduate Institute of Medical Education & Research (PGIMER), Chandigarh, 160 012, India

### ARTICLE INFO

#### Keywords:

Coronavirus  
Vaccine acceptance  
Perceived risk  
Village health workers  
Willingness

### ABSTRACT

**Background:** Vaccine hesitancy is of considerable concern as it threatens the great potential of a vaccine against COVID-19. This study aims to determine factors associated with community health workers' willingness to participate in clinical trials of COVID-19 vaccine, and their vaccination intention, in India.

**Methods:** A cross-sectional study was conducted among 377 community health workers using self-administered anonymous questionnaire during the lockdown periods in India. Participant's socio-demographics, willingness-to-participate in COVID-19 vaccine trials, intention to accept COVID-19 vaccine were recorded in a Likert scale. Data were analysed descriptively, and a multivariate logistic regression model was used to investigate factors associated with willingness to participate and accept the vaccine.

**Results:** Among 377 CHWs, 70 (19%) intended to participate in COVID-19 vaccine trial, 151 (40%) responded positively regarding their intention to get vaccinated. Those with knowledge on development of COVID-19 vaccine [aOR 3.05 (95% CI: 1.18–7.88),  $p = 0.021$ ], and men [aOR 3.69 (95% CI: 1.51–8.97),  $p = 0.004$ ] were more willing to participate in clinical-trial, while an undergraduate degree, and trust in domestic vaccines were identified as deterrents for the same. Perceiving COVID-19 as risk [aOR 2.31 (95% CI: 1.24–4.31),  $p =$

**Abbreviations:** CHW, Community health worker; COVID-19, Coronavirus disease-2019; WHO, World Health organization.

\* Corresponding author. Department of Community Medicine and School of Public Health, Post Graduate Institute of Medical Education & Research (PGIMER), Chandigarh, 160 012, India.

**E-mail addresses:** [drkapil123@gmail.com](mailto:drkapil123@gmail.com) (K. Goel), [drarunimasen@gmail.com](mailto:drarunimasen@gmail.com) (A. Sen), [parul006@gmail.com](mailto:parul006@gmail.com) (P. Goel), [prakasini.satapathy@gmail.com](mailto:prakasini.satapathy@gmail.com) (P. Satapathy), [lavijain001@gmail.com](mailto:lavijain001@gmail.com) (L. Jain), [jatinavij6@gmail.com](mailto:jatinavij6@gmail.com) (J. Vij), [patrobinod@gmail.com](mailto:patrobinod@gmail.com) (B.K. Patro), [drsitanishukar@gmail.com](mailto:drsitanishukar@gmail.com) (S.S. Kar), [venkatesan.chakrapani@gmail.com](mailto:venkatesan.chakrapani@gmail.com) (V. Chakrapani), [drriteshsingh@yahoo.com](mailto:drriteshsingh@yahoo.com) (R. Singh), [starpala@gmail.com](mailto:starpala@gmail.com) (S. Pala), [lalit.sankhe@gmail.com](mailto:lalit.sankhe@gmail.com) (L. Sankhe), [bhavmod@yahoo.com](mailto:bhavmod@yahoo.com) (B. Modi), [Surya.CFM@aaimsbhupal.edu.in](mailto:Surya.CFM@aaimsbhupal.edu.in) (S. Bali), [drneetigoswami@gmail.com](mailto:drneetigoswami@gmail.com) (N. Rustagi), [dranuradhagims@gmail.com](mailto:dranuradhagims@gmail.com) (A. Nadda), [drvineethrajagopal@gmail.com](mailto:drvineethrajagopal@gmail.com) (V. Rajagopal), [tanvikiran3@yahoo.com](mailto:tanvikiran3@yahoo.com) (T. Kiran), [aggak63@gmail.com](mailto:aggak63@gmail.com) (A.K. Aggarwal), [madhugupta21@gmail.com](mailto:madhugupta21@gmail.com) (M. Gupta), [bkpadhi@gmail.com](mailto:bkpadhi@gmail.com) (B.K. Padhi).

<https://doi.org/10.1016/j.cegh.2022.101113>

Received 21 March 2022; Received in revised form 9 July 2022; Accepted 14 July 2022

Available online 30 July 2022

2213-3984/© 2022 The Author(s). Published by Elsevier B.V. on behalf of INDIACLEN. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

0.009], and male gender [aOR 2.39 (95% CI: 1.17–4.88),  $p = 0.017$ ] were factors associated with intention to get vaccinated. Respondents who had knowledge about COVID-19 virus were less likely to uptake the hypothetical vaccine [aOR 0.32 (95% CI: 0.12–0.88),  $p = 0.027$ ].

**Conclusions:** Increasing knowledge regarding COVID-19 is not enough to improve vaccine acceptance rates. Targeted interventions addressing socio-demographic determinants related to COVID-19 vaccination should help improve acceptance.

## 1. Background

The ongoing Coronavirus disease-2019 (COVID-19) pandemic has affected over 173 million people and caused more than 3.7 million deaths globally.<sup>1</sup> Imposing enormous morbidity and mortality burdens, the disease continues to disrupt societies and economies across the globe. Around ten million people have been affected in India alone.<sup>2</sup> Working on the frontline, thousands of healthcare workers (HCW) have been infected and lost their lives in the pandemic.<sup>3,4</sup> Though exact numbers are not known, the Indian Medical Association (IMA) reported 665 physicians in India lost lives in the line of duty.<sup>5</sup>

Over the past century, vaccines have become indispensable in eliminating and eradicating viral illnesses.<sup>6</sup> Besides preventing diseases among the immunized, vaccines have reduced infections in the population through herd immunity.<sup>7</sup> Government of India's focus on COVID-19 immunization is palpable as the finance minister allocated a massive ₹35,000 crores exclusively for the vaccines to bring an end to the pandemic.<sup>8</sup> Following the much-awaited COVID-19 vaccine launch, an estimated one crore frontline health workers, including physicians, nurses, and community health workers, have been identified for receiving the vaccine in the first phase. Genetics, race, and environment can affect vaccine response.<sup>9,10</sup> It is therefore imperative that vaccines are investigated amongst specific populations before rolling them out. High risk of acquiring infection makes frontline workers a suitable population for COVID-19 vaccine trials globally, and in India.

Vaccine hesitancy is defined as "delay in acceptance or refusal of vaccination despite the availability of vaccination services."<sup>11</sup> It is of considerable concern as it threatens the great potential of a vaccine against COVID-19. The WHO has identified "vaccine hesitancy" as one of the top ten threats to public health in 2019, globally.<sup>12</sup> Hesitancy and misinformation prevent the achievement of required vaccination coverage in India and in other countries. The situation is even worse following the introduction of a new vaccine.<sup>13</sup>

A systematic review reported the acceptance rate for H1N1 influenza pandemic vaccine varied between 8% and 67%.<sup>14</sup> Acceptance rate of the COVID-19 vaccine, as reported by a global survey, was 72%. High heterogeneity was observed between countries, ranging from 90% in China and less than 55% in Russia.<sup>15</sup> Vaccine safety and efficacy, adverse health outcomes, absence of trust in the health system and lack of knowledge are some of the reasons reported by numerous researchers.<sup>16–18</sup> However, research trends reveal, most studies conducted on COVID-19 vaccines are from developed countries.<sup>19</sup>

Community health worker (CHW) is a frontline public health worker, and is involved in planning, identifying target groups, community engagement, service delivery, tracking, and follow-up of healthcare delivery activities. They are critical in introducing a new vaccine. These grass-root level workers are vital interlocutors. The knowledge of "last mile" health service delivery, shared lived experience that fosters trust and credibility within communities, and previous experience in vaccination makes them indispensable to the COVID-19 vaccination drive.<sup>20</sup> Apart from affecting them, their intention to get vaccinated also affect the community's perception about the vaccine. Understanding key factors influencing uptake of the vaccine by CHWs may help policymakers to develop strategies for effective implementation. Since vaccine acceptance differs between countries, cultures, and due to the vaccine, itself, this study aims to determine the factors associated with community health care workers' intention to participate in a clinical trial of

covid-19 vaccine, and their intention get vaccinated against COVID-19, in India.

## 2. Methods

### 2.1. Study design, setting, and sample

A cross-sectional survey was conducted across major geographical regions in India during the first wave of the pandemic (November–December 2020), before the introduction of COVID-19 vaccines in India. A non-probability snowball sampling ( $N = 377$ ) technique was used. Community healthcare workers (ASHA: accredited social health activist; MPHW: Multi-purpose health worker; and CHO: Community Health Officer) were contacted through social media (WhatsApp, Telegram, Facebook, Twitter) and were requested to share the invitation link with their peers. The sample size was calculated using OpenEpi Version 3.01 with a hypothesized  $60\% \pm 5\%$  prevalence of vaccine acceptance at 95% confidence level. The design effect was kept one. The minimal sample size, which came on estimation at 95% confidence level, was 370. CHWs, aged 18 and above and willing to participate in the study were recruited for data collection.

### 2.2. Study procedure

Web-based self-administered questionnaires were developed and shared with the participants through social media. The participants were requested to share the link with their peers in their circle. On clicking on the received link, the participants were auto directed to the informed consent page. Only those providing informed consent, were allowed to take the survey. The questionnaire was based on literature review of similar studies. It consisted of sections on 1) Socio-demographic details, including age, sex, religion, residence, income, socio-economic status, marital status, educational status, and social caste 2) Questions to understand knowledge, perception of risk of getting infected with COVID-19, trust in the health system, and willingness to accept the COVID-19 vaccine, once available. Intention to get vaccinated was assessed by the question "Do you intend to get vaccinated against Coronavirus when the vaccine is available?" followed by the response options, "yes," "no," and "not sure." Based on their response, they were asked why they intended/did not intend/were not sure to get vaccinated through pre-specified reasons followed by response options, "yes" and "no." For assessing knowledge regarding COVID-19 and COVID-19 vaccine, participants were asked, "Before this interview, were you aware that COVID-19 virus is currently circulating in the community?"; and "is there currently a vaccine being prepared for the pandemic coronavirus strain?". To understand the history of vaccine hesitancy, "have you ever postponed a vaccine recommend by a physician?"; "have you ever refused a vaccine for yourself or a child because you considered it as useless or dangerous?" were asked. Other important questions included, "how concerned are you that you or someone in your family will be infected with COVID-19 virus?"; "Do you have trust in the healthcare system to manage the current situation?"; "How confident are you on domestic vaccines?".

### 2.3. Data analysis

Participant characteristics were summarized using frequency

(percentage). Responses to questions on previous immunization behavior, risk perception, knowledge on COVID-19, and personal experience regarding the disease were categorized into “Yes” and “No”. Chi square test was used to examine the distribution of intention to accept COVID-19 vaccine with respondents’ socio-demographic characteristics. Logistic regression was used to identify association between independent variables and the intention to accept the vaccine. Odds ratios (OR) and their 95% confidence intervals (95% CI) were reported. A two tailed p-value <0.05 was considered to be statistically significant. All data analysis was performed using STATA 13.0.

#### 2.4. Ethical consideration

The study was approved by the Institutional Research Ethics Committee of the Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh. Informed consent was obtained from all study participants. Steps were taken to ensure confidentiality.

### 3. Results

Among 377 community health workers who completed the survey, 255 (68%) belonged to the age group 30–49 years, and were mostly women (n = 321, 85%). A quarter of them were resident of eastern India (n = 98, 26%) and 204 (54%) were from urban areas. A majority, 254 (67%) were from medium socioeconomic status, and 195 (52%) had a family income above INR 50000. Highest education was completion of high school/diploma for 144 (38%) participants. More than half (n = 198, 53%) belonged to the other backward caste (OBC) category, and 270 (72%) were Hindus. Most of them were married (n = 270, 72%), and had a family size of five and below (n = 276, 73%) [Table 1].

Of the total respondents, 70 (19%) were willing to participate in COVID-19 vaccine trial, and 151 (40%) intended to accept the vaccine once it was available. Exposure to COVID-19 cases were reported by 199 (53%), 355 (94%) had knowledge about COVID-19 while 308 (82%) had knowledge about development of the vaccine. History of vaccine hesitancy was present in 41 (11%), and 90 (24%) perceived COVID-19 infection as a risk. More than half the participants, 219 (58%) trusted the healthcare system while 164 (44%) did not trust domestic vaccines. [Table 2].

On logistic regression analysis, the odds of intending to participate in COVID-19 vaccine trial were higher among men (aOR: 3.69 [95% CI: 1.51–8.97], p = 0.004) and those having knowledge regarding COVID-19 vaccine development (aOR: 3.05 [95% CI: 1.18–7.88], p = 0.02). Those who trusted domestic vaccines and graduates were less likely to participate in a vaccine trial, aOR of 0.32 (95% CI: 0.12–0.85), and 0.42 (95% CI: 0.20–0.87) respectively. The association was statistically significant (p < 0.05). [Table 3].

Participants who intended to uptake the hypothetical vaccine were less likely to know about COVID19 virus (aOR: 0.32[95% CI: 0.12–0.88], p value = 0.03). Men were 2.39 (95% CI: 1.17–4.88) times more inclined to get vaccinated. The association was statistically significant (p value = 0.02). The odds of participants to get vaccinated was 2.04 (95% CI: 1.24–4.31) times more among those who perceived COVID-19 as a risk. (p = 0.009) [Table 4].

### 4. Discussions

This study is first of its kind to depict the COVID-19 vaccination intention and intention to participate in clinical trial of COVID-19 vaccine among community health workers in India. Of the 377 CHWs, less than half responded positively regarding intention to uptake COVID-19 vaccination, while not even a quarter intended to volunteer for vaccine clinical trial. Knowledge about COVID-19 virus, perception of risk, and gender affected intention to get vaccinated. Gender, and knowledge regarding COVID-19 vaccine development positively affected the willingness to participate in a vaccine trial, while trust in domestic vaccines,

**Table 1**  
Demographic characteristics of study participants (N = 377).

Variables	Total (377)
Age	
18-29	122 (32.36%)
30-49	255 (67.64%)
Gender	
Male	56 (14.85%)
Female	321 (85.15%)
Highest education	
Primary School	30 (7.96%)
Diploma/High School	144 (38.20%)
Undergraduate	125 (33.16%)
Postgraduate	78 (20.69%)
Marital status	
Married	270 (71.62%)
Single	107 (28.38%)
Family size	
Five and below	276 (73.21%)
Six and above	101 (26.79%)
Family income	
below 10000	59 (15.65%)
11000-20000	52 (13.79%)
21000-50000	71 (18.83%)
above 50000	195 (51.72%)
Socio-economic status	
Low	28 (7.43%)
Medium	254 (67.37%)
High	95 (25.20%)
Region of residence	
Eastern	98 (25.99%)
Western	40 (10.61%)
Northern	85 (22.55%)
Southern	93 (24.67%)
Central	41 (10.88%)
North-east	20 (5.31%)
Area of residence	
Urban	204 (54.11%)
Rural	173 (45.89%)
Social caste	
Other Backward Caste	198 (52.52%)
Other	126 (33.42%)
Scheduled Caste	33 (8.75%)
Scheduled Tribe	20 (5.31%)
Religion	
Hindu	270 (71.62%)
Muslim	54 (14.32%)
Christian	25 (6.63%)
Sikhs	28 (7.43%)

and higher educational status were identified as deterrents for the same.

While around one-third of the study participants reported being undecided regarding their vaccination intention, four in ten CHWs intended to get vaccinated. This level of acceptance, however, will not be sufficient to break the chain of transmission.<sup>21,22</sup> In a survey conducted among French healthcare workers, 77% declared they would intend to get vaccinated against COVID-19.<sup>23</sup> Rates of intention ranged from 92% in physicians, 65% among nurses, 70% among midwives and 67% in other HCWs.<sup>23</sup> Healthcare workers in Congo reported, around 28% were willing to get vaccinated.<sup>24</sup> In India, 86% planned to get COVID-19 vaccination whenever available, in a survey conducted among the general population.<sup>25</sup> The differences in study population and the time when the survey was conducted might explain the differences.

Those participants who knew about COVID-19 virus were less inclined to uptake the hypothetical vaccine in the current study. This was in contrast to studies conducted elsewhere.<sup>26</sup> Source of information, and the effect of misinformation were unexplored in the study and might have affected the result.

Risk perception was an independent predictor of vaccine uptake in the current study which was similar to other surveys conducted among healthcare workers and the general population.<sup>23,27,28</sup> In a survey conducted among adults in USA, perceived likelihood of COVID-19

**Table 2**

Vaccination intention, Knowledge, Vaccine complacency, and Vaccination confidence of the study participants (N = 377).

Variables	n (%)
<b>Intend to participate COVID-19 vaccine clinical trial</b>	
Yes	70 (18.57%)
No	177 (46.95%)
Undecided	130 (34.48%)
<b>If Vaccine against Corona virus is available, I will take it</b>	
Yes	151 (40.05%)
No	85 (22.55%)
Undecided	141 (37.40%)
<b>Exposed to COVID-19 cases</b>	
No	199 (52.79%)
Yes	178 (47.21%)
<b>Knowledge about COVID19</b>	
No/Not Sure	22 (5.84%)
Yes	355 (94.16%)
<b>Knowledge about development of the COVID19 vaccine</b>	
No/Not Sure	69 (18.30%)
Yes	308 (81.70%)
<b>History of vaccine hesitancy</b>	
Yes	41 (10.88%)
No	336 (89.12%)
<b>Risk perception</b>	
Yes	90 (23.87%)
No	287 (76.13%)
<b>Trust in the healthcare system</b>	
No	158 (41.91%)
Yes	219 (58.09%)
<b>Trust in domestic vaccines</b>	
Better	95 (25.20%)
Neutral	118 (31.30%)
Worse	164 (43.50%)

infection in the future, and perceived severity of COVID-19 infection were significantly associated with vaccine acceptance.<sup>29</sup> Perception of risk is central to many health behavior theories. A meta-analysis that looked into the association between adult vaccination and risk perception concluded that those perceiving a higher likelihood of getting ill and those who perceived the severity of illness to be higher were more likely to be vaccinated.<sup>30</sup>

This study reported a significant male predominance in willingness to accept vaccination and intention to participate in COVID-19 vaccine trial. This was similar to other studies.<sup>26,31,32</sup> Misinformation regarding the vaccine's effect on reproduction and fertility might explain women's skepticism regarding acceptance of the vaccine.<sup>33</sup> Further studies explaining gender disparity related to COVID-19 vaccine acceptance is warranted.

Willingness to participate in vaccine trials was 19% in the current study. This was in contrast to other studies.<sup>32,34</sup> Those who trusted domestic vaccines, and had a graduate degree were less likely to participate in vaccine trials. Decreased willingness to participate in vaccine research with higher educational qualification has been reported previously.<sup>32</sup> Knowledge regarding development of COVID-19 vaccine increased likelihood of participating in vaccine trial. It can be hypothesized that those who knew about the development of vaccine would also be aware of its benefits to the society. Altruism as an independent motivator for participating in scientific research has been reported.<sup>32,35</sup> However, it was not explored in our study.

This is the first study as per our knowledge which has examined the intention to accept COVID-19 vaccine, and intention to participate in vaccine clinical trial among community health workers in India. However, it has a number of limitations. First, The predictors of vaccine uptake may not be causal owing to the cross-sectional nature of the study, however the identified predictors were in line with potential mechanisms of vaccine acceptance documented in literature. Also, the intention to receive the vaccine may change with time. Second, a convenient snowball sampling was used to recruit participants, which would affect the generalizability of the result. Third, the responses were

**Table 3**

Factors associated with willingness to participate clinical trial of COVID-19 vaccine among community health workers, India (N = 377).

Variable	OR [95% CI]	aOR [95% CI]	P-value
<b>Exposed to COVID-19 cases</b>			
No	Ref	Ref	
Yes	1.23 [0.731, 2.068]	1.727 [0.922, 3.233]	0.088
<b>Knowledge about COVID-19 virus</b>			
No	Ref	Ref	
Yes	1.027 [0.336, 3.136]	0.997 [0.295, 3.367]	0.996
<b>Knowledge on development of COVID19 vaccine</b>			
No	Ref	Ref	
Yes	1.921 [1.874, 4.225]	3.049 [1.180, 7.877]	0.021
<b>History of vaccine hesitancy</b>			
Yes	Ref	Ref	
No	2.261 [1.778, 6.566]	2.053 [0.643, 6.554]	0.225
<b>Risk perception</b>			
No	Ref	Ref	
Yes	1.316 [0.693, 2.496]	2.027 [0.908, 4.526]	0.085
<b>Trust in the healthcare system</b>			
No	Ref	Ref	
Yes	1.101 [0.649, 1.869]	1.207 [0.662, 2.202]	0.539
<b>Trust in domestic vaccines</b>			
Worse	Ref	Ref	
Better	0.547 [0.254, 1.180]	0.320 [0.121, 0.847]	0.022
Neutral	1.658 [1.934, 2.943]	1.631 [0.795, 3.348]	0.182
<b>Age</b>			
18-29	Ref	Ref	
30-49	0.661 [0.387, 1.131]	0.756 [0.277, 2.061]	0.585
<b>Gender</b>			
Female	Ref	Ref	
Male	1.577 [0.807, 3.082]	3.685 [1.513, 8.974]	0.004
<b>Marital status</b>			
Married	Ref	Ref	
Single	1.648 [0.953, 2.849]	1.261 [0.446, 3.569]	0.662
<b>Highest education</b>			
Primary/High School	Ref	Ref	
Undergraduate	0.477 [0.240, 0.948]	0.418 [0.201, 0.869]	0.019
Postgraduate	1.721 [0.931, 3.182]	1.672 [0.819, 3.415]	0.158
<b>Socio-economic status</b>			
Low	Ref	Ref	
Medium	0.963 [1.347, 2.673]	0.474 [0.152, 1.477]	0.198
High	1.305 [0.442, 3.850]	0.492 [0.145, 1.673]	0.256
<b>Area of residence</b>			
Urban	Ref	Ref	
Rural	0.923 [0.547, 1.557]	0.915 [0.521, 1.606]	0.758

OR- Odd's Ratio, aOR – adjusted odd's ratio, CI – Confidence interval.

recorded using an online survey which might have led to potential biases in reporting. Also, questions were available in English language and not in regional languages which might have prevented non-English speaking CHWs from participating.

Despite almost all participants having knowledge regarding the virus and the development of COVID-19 vaccine, it is of considerable concern that not even half expressed their intention to uptake the vaccine once it's available. In a country like India, where CHWs act as a bridge between the healthcare system and the general population, their recommendation plays an influential role in the general population's vaccination behavior. The grass-root level workers serve as an important source of information for the community, and their perception of COVID-19 vaccination can be a key factor in influencing the public's decision to get vaccinated. The low positive response regarding acceptance of a COVID-19 vaccine among the study participants is worrying. There is a significant need to address the CHW's vaccine related concerns, and develop strategies to increase acceptance rate of COVID-19 vaccine before the undecided make up their mind.

## 5. Conclusions

In this study, we found sub-optimal level of willingness among CHWs to participate in a vaccine trial, and to receive COVID-19 vaccine

**Table 4**  
Factors associated with the intention to receive COVID-19 vaccine among community health workers, India (N = 377).

Variable	OR [95% CI]	aOR [95% CI]	P-value
<b>Exposed to COVID-19 cases</b>			
No	Ref	Ref	
Yes	1.178 [.780, 1.780]	1.330 [0.818, 2.163]	0.250
<b>Knowledge about COVID-19 virus</b>			
No	Ref	Ref	
Yes	0.3591 [0.146, 0.878]	0.317 [0.115, 0.875]	0.027
<b>Knowledge on development of COVID19 vaccine</b>			
No	Ref	Ref	
Yes	1.422 [0.821, 2.463]	1.459 [0.766, 2.779]	0.251
<b>History of vaccine hesitancy</b>			
Yes	Ref	Ref	
No	2.053 [0.643, 6.554]	2.038 [0.862, 4.819]	0.105
<b>Risk perception</b>			
No	Ref	Ref	
Yes	3.056 [1.370, 6.816]	2.308 [1.237, 4.305]	0.009
<b>Trust in the healthcare system</b>			
No	Ref	Ref	
Yes	1.604 [1.049, 2.452]	1.292 [0.807, 2.068]	0.286
<b>Trust in domestic vaccines</b>			
Worse	Ref	Ref	
Better	1.085 [0.643, 1.831]	0.532 [0.274, 1.033]	0.062
Neutral	1.607 [0.992, 2.602]	1.241 [0.700, 2.200]	0.461
<b>Age</b>			
18-29	Ref	Ref	
30-49	0.944 [0.608, 1.465]	0.649 [0.301, 1.403]	0.272
<b>Gender</b>			
Female	Ref	Ref	
Male	1.479 [0.836, 2.616]	2.386 [1.167, 4.878]	0.017
<b>Marital status</b>			
Married	Ref	Ref	
Single	1.063 [0.674, 1.678]	0.948 [0.424, 2.121]	0.897
<b>Highest education</b>			
Primary/High School	Ref	Ref	
Undergraduate	1.205 [0.757, 1.919]	1.168 [0.702, 1.945]	0.550
Postgraduate	0.7008 [0.398, 1.231]	0.612 [0.318, 1.181]	0.143
<b>Socio-economic status</b>			
Low	Ref	Ref	
Medium	0.819 [0.3676, 1.825]	0.578 [0.240, 1.389]	0.220
High	1.868 [0.791, 4.413]	1.298 [0.511, 3.298]	0.584
<b>Area of residence</b>			
Urban	Ref	Ref	
Rural	0.987 [0.652, 1.492]	1.004 [0.643, 1.568]	0.987

OR- Odd's Ratio, aOR – adjusted odd's ratio, CI – Confidence interval.

indicating high levels of vaccine hesitancy. Knowledge about COVID-19 virus, perception of risk, and gender affected intention to get vaccinated. Gender, and knowledge regarding COVID-19 vaccine development positively affected the willingness to participate in a vaccine trial, while trust in domestic vaccines, and higher educational status lowered willingness to participate. Community health workers are trusted influencers and ambassadors of vaccine promotion. Increasing knowledge about COVID-19 disease and the vaccine is not enough to improve vaccine acceptance rates among them. It is important to design

evidence-based strategies to promote the uptake of vaccination by addressing vaccine hesitancy. Spreading awareness regarding risks of the disease, demonstrating the effectiveness and safety of vaccines, and addressing gender disparity in vaccine acceptance are essential when rolling out the novel vaccine. These strategies will have implications beyond the current pandemic.

#### Sources of support

None.

#### Presentation at a meeting

No.

#### Conflicting interest

None declared.

#### Funding

This study did not receive any funding from any organization.

#### Availability of data and materials

Data is available upon request.

#### Ethics approval and consent to participate

The study protocol was reviewed and approved by the Institutional Ethical Committee of Post Graduate Institute of Medical Education and Research (PGIMER), Chandigarh, India. Informed consent was obtained from all participants. Anonymized data was used for interpretation and reporting.

#### Consent for publication

Not applicable.

#### Declaration of competing interest

The authors declare they have no competing interests.

#### Acknowledgements

The authors would like to acknowledge the study participants for their time and contributions to the study.

#### References

- World Health Organization. WHO coronavirus (COVID-19) dashboard. <https://covid19.who.int/>. Accessed February 5, 2021.
- Government of India. Ministry of health and family welfare. <https://www.mohfw.gov.in/>. Accessed February 5, 2021.
- Erdem H, Lucey DR. Healthcare worker infections and deaths due to COVID-19: a survey from 37 nations and a call for WHO to post national data on their website. *Int J Infect Dis.* 2021;102:239–241.
- Bandyopadhyay S, Baticulon RE, Kadhum M, et al. Infection and mortality of healthcare workers worldwide from COVID-19: a systematic review. *BMJ Global Health.* 2020;5:3097.
- Indian Medical Association. Sacrifice of 665 Indian doctors in the fight against COVID-19. <https://www.ima-india.org/ima/free-way-page.php?pid=721>. Accessed February 5, 2021.
- Hajj Hussein I, Chams N, Chams S, et al. Vaccines through centuries: major cornerstones of global health. *Front Public Health.* 2015;3:269.
- Fine P, Eames K, Heymann DL. Herd immunity: a rough guide. *Clin Infect Dis.* 2011; 52:911–916.
- Government of India. Budget 2021-2022. 2021;:7 [https://www.indiabudget.gov.in/doc/Budget\\_Speech.pdf](https://www.indiabudget.gov.in/doc/Budget_Speech.pdf). Accessed February 5, 2021.
- Castiblanco J, Anaya J-M. Genetics and vaccines in the era of personalized medicine. *Curr Genom.* 2014;16:47–59.

- 10 Marchant A, Pihlgren M, Goetghebuer T, et al. Predominant influence of environmental determinants on the persistence and avidity maturation of antibody responses to vaccines in infants. *J Infect Dis*. 2006;193:1598–1605.
- 11 MacDonald NE, Eskola J, Liang X, et al. Vaccine hesitancy: definition, scope and determinants. *Vaccine*. 2015;33:4161–4164.
- 12 World Health Organization. *Ten Threats to Global Health in 2019*. World Health Organization; 2019. <https://www.who.int/news-room/spotlight/ten-threats-to-global-health-in-2019>. Accessed February 5, 2021.
- 13 Sankaranarayanan S, Jayaraman A, Gopichandran V. Assessment of vaccine hesitancy among parents of children between 1 and 5 years of age at a tertiary care hospital in Chennai. *Indian J Community Med*. 2019;44:394–396.
- 14 Nguyen T, Henningsen K, Brehaut J, Hoe E, Wilson K. Acceptance of a pandemic influenza vaccine: a systematic review of surveys of the general public. *Infect Drug Resist*. 2011;4:197–207.
- 15 Lazarus JV, Ratzan SC, Palayew A, et al. A global survey of potential acceptance of a COVID-19 vaccine. *Nat Med*. 2021;27:225–228.
- 16 Larson HJ, Jarrett C, Eckersberger E, Smith DMD, Paterson P. Understanding vaccine hesitancy around vaccines and vaccination from a global perspective: a systematic review of published literature. *Vaccine*. 2014;32:2150–2159, 2007-2012.
- 17 Salmon DA, Dudley MZ, Glanz JM, Omer SB. Vaccine hesitancy: causes, consequences, and a call to action. *Am J Prev Med*. 2015;49:S391–S398.
- 18 Abu Farha RK, Alzoubi KH, Khabour OF, Alfaqih MA. Exploring perception and hesitancy toward COVID-19 vaccine: a study from Jordan. *Hum Vaccines Immunother*. 2021;17(8):2415–2420.
- 19 Ahmad T, Murad MA, Baig M, Hui J. Research trends in COVID-19 vaccine: a bibliometric analysis. *Hum Vaccines Immunother*. 2021;17(8):2367–2372.
- 20 World Health Organization. *The Role of Community Health Workers in COVID-19 Vaccination. Implementation Support Guide*. World Health Organization; 2021. <https://apps.who.int/iris/bitstream/handle/10665/340986/WHO-2019-nCoV-NDVP-%0ACHWs-role-2021.1-eng.pdf>. Accessed June 10, 2021.
- 21 World Health Organization. COVID-19: science in 5: episode #1 - herd immunity. World health organization. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/media-resources/science-in-5/episode-1>. Accessed February 7, 2021.
- 22 Altmann DM, Douek DC, Boyton RJ. What policy makers need to know about COVID-19 protective immunity. *Lancet*. 2020;395:1527–1529.
- 23 Gagneux-Brunon A, Detoc M, Bruel S, et al. Intention to get vaccinations against COVID-19 in French healthcare workers during the first pandemic wave: a cross-sectional survey. *J Hosp Infect*. 2021;108:168–173.
- 24 Kabamba Nzaji M, Kabamba Ngombe L, Ngoie Mwamba G, et al. Acceptability of vaccination against COVID-19 among healthcare workers in the democratic republic of the Congo. *Pragmatic Observational Res*. 2020;11:103–109.
- 25 Sharun K, Faslur Rahman CK, Haritha CV, Jose B, Tiwari R, Dhama K. Covid-19 vaccine acceptance: beliefs and barriers associated with vaccination among the general population in India. *J Exp Biol Agric Sci*. 2020;8 Special(1). S210-S.
- 26 Bono SA, Faria de Moura Villela E, Siau CS, et al. Factors affecting COVID-19 vaccine acceptance: an international survey among low- and middle-income countries. *Vaccines*. 2021;9:515.
- 27 Harapan H, Wagner AL, Yufika A, et al. Acceptance of a COVID-19 vaccine in Southeast Asia: a cross-sectional study in Indonesia. *Front Public Health*. 2020;8:381.
- 28 Al-Mohaithef M, Padhi BK. Determinants of covid-19 vaccine acceptance in Saudi Arabia: a web-based national survey. *J Multidiscip Healthc*. 2020;13:1657–1663.
- 29 Reiter PL, Pennell ML, Katz ML. Acceptability of a COVID-19 vaccine among adults in the United States: how many people would get vaccinated? *Vaccine*. 2020;38:6500–6507.
- 30 Brewer NT, Chapman GB, Gibbons FX, Gerrard M, McCaul KD, Weinstein ND. Meta-analysis of the relationship between risk perception and health behavior: the example of vaccination. *Health Psychol*. 2007;26:136–145.
- 31 Wang Q, Yang L, Jin H, Lin L. Vaccination against COVID-19: a systematic review and meta-analysis of acceptability and its predictors. *Prev Med*. 2021;150, 106694.
- 32 Kitonsa J, Kamacooko O, Bahemuka UM, et al. Willingness to participate in COVID-19 vaccine trials; a survey among a population of healthcare workers in Uganda. *PLoS One*. 2021;16, e0251992.
- 33 Iacobucci G. Covid-19: No evidence that vaccines can affect fertility, says new guidance. *BMJ*. 2021;372. n509.
- 34 Sun S, Lin D, Operario D. Interest in COVID-19 vaccine trials participation among young adults in China: willingness, reasons for hesitancy, and demographic and psychosocial determinants. *Prev Med Rep*. 2021;22, 101350.
- 35 Cattapan A, Browne K, Halperin DM, et al. Motivation for participating in phase 1 vaccine trials: comparison of an influenza and an Ebola randomized controlled trial. *Vaccine*. 2019;37:289–295.