

A cross-sectional study on COVID-19 vaccine hesitancy in peri-urban areas in Kanpur, Uttar Pradesh, India

Correspondence: Abhishek Jaiswal, Room no. 14, PG Room, CCM, Old OT-Block, Center for Community Medicine, All India Institute of Medical Sciences, New Delhi 110029, India.
Tel.: +91-9205624317.
E-mail: jaiswal.aiims@gmail.com

Key words: COVID-19, vaccine hesitancy, non-confidence, complacency, non-convenience.

Contributions: AJ, ADG, MK, analysis. All the authors were involved in the study conceptualization and the preparation and finalization of the draft.

Conflict of interest: the authors declare that they have no competing interests, and all authors confirm accuracy.

Ethics approval and consent to participate: the study received ethical approval from the Institute's Ethical Committee [IEC/RAMA MEDICAL COLLEGE/Estt. /Dean/2021/12033].

Informed consent: participants were informed about the objective of the study and provided with a Participant Information sheet in the local language (Hindi). They were explained about the study in the local language and were given a chance to ask any questions pertaining to it. Informed written consent was taken from each participant. Participants were also given confirmation that they were free to withdraw consent and discontinue participation at any time during the study. Throughout the procedure, the privacy and confidentiality of the information gathered was maintained.

Funding: none.

Availability of data and materials: data will be provided by the corresponding author upon reasonable request.

Acknowledgments: the authors appreciate Dr. Pooja Punthir for her efforts in proofreading the manuscript. Moreover, they appreciate the efforts of Ms. Shikha and Mr. Narendra in collecting the data from the field practice area using Epicollect-5. They also thank Prof. PVM Lakshmi for her guidance in editing the manuscript.

Received: 10 March 2023.

Accepted: 11 May 2023.

Early view: 31 May 2023.

Publisher's note: all claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article or claim that may be made by its manufacturer is not guaranteed or endorsed by the publisher.

©Copyright: the Author(s), 2023

Licensee PAGEPress, Italy

Monaldi Archives for Chest Disease 2024; 94:2577

doi: 10.4081/monaldi.2023.2577

This article is distributed under the terms of the Creative Commons Attribution-NonCommercial International License (CC BY-NC 4.0) which permits any noncommercial use, distribution, and reproduction in any medium, provided the original author(s) and source are credited.

Ashish Punthir,¹ Abhishek Jaiswal,² Poonam Kushwaha,³ Akhil Dhanesh Goel,⁴ Anju Gahlot,³ Lakshmi Singh,³ Manmeet Kaur⁵

¹Department of Community Medicine and Family Medicine, All India Institute of Medical Sciences, Kalyani; ²Center for Community Medicine, All India Institute of Medical Sciences, Ansari Nagar, New Delhi; ³Department of Community Medicine, Rama Medical College Hospital and Research Center, Kanpur, Uttar Pradesh; ⁴Department of Community Medicine and Family Medicine, All India Institute of Medical Sciences, Jodhpur, Rajasthan; ⁵School of Public Health, Post Graduate Institute of Medical Education and Research, Chandigarh, India

Abstract

Vaccination is a potential public health solution for the prevention of infection. It reduces the severity of symptoms in the case of COVID-19. Despite the availability of vaccines, some people are hesitant to be vaccinated. The objectives of this study were to measure the proportion of vaccine hesitancy among the peri-urban population and identify its determinants. An adult population of 303 from two peri-urban areas in the field practice area of the Urban Health Training Center, Rama Medical College, was interviewed from February 22 to March 25, 2021. Epicollect 5 was used for collecting data, and STATA 16 was used for analysis. Multivariable logistic regression was applied to compute the adjusted odd ratio (AOR) (95% confidence interval) to find out the determinants of vaccine hesitancy. The 3Cs model-guided tools were used for data collection and analysis. More than one-fourth (28%) of the participants were vaccine-hesitant, whereas 34.6% had no confidence in the vaccine. Other reasons were complacency (40.6%) and convenience (35.9%). Vaccine hesitancy was significantly associated with gender [AOR=2.40 (1.12-5.16)] and trust in government [AOR=0.18 (0.08-0.45)], but there was no association with age group, political affiliation, or source of information about the vaccine. It is important to build people's trust in vaccines, make them convenient, and resolve the issues that are making them complacent. The health system needs to involve non-governmental organizations to reach out to those for whom there are issues of availability and approach.

Introduction

The World Health Organization declared COVID-19 a pandemic, which created an unprecedented challenge to the global public healthcare system, leading to 155,665,214 confirmed cases of COVID-19 as of May 6, 2021. A day before, *i.e.*, May 5, 2021, it was reported that a total of 1,170,900,000 vaccine doses had been administered [1-3]. From the initial stage of this pandemic, scientists were focused on either repurposing the existing drugs or developing vaccines against COVID-19.

Though the vaccine is now available, its reach and response to vaccination have yet to be measured [4]. Vaccine hesitancy has been a major barrier to vaccine uptake and could prevent the achievement of the COVID-19 herd immunity threshold [5]. However, a delay in acceptance or refusal of vaccines despite the availability of the COVID-19 vaccine needs to be understood in a larger context [6].

Vaccine hesitancy has been common for all vaccines. Vaccine hesitancy has been influenced by several factors, including trust in vaccines [4]. Distrust could be in the vaccine or its provider (vaccine confidence). Many times people do not perceive the need for vaccinating or valuing the vaccine (vaccine complacency), and there could be difficulty in access (vaccine convenience) [7]. Besides, there are factors at individual levels in attitudes and the socio-political domain [8-13].

Globally, many studies have assessed COVID-19 vaccine hesitancy among key workers (working in health and social care, education, transport, key public services, local or national government, food and necessity goods, public safety, and certain utilities, communications, and financial services), students (medical, engineering, arts, *etc.*), and different communities. There is less information available on the knowledge, side-effects, short-term effects, long-term effects, affordability, and effectiveness of vaccination [2,8,9,14-18].

Therefore, vaccine hesitancy needs to be understood wherever we work, and timely actions need to be taken to build confidence in vaccines and achieve the goal of herd immunity.

The objective of this study is to estimate vaccine hesitancy and identify determinants of hesitancy in the peri-urban areas of the field practice area of the Urban Health Training Center, Rama Medical College Hospital and Research Center, Mandhana, Kanpur.

Materials and Methods

This cross-sectional study was part of the original intended study, "A sequential mixed method study on COVID-19 vaccine hesitancy among rural population in block Kalyanpur, district Kanpur, Uttar Pradesh, India". Due to the state government-imposed lockdown and taking into account the current pandemic situation, the qualitative component was postponed until the situation improved.

Rama Medical College Urban Health Training Center covers about 14 peri-urban areas. All the peri-urban sites are within 5 km and are approachable; only the two peri-urban areas, namely Berikhera and Akbarpur, which were nearest and where travel was allowed, were considered for selecting the study participants for this study. The adult population (≥ 18 years of age) was included in the study.

Sample size

Taking a relative error of 5%, the prevalence of vaccine hesitancy in a slum area was 83% [13]; hence, it was presumed that in the peri-urban area, the prevalence would be slightly higher (85%) and the non-response rate 20%, a sample size of 338 was calculated using formula $z^2(1-\alpha/2)pq/d^2$ (where p is 0.85, $q=1-p$, d =relative error (5% of p)). The data was collected between February 22 and March 25, 2021. It is important to mention that the refusal rate for participation in the study was quite high (57.6%) during this phase of the pandemic. Every refusal was compensated by the next study participant, and the survey continued until the total sample was covered.

After obtaining written informed consent from the participants,

the data were collected using the online data capture tool Epicollect 5 [19]. The questionnaire was developed based on a review of the literature. The sections on socio-demographics, COVID-19 information, political affiliation, and willingness to accept the vaccine were taken from the validated questionnaires [8,10,16,18]. After collecting the data, the participants were educated on the importance of being vaccinated and the profile of the vaccine (safety, effectiveness of the vaccine and its contra-indication, side effects).

Measures

As per our operational definition, the measures are defined as follows: i) vaccine hesitancy is the unwillingness to accept the vaccine (Covishield or Covaxin Vaccine) on its availability (those who responded as "No" to the question on willingness to be vaccinated) [7]; ii) non-confidence is defined as not having trust in the vaccine or vaccine provider (those who responded as "No" to the question on trust in vaccine or vaccine provider) [7]; iii) complacency is defined as not perceiving the need to be vaccinated (those who responded as "No" to the question on the perceived need to be vaccinated) [7]; iv) non-convenience is defined as not having access to the vaccine (those who responded as "No" for the question on access for vaccine despite its availability) [7]. These were measured as binary outcomes "Yes" or "No".

Analysis

Data was analyzed using STATA16 (StataCorp, College Station, TX, USA). Vaccine hesitancy and its components have been reported as proportions. Categorical variables were analyzed using the Chi-square test/Fisher test. Univariate logistic regression was performed for all the variables, and the crude odds ratio (OR) was reported with a 95% confidence interval (CI) and p value. Variables were analyzed for collinearity through the variation inflation factor (VIF) (VIF10 was taken as the cut-off for dropping the variables from the multivariable logistic regression model). Multivariable logistic regression was used for computing the adjusted OR (which was reported with a 95% CI and p value) to find an association between vaccine hesitancy (and its components: confidence, complacency, convenience) and socio-demographic variables, political and health indicators and COVID-19 vaccine variables. A $p < 0.05$ was taken as the cut-off for statistical significance.

Ethics approval and informed consent

The study received ethical approval from the Institute's Ethical Committee [IEC/RAMA MEDICAL COLLEGE/Estt./Dean/2021/12033]. Participants were informed about the objective of the study and provided with a Participant Information sheet in the local language (Hindi). They were explained about the study in the local language and given a chance to ask any questions pertaining to it. Informed written consent was obtained from each participant. Participants were also given confirmation that they were free to withdraw consent and discontinue participation at any time during the study. Throughout the procedure, the privacy and confidentiality of the information gathered were maintained.

Results

Socio-demographic profile

A total of 303 participants were recruited for the study. The mean (standard deviation) age of the participants was 38.2 (15.1)

years. About one-third (68%) of the participants were women, and most (98.7%) were Hindus. In terms of education, the majority of the participants were graduates (27%), followed by the illiterate (20.5%) (Table 1).

Vaccine hesitancy

More than one-fourth of participants (27.7%) were not willing to get the vaccine. Lack of confidence, convenience, and complacency were seen in 34.9%, 35.9%, and 40.6% of participants, respectively. There was no association between vaccine hesitancy and age group, marital status, political affiliations, employment status, or sources of information about vaccines from various types of media. The odds of vaccine hesitancy among females were 2.4 times the odds of vaccine hesitancy among males (95% CI 1.12-5.16, $p=0.024$). The odds of vaccine hesitancy were significantly lower among those who trust the government as compared to those who do not (adjusted OR=0.18, $p<0.001$) (Table 2). Literate participants had significantly lower odds of being vaccine-hesitant (OR=0.38) compared to illiterate participants in univariable analysis,

Table 1. Socio-demographic political profile of participants (n=303).

Variables	Frequency (n)	Percentage (%)
Mean age (standard deviation)	38.2	15.1
Gender		
Male	97	32.0
Female	206	68.0
Religion		
Hindu	299	98.7
Muslim	4	1.3
Sikh	0	-
Education		
Illiterate	62	20.5
Primary school	48	15.8
Middle school	26	8.6
High School	52	17.2
Intermediate	33	10.9
Graduate and above	82	27.1
Occupation		
Unemployed	13	4.3
Employed	82	27.1
Housewife	153	50.5
Student	55	18.2
Marital status		
Married	229	75.6
Unmarried	73	24.1
Separated	1	0.3
Type of family		
Nuclear	242	79.9
Joint	61	20.1
Living alone	0	-
Village residence		
Berikhera	197	65.0
Akbarpura	106	34.9
Political party affiliation		
BJP	156	51.5
Congress	1	0.3
Samajwadi	4	1.3
Bahujan party	31	10.2
Do not support any party	111	36.6

BJP, Bharatiya Janata Party.

but this association was not significant in multivariable analysis. Awareness regarding the availability of COVID-19 vaccines in the country was also associated with lower vaccine hesitancy [crude OR=0.40 (0.17-0.94), $p=0.036$], although the variable did not load in multivariable logistic regression due to collinearity. Having awareness regarding Covaxin and Covishield vaccines was also associated with a lower OR [crude OR=0.45 (0.22-0.91), $p=0.027$] for vaccine hesitancy. The relationship was not significant after multivariable logistic regression (Table 2).

Non-confidence

A total of 106 participants (34.9%) were not confident about the available vaccines (Figure 1). Gender was significantly associated with vaccine non-confidence; more women had non-confidence in the vaccine with an OR of 1.87 (1.09-3.18, $p=0.022$) in the univariate model. Having trust in the government was significantly protective against non-confidence in vaccination, with an OR of 0.05 (0.02-0.12, $p<0.001$) (Table 3). Literate participants had significantly lower odds of being non-confident (OR=0.28) compared to illiterate participants in univariable analysis, but this association was not significant in the multivariable model. Participants who had received information about COVID-19 through television [adjusted OR=0.40 (0.17-0.93)] and government [adjusted OR=0.10 (0.02-0.52)] had a significant association with non-confidence in the vaccine compared to those who did not get information through these media. Those who were aware of adverse effects following the COVID-19 vaccination were significantly more non-confident in the vaccine than those who were not (Table 3).

Complacency

Complacency was present in 123 (40.6%) participants (Figure 1). Literate participants had significantly lower odds of being complacent [adjusted OR=0.32 (0.13-0.81)] compared to illiterate participants in the multivariable analysis. Having trust in the government was significantly associated [adjusted OR=0.08 (0.03-0.24)] with non-complacency compared to not having it. Supporters of the Bharatiya Janata Party were significantly associated with lower complacency as compared to non-supporters of any party [adjusted OR=0.27 (0.11-0.66)] as well as supporters of other parties [adjusted OR=0.28 (0.09-0.88)] (Table 4). Having awareness regarding the availability of COVID-19 vaccines in the country was also associated with lower complacency [crude OR=0.49 (0.25-0.98), $p=0.044$], although the variable did not load in multivariable logistic regression due to collinearity. Having awareness regarding Covaxin and Covishield vaccines was also associated with a lower

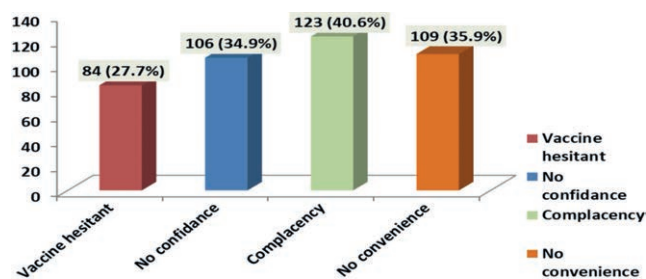


Figure 1. Depiction of COVID-19 vaccine hesitancy and its components (n=303).

OR [crude OR=0.42 (0.21-0.84), $p=0.015$] for complacency compared to not having it, although the relationship was not significant after multivariable logistic regression. Those who did not hear of vaccine side effects were more likely to have no complacency as compared to those who heard about it. Moreover, there was statistical significance (Table 4).

Non-convenience

A total of 109 (35.9%) participants had non-convenience (Figure 1). Non-convenience was more frequent in the elderly age group [adjusted OR=4.75 (1.12-20.21)] as compared to the 18-44 age group (Table 5). Education was not found to be associated with non-

Table 2. Association of vaccine hesitancy with various factors (univariable and multivariable analysis).

Variables		Total (n)	Vaccine hesitancy present (n)	(%)	Crude OR	p value	Adjusted OR	p value
Age group (in years)	18-44	188	52	27.7	Reference	-	Reference	-
	45-59	86	25	29.1	1.07 (0.61-1.88)	0.810	1.17(0.55-2.51)	0.685
	60	29	7	24.1	0.83 (0.33-2.06)	0.692	1.29(0.38-4.37)	0.687
Sex	Male	97	13	13.4	Reference	-	Reference	-
	Female	206	71	34.5	3.39 (1.77-6.51)	<0.001	2.40(1.12-5.16)	0.024
Education	Illiterate	62	24	38.7	Reference	-	Reference	-
	Literate	241	60	24.9	0.38 (0.18-0.81)	0.012	0.83(0.33-2.12)	0.701
Occupation	Unemployed	13	5	38.5	Reference	-	*	*
	Employed	82	14	17.1	0.33 (0.09-1.16)	0.083	*	*
	Homemaker	153	54	35.3	0.87 (0.27-2.78)	0.819	*	*
	Student	55	11	20.0	0.40 (0.11-1.46)	0.167	*	*
Marital status	Never married	73	15	20.5	Reference	-	*	*
	Married/separated	230	69	30.0	1.65 (0.87-3.12)	0.118	*	*
Family type	Nuclear	242	67	27.7	Reference	-	Reference	-
	Joint	61	17	27.9	1.01 (0.54-1.88)	0.977	0.72(0.29-1.80)	0.481
Party	No party	111	40	36.0	Reference	-	Reference	-
	BJP	156	33	21.1	0.48 (0.28-0.82)	0.008	1.10(0.48-2.49)	0.820
	Other parties	36	11	30.5	0.78 (0.35-1.75)	0.549	0.91(0.31-2.70)	0.866
Trust in government	No	47	29	61.7	Reference	-	Reference	-
	Yes	256	55	21.5	0.17 (0.09-0.33)	<0.001	0.18(0.08-0.45)	<0.001
Aware of vaccine availability in the country	No	37	16	43.2	Reference	-	*	*
	Yes	266	68	25.6	0.40 (0.17-0.94)	0.036	*	*
Aware about COVID-19 vaccine	No	215	61	28.4	Reference	-	Reference	-
	Yes	51	7	13.7	0.45 (0.22-0.91)	0.027	0.50(0.17-1.44)	0.199
Source of info for COVID-19								
Frontline workers	No	249	66	26.5	Reference	-	Reference	-
	Yes	17	2	11.8	0.37 (0.08-1.66)	0.194	0.52(0.10-2.74)	0.440
Television	No	66	25	37.9	Reference	-	Reference	-
	Yes	200	43	21.5	0.45 (0.25-0.82)	0.009	0.48(0.22-1.04)	0.063
Telephone	No	121	30	24.8	Reference	-	Reference	-
	Yes	145	38	26.2	1.08 (0.62-1.87)	0.792	1.18(0.53-2.62)	0.42
Social Media	No	191	53	27.8	Reference	-	Reference	-
	Yes	75	15	20.0	0.65 (0.34-1.24)	0.194	1.23(0.43-3.47)	0.701
Radio	No	204	52	25.5	Reference	-	Reference	-
	Yes	62	16	25.8	1.02 (0.53-1.95)	0.960	3.42(0.94-12.44)	0.062
News	No	84	29	34.5	Reference	-	Reference	-
	Yes	180	39	21.7	0.52 (0.29-0.93)	0.027	0.72(0.32-1.58)	0.407
Government	No	219	59	26.9	Reference	-	Reference	-
	Yes	47	9	19.2	0.64 (0.29-1.41)	0.269	0.51(0.14-1.87)	0.311
Friend	No	181	45	24.9	Reference	-	Reference	-
	Yes	85	23	27.1	1.12 (0.62-2.01)	0.702	1.14(0.37-3.56)	0.819
Family	No	181	44	24.3	Reference	-	Reference	-
	Yes	85	24	28.2	1.22 (0.68-2.19)	0.494	0.62(0.24-1.59)	0.321
COVID-19 heard anyone vaccinated	No	94	28	29.8	Reference	-	Reference	-
	Yes	172	40	23.3	0.71 (0.41-1.26)	0.244	0.78(0.36-1.69)	0.533
Heard COVID-19 vaccine side effects	No	76	18	23.7	0.87 (0.46-1.61)	0.657	0.83(0.37-1.86)	0.648
	Yes	190	50	26.3	Reference	-	Reference	-

OR, odds ratio; BJP, Bharatiya Janata Party; *variable was dropped due to collinearity and variance inflation factor ≥ 10 .

convenience in both univariable and multivariable analyses. Participants who had received information about COVID-19 through television [(adjusted OR=0.26 (0.08-0.80)] were significantly associated with non-convenience, with lower odds amongst those who got information through television media compared to not getting it. However, participants who received information through radio had

significantly higher odds compared to those who did not [13.04 (2.52-67.53)] (Table 5). Having awareness regarding Covaxin and Covishield vaccines was associated with lower odds (crude OR=0.12 (0.05-0.27) for non-convenience as compared to not having awareness. Those who heard someone being vaccinated [0.22 (0.80-0.58)] were associated with lower odds of non-convenience (Table 5).

Table 3. Association of vaccine non-confidence with various factors (univariable and multivariable analysis).

Variables		Total (n)	Non-confidence present (n)	(%)	Crude OR	p value	Adjusted OR	p value
Age group (in years)	18-44	188	61	32.4	Reference	-	Reference	-
	45-59	86	35	40.7	1.43 (0.84-2.42)	0.185	1.23(0.55-2.76)	0.620
	60	29	10	34.5	1.09 (0.48-2.50)	0.828	1.12(0.30-4.19)	0.865
Sex	Male	97	25	25.8	Reference	-	Reference	-
	Female	206	81	39.3	1.87 (1.09-3.18)	0.022	1.10(0.52-2.33)	0.796
Education	Illiterate	62	33	53.2	Reference	-	Reference	-
	Literate	241	73	30.3	0.28 (0.14-0.58)	<0.001	0.47(0.18-1.21)	0.119
Occupation	Unemployed	13	5	38.5	Reference	-	*	*
	Employed	82	22	26.8	0.59 (0.17-1.98)	0.391	*	*
	Homemaker	153	63	41.2	1.12 (0.35-3.58)	0.849	*	*
	Student	55	16	29.1	0.66 (0.19-2.31)	0.513	*	*
Marital status	Never married	73	20	27.4	Reference	-	*	*
	Married/separated	230	86	37.4	1.58 (0.89-2.82)	0.121	*	*
Family type	Nuclear	242	84	34.7	Reference	-	Reference	-
	Joint	61	22	36.1	1.06 (0.59-1.91)	0.843	0.89(0.33-2.43)	0.820
Party	No party	111	55	49.6	Reference	-	Reference	-
	BJP	156	39	25.0	0.34 (0.20-0.57)	<0.001	0.41(0.17-1.03)	0.059
	Other parties	36	12	33.3	0.51 (0.23-1.12)	0.092	0.18(0.05-0.67)	0.010
Trust in govt.	No	47	41	87.2	Reference	-	Reference	-
	Yes	256	65	25.4	0.05 (0.02-0.12)	<0.001	0.04(0.01-0.12)	<0.001
Aware of vaccine availability in the country	No	266	86	32.3	Reference	-	*	*
	Yes	37	20	54.1	0.59 (0.28-1.18)	0.138	*	*
Aware about COVID-19 vaccine	No	215	74	34.4	Reference	-	Reference	-
	Yes	51	12	23.5	0.41 (0.20-0.81)	0.011	1.15(0.41-3.21)	0.792
Source of info for COVID-19								
Frontline workers	No	249	85	34.1	Reference	-	Reference	-
	Yes	17	1	5.9	0.12 (0.02-0.92)	0.042	0.32(0.03-3.15)	0.330
Television	No	66	32	48.5	Reference	-	Reference	-
	Yes	200	54	27.0	0.39 (0.22-0.70)	0.001	0.40(0.17-0.93)	0.033
Telephone	No	121	46	38.0	Reference	-	Reference	-
	Yes	145	40	27.6	0.62 (0.37-1.04)	0.071	0.52(0.22-1.21)	0.130
Social media	No	191	69	36.1	Reference	-	Reference	-
	Yes	75	17	22.7	0.52 (0.28-0.96)	0.036	1.26(0.41-3.93)	0.686
Radio	No	204	73	35.7	Reference	-	Reference	-
	Yes	62	13	20.9	0.48 (0.24-0.94)	0.031	4.12(0.88-19.18)	0.071
News	No	84	37	44.1	Reference	-	Reference	-
	Yes	180	48	26.7	0.46 (0.27-0.79)	0.005	0.88(0.38-2.02)	0.765
Government	No	219	82	37.4	Reference	-	Reference	-
	Yes	47	4	8.5	0.16 (0.05-0.45)	0.001	0.10(0.02-0.52)	0.006
Friend	No	181	62	34.2	Reference	-	Reference	-
	Yes	85	24	28.2	0.76 (0.43-1.33)	0.328	1.61(0.48-5.36)	0.438
Family	No	181	59	32.6	Reference	-	Reference	-
	Yes	85	27	31.8	0.96 (0.55-1.67)	0.892	0.35(0.12-1.01)	0.052
COVID-19 heard anyone vaccinated	No	94	34	36.2	Reference	-	Reference	-
	Yes	172	52	30.2	0.76 (0.45-1.30)	0.323	0.66(0.26-1.68)	0.381
Heard COVID-19 vaccine side effects	No	76	17	22.4	0.51 (0.27-0.93)	0.030	0.35(0.12-0.98)	0.046
	Yes	190	69	36.3	Reference	-	Reference	-

OR, odds ratio; BJP, Bharatiya Janata Party; *variable was dropped due to collinearity and variance inflation factor ≥ 10 .

Discussion

This quantitative cross-sectional study was conducted among the rural population of two villages. The findings indicate more than a quarter were vaccine-hesitant and hesitancy was predomi-

nant in the 45-59 age group, women, illiterate participants, joint family, married, and unemployed participants. About two-thirds of the population had confidence and compliance, while 40.6% were complacent.

There are demographic disparities in vaccine acceptance [2,9,18-20] but in our sample, socio-demographic variables were not

Table 4. Association of vaccine complacency with various factors (univariable and multivariable analysis).

Variables		Total (n)	Complacency present (n)	(%)	Crude OR	p value	Adjusted OR	p value
Age group (in years)	18-44	188	71	37.8	Reference	-	Reference	-
	45-59	86	39	45.4	1.36 (0.81-2.29)	0.235	1.57(0.73-3.39)	0.249
	60	29	13	44.8	1.33 (0.61-2.95)	0.468	1.58(0.48-5.18)	0.452
Sex	Male	97	31	31.9	Reference	-	Reference	-
	Female	206	92	44.7	1.72 (1.03-2.85)	0.037	0.99(0.50-1.98)	0.986
Education	Illiterate	62	36	58.1	Reference	-	Reference	-
	Literate	241	87	36.1	0.60 (0.26-1.41)	0.242	0.32(0.13-0.81)	0.016
Occupation	Unemployed	13	7	53.8	Reference	-	*	*
	Employed	82	25	30.5	0.38 (0.11-1.23)	0.106	*	*
	Homemaker	153	71	46.4	0.74 (0.24-2.31)	0.607	*	*
	Student	55	20	36.4	0.49 (0.14-1.66)	0.252	*	*
Marital status	Never married	73	23	31.5	Reference	-	*	*
	Married/separated	230	100	43.5	1.67 (0.96-2.92)	0.071	*	*
Family type	Nuclear	242	98	40.5	Reference	-	Reference	-
	Joint	61	25	40.9	1.02 (0.58-1.81)	0.945	0.72(0.28-1.84)	0.496
Party	No party	111	64	57.7	Reference	-	Reference	-
	BJP	156	44	28.2	0.29 (0.17-0.48)	<0.001	0.27(0.11-0.66)	0.004
	Other parties	36	15	41.7	0.52 (0.24-1.12)	0.097	0.28(0.09-0.88)	0.029
Trust in govt.	No	47	42	89.4	Reference	-	Reference	-
	Yes	256	81	31.6	0.06 (0.02-0.14)	<0.001	0.08(0.03-0.24)	<0.001
Aware of vaccine availability in the country	No	37	22	59.5	Reference	-	*	*
	Yes	266	101	37.9	0.49 (0.25-0.98)	0.044	*	*
Aware about COVID-19 vaccine	No	215	88	40.9	Reference	-	Reference	-
	Yes	51	13	25.5	0.42 (0.21-0.84)	0.015	0.53(0.20-1.38)	0.193
Source of info for COVID-19								
Frontline workers	No	249	98	39.4	Reference	-	Reference	-
	Yes	17	3	17.6	0.33 (0.09-1.18)	0.088	0.45(0.08-2.46)	0.355
Television	No	66	31	46.9	Reference	-	Reference	-
	Yes	200	70	35.0	0.61 (0.34-1.07)	0.084	0.94(0.42-2.12)	0.880
Telephone	No	121	47	38.8	Reference	-	Reference	-
	Yes	145	54	37.2	0.93 (0.57-1.53)	0.789	0.92(0.42-2.04)	0.838
Social media	No	191	75	39.3	Reference	-	Reference	-
	Yes	75	26	34.7	0.82 (0.47-1.43)	0.487	1.97(0.70-5.50)	0.197
Radio	No	204	81	39.7	Reference	-	Reference	-
	Yes	62	20	32.3	0.72 (0.39-1.32)	0.291	1.47(0.36-5.94)	0.592
News	No	84	42	50.0	Reference	-	Reference	-
	Yes	180	57	31.7	0.46 (0.27-0.78)	0.004	0.81(0.37-1.79)	0.606
Government	No	219	90	41.1	Reference	-	Reference	-
	Yes	47	11	23.4	0.44 (0.21-0.91)	0.026	0.35(0.09-1.34)	0.125
Friend	No	181	69	38.1	Reference	-	Reference	-
	Yes	85	32	37.7	0.98 (0.58-1.67)	0.941	1.17(0.37-3.70)	0.784
Family	No	181	66	36.5	Reference	-	Reference	-
	Yes	85	35	41.2	1.22 (0.72-2.07)	0.461	0.66(0.25-1.78)	0.416
COVID-19 heard anyone vaccinated	No	94	46	48.9	Reference	-	Reference	-
	Yes	172	55	31.9	0.49 (0.29-0.82)	0.007	0.32(0.14-0.72)	0.006
Heard COVID-19 vaccine side effects	No	76	23	30.3	0.62 (0.35-1.10)	0.103	0.41(0.17-0.98)	0.044
	Yes	190	78	41.1	Reference	-	Reference	-

OR, odds ratio; BJP, Bharatiya Janata Party; *variable was dropped due to collinearity and variance inflation factor ≥ 10 .

associated with vaccine hesitancy. Despite having no significant association with most variables, vaccine hesitancy was associated with being younger than 60 years of age, having a lower level of education, and having inadequate knowledge about the recommended action, as has been mentioned in other studies [11,18,21]. Gender and education do affect the acceptance of vaccination. Not only in

our population but men compared to women and graduates were also pro-vaccination [16,20].

In our study, almost 85% of participants had trust in the government. On the contrary, 46.2% of Austrians had trust in the government to provide safe vaccines [20]. Those who had received information about COVID-19 through television and the news

Table 5. Association of vaccine non-convenience with various factors (univariable and multivariable analysis).

Variables		Total (n)	Non-convenience present (n)	(%)	Crude OR	p value	Adjusted OR	p value
Age group (in years)	18-44	188	72	38.3	Reference	-	Reference	-
	45-59	86	23	26.7	0.59 (0.34-1.03)	0.064	1.11(0.40-3.07)	0.837
	60	29	14	48.3	1.50 (0.69-3.30)	0.309	4.75(1.12-20.21)	0.035
Sex	Male	97	22	22.6	Reference	-	Reference	-
	Female	206	87	42.2	2.49 (1.44-4.32)	0.001	0.78(0.29-2.10)	0.623
Education	Illiterate	62	17	27.4	Reference	-	Reference	-
	Literate	241	92	38.2	1.63 (0.88-3.02)	0.118	2.53(0.56-11.54)	0.230
Occupation	Unemployed	13	6	46.2	Reference	-	*	*
	Employed	82	18	22.0	0.32 (0.10-1.10)	0.071	*	*
	Homemaker	153	65	42.5	0.86 (0.28-2.69)	0.797	*	*
	Student	55	20	36.4	0.67 (0.20-2.26)	0.515	*	*
Marital status	Never Married	73	27	37.0	Reference	-	Reference	-
	Married/Separated	230	82	35.6	0.94 (0.55-1.63)	0.836	-	-
Family type	Nuclear	242	73	30.2	Reference	-	Reference	-
	Joint	61	36	59.0	3.33 (1.87-5.95)	<0.001	1.05(0.37-3.02)	0.922
Party	No party	111	72	64.9	Reference	-	Reference	-
	BJP	156	32	20.5	0.14(0.08-0.24)	<0.001	0.44(0.17-1.13)	0.089
	Other parties	36	5	13.9	0.09(0.03-0.24)	<0.001	0.40(0.08-2.10)	0.279
Trust in government	No	47	18	38.3	Reference	-	Reference	-
	Yes	256	91	35.6	0.89 (0.47-1.69)	0.718	0.66(0.21-2.14)	0.492
Aware of vaccine availability in the country	No	215	60	27.9	Reference	-	*	*
	Yes	51	20	39.2	1.67 (0.88-3.15)	0.116	*	*
Aware about COVID-19 vaccine	No	37	29	78.4	Reference	-	Reference	-
	Yes	266	80	30.1	0.12 (0.05-0.27)	<0.001	0.51(0.16-1.69)	0.273
Source of info for COVID-19								
Frontline workers	No	249	69	27.7	Reference	-	Reference	-
	Yes	17	11	64.7	4.78 (1.70-13.43)	0.003	0.79(0.18-3.43)	0.749
Television	No	66	21	31.8	Reference	-	Reference	-
	Yes	200	59	29.5	0.90 (0.49-1.63)	0.722	0.26(0.08-0.80)	0.019
Telephone	No	121	10	8.3	Reference	-	Reference	-
	Yes	145	70	48.3	10.36 (5.-2-21.38)	<0.001	2.39(0.76-7.51)	0.136
Social media	No	191	37	19.4	Reference	-	Reference	-
	Yes	75	43	57.3	5.59 (3.13-10.00)	<0.001	2.07(0.54-7.97)	0.289
Radio	No	204	31	15.2	Reference	-	Reference	-
	Yes	62	49	79.0	21.03 (10.23-43.26)	<0.001	13.04(2.52-67.53)	0.002
News	No	84	21	25.0	Reference	-	Reference	-
	Yes	180	58	32.2	1.43 (0.79-0.26)	0.234	0.76(0.24-2.42)	0.647
Government	No	219	45	20.6	Reference	-	Reference	-
	Yes	47	35	74.5	11.28 (5.42-23.47)	<0.001	0.66(0.12-3.48)	0.622
Friend	No	181	21	11.6	Reference	-	Reference	-
	Yes	85	59	69.4	17.29 (9.04-33.05)	<0.001	3.72(0.91-15.19)	0.067
Family	No	181	27	14.9	Reference	-	Reference	-
	Yes	85	53	62.4	9.45 (5.19-17.21)	<0.001	1.59(0.52-4.82)	0.412
COVID-19 heard anyone vaccinated	No	94	44	46.8	Reference	-	Reference	-
	Yes	172	36	20.9	0.30 (0.17-0.52)	<0.001	0.22(0.08-0.58)	0.002
Heard COVID-19 vaccine side effects	No	76	28	36.8	1.55 (0.88-2.72)	0.129	0.49(0.19-1.25)	0.136
	Yes	190	52	27.3	Reference	-	Reference	-

OR, odds ratio; BJP, Bharatiya Janata Party; * Variable was dropped due to collinearity and variance inflation factor ≥ 10 .

media and were aware of the availability of COVID-19 vaccines in the country were also associated with lower vaccine hesitancy. Other studies reported that reliance on social media as the main source of information about COVID-19 vaccines was associated with vaccine hesitancy [22]. The existing literature points out that the frequency of social media use, type of content, and emotional appeal influence the anti-vaccination movement online [23].

Studies have shown political affiliation influences vaccine hesitancy, which has been documented in a survey among US and Austrian adults and the Irish and UK populations. [10,12,20]. About a quarter of both UK and Irish participants were vaccine-hesitant [10]. Moreover, vaccine hesitancy among the Austrian adult population was higher among those who voted for the opposition party or no party [20]. However, our study showed no association between vaccine hesitancy and political affiliation, which may be due to the non-representative nature of the sample.

It was reported that vaccine hesitancy/resistance in the UK and Turkey was evident in 35% and 31% of the populations, respectively. Perceived risk of contracting infection and frequency of watching, reading, and listening to news had positive effects on vaccine hesitancy. Those resistant to the COVID-19 vaccine were less likely to obtain information about the pandemic from traditional and authoritative sources and had mistrust of these sources [24].

The studies that have been conducted to assess vaccine hesitancy among communities (Australia, Austria, Europe, Arabian countries, the US, UK, France, Turkey, *etc.*) are online studies [12,16,18,20,21,24]. The limitations of online studies are constraints in generalizability, sampling issues, self-selection bias, non-response rates, *etc.* [25].

A study assessing the 5Cs (confidence, complacency, convenience, calculated risk, and concern) using a 5-item Likert scale among 26,234 respondents found that a willingness to be vaccinated had the highest correlations with confidence in the safety of the vaccine, concern about protecting others by being vaccinated, and believing COVID-19 was serious enough to merit vaccination [26].

We assessed confidence, complacency, and convenience (3Cs) as a binary outcome (present or absent), unlike previous studies using a Likert scale to assess the 3Cs in other vaccines, such as the influenza vaccine [27,28] and found confidence in the vaccine, convenience of vaccination, and no complacency were associated with trusting the government and supporting the ruling party. The documented limitations in using a Likert scale are the following: social desirability bias, central tendency bias (participants avoid extreme response categories), acquiescence bias (agree with the statements in order to please the experimenter), and validity, which is difficult to demonstrate [29].

A qualitative study is warranted for exploring and understanding the socio-demographic characteristics of the study population, some outside factors (*i.e.*, confounders) that could not be controlled, a different source of media for the COVID-19 vaccine that influences vaccine hesitancy, and the 3Cs to explore the non-significant results with a different set of variables. Further analysis is necessary to comprehend how vaccine hesitancy manifests itself or *vice versa* when confidence, complacency, or convenience are present.

This study has a few limitations that warrant consideration. This study followed a cross-sectional study design that cannot establish causal inferences. Therefore, a longitudinal study would overcome this limitation in understanding potential causal relationships. Moreover, the small sample size and study setting are only representative of similar settings and cannot be generalized. Therefore, studies utilizing larger samples from more representative populations are needed.

Conclusions

The findings indicate the population of these two peri-urban areas is vaccine-hesitant, and gender and trust in government were the significant determinants. A multi-sectorial (health system, media, and administration) approach is required for mitigating and addressing vaccine hesitancy issues, and a qualitative study is to be conducted to understand the factors influencing the 3Cs.

References

- Centers for Disease Control and Prevention. Vaccines for COVID-19. 2021. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/index.html>.
- Lin Y, Hu Z, Zhao Q, et al. Understanding COVID-19 vaccine demand and hesitancy: a nationwide online survey in China. *PLoS Negl Trop Dis* 2020;14:e0008961.
- World Health Organization. Coronavirus (COVID-19) Dashboard. Available from: <https://covid19.who.int/>.
- World Health Organization. MODULE 2 - overview and outcomes - WHO vaccine safety basics. Available from: <https://apps.who.int/iris/bitstream/handle/10665/340576/WHO-HIS-2013.06-eng.pdf?sequence=1&isAllowed=y>
- Perry C, Mizer A, Wynn A, Kruczek C. Countering COVID-19 vaccine hesitancy. *Southwest Respir Crit Care Chron* 2020; 8:32-46.
- Bhatia A. Diseases V. Vaccine hesitancy: what it means and what we need to know in order to tackle it, expert explains. 2021. Available from: <https://swachhindia.ndtv.com/vaccine-hesitancy-what-it-means-and-how-we-can-tackle-it-experts-explain-55729/>.
- MacDonald NE, SAGE Working Group on Vaccine Hesitancy. Vaccine hesitancy: definition, scope and determinants. *Vaccine* 2015;33:4161-4.
- Butter S, McGlinchey E, Berry E, Armour C. Psychological, social, and situational factors associated with COVID-19 vaccination intentions: a study of UK key workers and non-key workers. *Br J Health Psychol* 2022;27:13-29.
- Freeman D, Loe BS, Chadwick A, et al. COVID-19 vaccine hesitancy in the UK: the Oxford coronavirus explanations, attitudes, and narratives survey (OCEANS) II. *Psychol Med* 2022;52: 3127-41.
- Murphy J, Vallières F, Bentall RP, et al. Psychological characteristics associated with COVID-19 vaccine hesitancy and resistance in Ireland and the United Kingdom. *Nat Commun* 2021;12:29.
- Detoc M, Bruel S, Frappe P, et al. Intention to participate in a COVID-19 vaccine clinical trial and to get vaccinated against COVID-19 in France during the pandemic. *Vaccine* 2020;38: 7002-6.
- Kreps S, Prasad S, Brownstein JS, et al. Factors associated with US adults' likelihood of accepting COVID-19 vaccination. *JAMA Netw Open* 2020;3:e2025594.
- Dasgupta P, Bhattacharjee S, Mukherjee A, Dasgupta S. Vaccine hesitancy for childhood vaccinations in slum areas of Siliguri, India. *Indian J Public Health* 2018;62:253-8.
- 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 Obs Res* 2020;11:103-9.
- Kwok KO, Li KK, Wei WI, et al. Influenza vaccine uptake,

- COVID-19 vaccination intention and vaccine hesitancy among nurses: a survey. *Int J Nurs Stud* 2021;114:103854.
16. Neumann S, Nirosha B, Varghese E, et al. Once we have it, will we use it? A European survey on willingness to be vaccinated against COVID-19. *Eur J Heal Econ* 2020;21:977-82.
 17. Lockyer B, Islam S, Rahman A, et al. Understanding COVID-19 misinformation and vaccine hesitancy in context: findings from a qualitative study involving citizens in Bradford, UK. *Health Expect* 2021;24:1158-67.
 18. Rhodes A, Hoq M, Measey MA, Danchin M. Intention to vaccinate against COVID-19 in Australia. *Lancet Infect Dis* 2021;21:e110.
 19. EpiCollect5. Free and easy-to-use mobile data-gathering platform. Available from: <https://five.epicollect.net/>. Accessed on: 9/05/2023.
 20. Schernhammer E, Weitzer J, Laubichler MD, et al. Correlates of COVID-19 vaccine hesitancy in Austria: trust and the government. *J Public Health (Oxf)* 2022;44:e106-16.
 21. Malik AA, Mcfadden SM, Elharake J, Omer SB. Determinants of COVID-19 vaccine acceptance in the US. *EClinicalMedicine* 2020;26:100495.
 22. Sallam M, Dababseh D, Eid H, et al. High rates of COVID-19 vaccine hesitancy and its association with conspiracy beliefs: a study in Jordan and Kuwait among other Arab countries. *Vaccines (Basel)* 2021;9:42.
 23. Wawrzuta D, Jaworski M, Gotlib J, Panczyk M. Characteristics of antivaccine messages on social media: systematic review. *J Med Internet Res* 2021;23:e24564..
 24. Salali GD, Uysal MS. COVID-19 vaccine hesitancy is associated with beliefs on the origin of the novel coronavirus in the UK and Turkey. *Psychol Med* 2020;19:1-3.
 25. Wright K. Researching internet-based populations: advantages and disadvantages of online survey research, online questionnaire authoring software packages, and web survey services. *J Comput-Mediat Commun* 2005;10:JCMC1034.
 26. Dorman C, Perera A, Condon C, et al. Factors associated with willingness to be vaccinated against COVID-19 in a large convenience sample. *J Community Health* 2021;46:1013-9.
 27. Gonzalez Block MA, Guterrez Calderon E, Pelcastre Villafuerte B, et al. Influenza vaccination hesitancy in five countries of South America. Confidence, complacency and convenience as determinants of immunization rates. *PloS One* 2020;15:e0243833.
 28. Moretti F, Sentin D, Bovolenta E, et al. Attitudes of nursing home staff towards influenza vaccination: opinions and factors influencing hesitancy. *Int J Environ Res Public Health* 2020;17:1851.
 29. Bertram D. Likert Scales: CPSC 681- topic report. 2006. Available from: <https://view.officeapps.live.com/op/view.aspx?src=http%3A%2F%2Fpages.cpsc.ucalgary.ca%2F~saul%2Fwiki%2Fuploads%2FCPSC681%2Ftopic-dane-likert.doc&wdOrigin=BROWSELIN>. Accessed on: 9/05/2023.