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Prevalence & correlates of COVID-19 vaccine hesitancy in a rural community of Bengaluru district, southern India: A preliminary cross-sectional study

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***Background & objectives*: Studying vaccine hesitancy is important for helping improve vaccine coverage against COVID-19. The objective of this study was to assess the prevalence and correlates of COVID-19 vaccine hesitancy in a rural community in India.**

***Methods*: A cross-sectional study of all adults aged over 18 yr was undertaken during July-August 2021, in a village outside Bengaluru city in southern India.**

***Results*: In our study, 68.7 per cent of the eligible 297 adult population accepted vaccination immediately, another 9.4 per cent hesitated but accepted vaccination without delay, a further 10.4 per cent delayed their vaccination and the remaining 11.5 per cent refused vaccination. The prevalence (95% confidence interval) of vaccine hesitancy was 21.9±4.8 per cent. Full vaccination was higher among males (76%) compared to females (58%, *P*<0.001). Those who hesitated and delayed vaccination (converts) were more likely to be from a nuclear family, whereas those who refused the vaccine were from a joint/three-generation family. Those who refused vaccination were adversely influenced by social media predominantly as also their religious/cultural beliefs and distrust on the pharmaceutical industry. Those who delayed but accepted vaccination were positively influenced by healthcare professionals and others who had accepted the vaccine recently. Geographic factors, cost of vaccine, and mode of administration were not the major concerns.**

***Interpretation & conclusions*: Vaccine uptake is a continuum. Our study helped identify the characteristics of those who delayed vaccination versus those who refused vaccination. This will help policymakers, programme managers and healthcare professionals to focus priority action on population subgroups for improving individual- and population-level protection.**

Key words COVID-19 - cross-sectional study - India - prevalence - vaccination hesitancy

Since the SARS-CoV-2 emerged in late 2019, it has killed a few millions, infected several millions more, caused a global economic downturn and forced governments around the world to lock down their

populations for varying periods. Protection against COVID-19 disease may be acquired via natural infection or through COVID-19 vaccination. The scientific community, regulatory authorities and manufacturers have worked in record time to bring COVID vaccines to the market[1]. While acceptance of vaccination is the norm in most populations worldwide, subsets of persons may hesitate or refuse to take the vaccine. Resource constrained countries that already have to deal with vaccine-distribution inequity[2], need to make efforts to study the levels and determinants of vaccine hesitancy[3]. Vaccine hesitancy refers to delaying or refusing vaccines despite the availability of vaccine services[4]. It is context specific, and so can vary with respect to time, place, person and vaccines. Vaccine hesitancy in a population is determined by individual and group influences, vaccine-related determinants as well as contextual factors[4].

In India, COVID-19 vaccines were rolled out for public use in mid-January 2021. While initial problems were related mostly to vaccine shortage, as the vaccination programme stabilized, vaccine hesitancy became critical since it can reduce vaccine uptake and compromise herd immunity. The objective of our study was to estimate the prevalence of COVID-19 vaccine hesitancy and determine the correlates of hesitancy in a rural community of Bengaluru, Karnataka, India.

Material & Methods

The cross-sectional study was undertaken by the department of Community Medicine, St. John's Medical College, Bengaluru, India, in a peri-urban village situated 10 km southwest of Bengaluru city. The study was undertaken during July-August 2021 after the second COVID wave had subsided in Karnataka state[5]. Adults (aged 18 yr and above) who were eligible to take the COVID-19 vaccine were the study participants.

Assuming an expected prevalence of 25 per cent vaccine hesitancy[6,7] and relative precision of five per cent, the sample size was estimated to be 288. Systematic random sampling method was used to identify the household, and the first eligible adult was selected for the interview within a household. Face-to-face interviews were conducted at the rural households by trained medical interns, after obtaining informed written consent and ensuring COVID-19 appropriate behaviour. Ethics approval was obtained from the St. John's Medical College Ethics Review Board.

Study instrument: Data were collected using a structured questionnaire to obtain the socio-demographic details of participants and identify their COVID-19 vaccination status as those who accepted without hesitation, delayed their vaccination (converts) or refused vaccination. For those who refused or delayed vaccination, details about contextual factors, individual and group influences and vaccine-related determinants were obtained on a Likert scale (1=strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree)[4].

Statistical analysis: Data were analyzed using SPSS Statistics for Windows 26.0 software (IBM Corp., NY, USA). $P<0.05$ was considered statistically significant.

Results & Discussion

The demographic profile of the 297 eligible participants (excluding two who had reported recent COVID-19 infection) was as follows. Males were 49.5 per cent (n=147). The mean age was 38±12.5 yr. The median (interquartile range) per capita income per day was ₹ 209 (127, 246) [USD: 2.8 (1.7, 3.3)] (1 USD= ₹ 74.5). Chief occupations were agriculture, small businesses and service sector jobs; 77.7 per cent (231/297) were ever married and the rest were never married. Religion-wise distribution was 91.6 per cent (272/297) – Hindus, 6.4 per cent (19/297) – Muslims and two per cent (6/297) – Christians. Sixty one per cent (181/297) lived in nuclear families, whereas 39 per cent (116/297) lived in joint/multi-generation families. Of these 12 per cent (34/297) were illiterate; 52 per cent (154/297) had completed middle- or high-school education and 37 per cent (109/297) had completed post-schooling education.

Overall, 76 per cent (111/147) males compared to 58 per cent (87/150) of females were fully vaccinated (P=0.001); 70 per cent (162/231) of ever-married persons were fully vaccinated compared to 55 per cent (36/66) of never-married persons (P=0.02). There was no significant difference in full vaccination status by religion, education or type of family, as of the time of the study.

The study identified four distinct groups of persons in the community, with regard to their vaccination uptake among the eligible population; 68.7 per cent (204/297) had accepted vaccination early, 9.4 per cent (28/297) hesitated but accepted vaccination without delay, 10.4 per cent (31/297) delayed their vaccination

Table. Sociodemographic characteristics of those who refused, accepted or delayed COVID-19 vaccination in a rural community in Bengaluru, 2021

Parameters	Refused vaccination (n=34)	Accepted vaccination (n=232)	Converts (delayed) (n=31)
Age (yr), mean±SD	39.1±12.7	37.3±12.0	39.7±17.0
Median per capita income/day (USD/₹)**	2.3/171	2.7/201	3.0/224
Sex, n (%)			
Males	14 (10)	118 (80)	15 (10)
Females	21 (14)	114 (76)	15 (10)
Religion, n (%)			
Hindu	31 (11)	210 (78)	31 (11)
Non-Hindu	3 (16)	22 (84)	0 (0)
Marital status, n (%)			
Never married	3 (4)	54 (81)	10 (15)
Ever married	32 (14)	177 (77)	21 (9)
Educational attainment, n (%)			
Illiterate	6 (17)	24 (66)	6 (17)
Up to high school	21 (14)	119 (78	12 (8)
Beyond high school	8 (7)	88 (81)	13 (12)
Type of family*, n (%)			
Nuclear	17 (10)	138 (76)	26 (14)
Joint	5 (10)	43 (86)	2 (4)
3-generation	12 (18)	51 (77)	3 (5)

*P**<0.05, ***<0.01. SD, standard deviation

and the remaining 11.5 per cent (34/297) refused vaccination. The prevalence (95% confidence interval) of vaccine hesitancy in this community was, therefore, 21.9 (4.8%).

The socio-demographic characteristics of those who refused (11.5%), accepted (77.1%) or delayed (10.4%) vaccination are shown in the Table. Those who refused vaccination were found to have lower incomes, were married and about half belonged to larger families, whereas those who delayed vaccination were found to be earning relatively higher, and were from nuclear families. Sociodemographic position was found to be significantly associated with refusal or conversion.

The responses of those who refused vaccination (n=34) or delayed vaccination (n=31) are shown in Figure A and B, respectively. Most of those who refused vaccination cited family/friends/neighbours and social media as the main reasons for them not taking the vaccine. This was despite the presence of influential gatekeepers such as healthcare professionals and local leaders encouraging them to take vaccines, and also the respondents having reported that they have sufficient trust in the government. Somewhat equal proportions of persons agreed or disagreed with statements such as 'government is pushed by the pharmaceutical industry' and 'religion/culture is against vaccination'. Factors such as distance, wait time, cost and mode of administration were not major barriers for a majority of persons. Other responses to open-ended questions included fear of side effects (44%, 14/34) and not aware of a vaccine being available (6%, 2/34).

Among those who delayed their vaccination, fear of side effects and, to a lesser extent, the worry of having to miss work due to side effects, were reported as major concerns. They reported that healthcare professionals allayed their anxieties with regard to vaccine/vaccination, and all reported that they would recommend the COVID-19 vaccine to others. An overwhelming majority (94%, 29/31) reported that they waited for someone they knew to get the vaccine before they got it themselves.

Promoting the uptake of COVID-19 vaccines requires understanding of whether people are

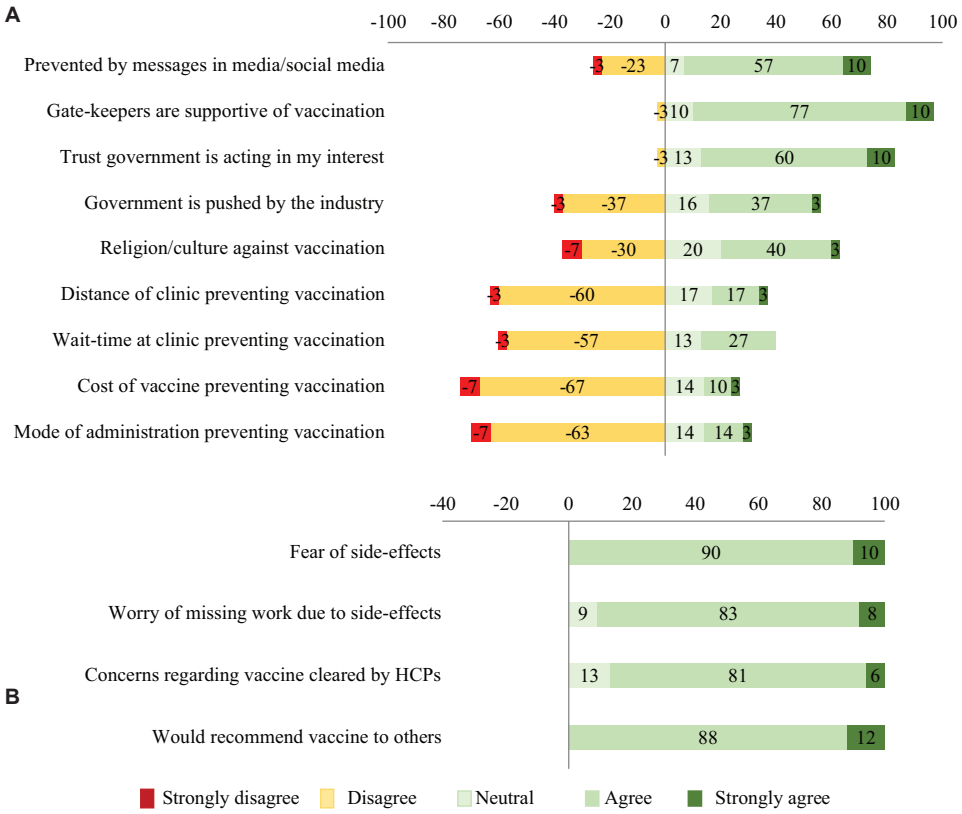

Figure. (**A**) Responses of those who had refused to take the COVID-19 vaccine (n=34). (**B**) Responses of those who had delayed but taken their COVID-19 vaccination (n=31). All values are represented as percentages. HCP, health care professional.

willing to be vaccinated or not, the reasons for why they are willing or unwilling to do so, and the diverse determinants that go into their decision-making. Full vaccine coverage in this peri-urban rural community was nearly 70 per cent, more than double that of the national average (~25%) for the same month[8]. The sex of the individual was found to be a significant predictor of vaccination; males were more likely to have been fully vaccinated compared to females. Others have called for the reporting of sex-disaggregated COVID-19 vaccination rates at national and subnational levels[9]. Age, religion and educational status were not found to be significant at this time point in our study setting.

Vaccine hesitancy was reported by 21.9 per cent of the population. This was generally in consonance with the rates usually seen in low- and middle-income countries and much lower than that seen in industrialized countries[3]. Within India, however, it was lower than that seen in the neighbouring State of Tamil Nadu[10].

Our study identified four subpopulations in the rural community – large majority who accepted vaccination without hesitation, those who had initial reluctance but accepted vaccination without any delay, an additional subset who hesitated and delayed their vaccination (=conversion) and the last group that refused vaccination even if the vaccine was provided free of cost at a time and place that was convenient for them. This was different from previous literature[7,10], wherein within the definition of vaccine hesitancy, those who refused their vaccination and those who delayed their vaccination were clubbed together. In our study, it was identified that this was not a homogenous group, but those who refused vaccination were distinct from those who delayed vaccination. Social structure was seen to be associated with refusal or conversion - belonging to a large joint or three-generation family was associated with refusal, while belonging to a nuclear family was association with conversion. Contextual influences such as media environment, socio-cultural, economic and political factors were relatively more important for refusers; for delayers, individual and group influences

and vaccine-specific issues such as risk–benefit ratio were important[11].

Elsewhere, vaccine hesitancy has been found to be more among certain ethnic groups, women, people of younger age group and people with lower formal education[12]. Within India, at the national level, vaccine hesitancy has been noted among both the marginalized and the educated, though for different sets of reasons[13,14].

COVID vaccine hesitancy denotes a deficiency of information that needs attention. Change in mind of a large majority of converts reporting that they waited for someone they knew to get the vaccine before they got it themselves may be 'lay epidemiology' of risk–benefit ratio recalculations at work by these individuals[15].

Information regarding COVID-19 vaccine has to fight for space against a misinfodemic (misinformation in place of gaps, fears and rumours, *etc.*)[16-18]. This is especially so in social media, where there is amplification of misinformation[19]. Hence, information must move from being a one-way communication to dialogue to address gaps in knowledge, and targeted information for sections of populations[18,19].

A key limitation of our study was that it was limited to one village and one time point only, adversely affecting the generalizability of findings across place and time. Further, the sample size calculation was undertaken for the point prevalence estimation and not for the association of correlates of vaccination. Information bias owing to reliance on self-reporting of incomes, vaccination dates and other information without validation remains a concern in observational studies. However, the strategy of elucidation of the extent, spectrum and determinants of the problem of vaccine hesitancy is likely to be useful in other settings as well.

Vaccine hesitancy can influence the pandemic dynamics if it affects the pace of vaccination. Hence, it is important to understand the determinants of vaccine hesitancy among locally disaggregated study groups to see if there are differences between those who delay versus those who refuse. Local contextual factors such as socio-demographic characteristics of subpopulations, sources of information, complacency, confidence and convenience underpin vaccine uptake. This has implication for community participation, scale-up of mass vaccination, future wave size determination and the burden on health systems.

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