Original Article

Are we really hesitant toward routine immunization: Findings from a cross-sectional study in urban area in the tribal dominant state of India

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Abstract

Background: Vaccine hesitancy has been inching up and its root cause lies in the factors that influence the vaccination. The present study was conducted to find out the proportion and factors contributing to vaccine hesitancy for routine childhood vaccinations in the slum population. **Methods:** A community-based cross-sectional study was carried out among 210 children between the age group of 0 and 59 months residing in the urban slums of Ranchi in 2021. Data were collected during the household visit by interviewing the parents using a predesigned pretested interview schedule which was developed based on the validated version of the vaccine hesitancy survey questionnaire originally developed by the World Health Organization Strategic Advisory Group of Experts' working group on vaccine hesitancy. Associations between variables were analyzed using logistic regression. **Results:** A total of 210 children whose parents had given consent were included in our study. The majority of the families, 188 (89.5%), were not hesitant while only 22 (10.5%) were vaccine hesitant. Tribal children and unreserved category children had adjusted odds ratio of 4.41 (95% CI, 1.61–45.46) and 7.75 (95% CI, 1.07–56.08) for the delay as against their reference category. **Conclusions:** Most of the children were vaccinated in our study area and the families have shown confidence in vaccines. Although there were delays in vaccination and the reasons for the delays must be addressed to prevent these vaccine-hesitant populations from turning into vaccine-refusal population. Uniformity in vaccination days in different health facilities in slum areas, appropriate antenatal information, and counseling regarding childhood vaccinations, widespread awareness, and improving mother's education can help address the issue of vaccine hesitancy.

Keywords: India, public health, slums, urban, vaccination, vaccine hesitancy

Introduction

Despite being the foremost public health measure in the contemporary world, vaccination is considered unsafe and unwanted by some sections of people all over the world. These sections of people are primarily labeled as vaccine-hesitant populations. The phenomenon of vaccine hesitancy was defined

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by the World Health Organization (WHO), SAGE committee as a "delay in acceptance or refusal of vaccine despite availability of vaccination services."[1] Vaccine hesitancy has become a universal issue and to support the systematic assessment of these factors, a global expert group named "Behavioural and social drivers of vaccination" (BeSD) was established by WHO in November 2018.[2] The under-vaccinated or non-vaccinated subjects represent a threat to public health as they hinder the achievement of herd immunity, essential to protect the entire community.[3] Vaccine-hesitant individuals are rather a heterogeneous group; some refuse certain vaccines but agree with others.[4,5] A vaccine decision-making model typically involves receiving information about vaccines, active engagement with the information, and decision-making, which is influenced by social, political, economic, religious, and cultural factors.[6] Trust in vaccination policy, the health system, vaccine providers, and specific vaccines play a major role in the decision-making. There is a dire need to understand the attitude toward vaccination and vaccine hesitancy among parents of children under five years to improve vaccine coverage in many areas.[7] High coverage of vaccination is required to effectively break the transmission of infectious diseases in the community. With this intent, WHO's Expanded Programme of Immunization (EPI) was formulated in 1974, thereafter Universal Immunization Program (UIP) was launched in 1985, targeting six main vaccine-preventable diseases namely tuberculosis, diphtheria, pertussis, tetanus, poliomyelitis, and measles.[8]

Decreasing the order of vaccine coverage related to increasing vaccine hesitancy can lead to endemic transmission and outbreaks of preventable diseases. Vaccine-hesitant individuals may be those who have doubts about the vaccine but still get their children vaccinated, or individuals who either refuse or delay a particular vaccine but receive others or individuals who reject all vaccines.[9] Vaccine hesitancy is said to be present when the immunization coverage remains low despite having optimum health services and regular health communication by grassroots level workers. Childhood vaccination programs contributed to major reductions in global morbidity and mortality in children under five years.[10,11] According to WHO, vaccine hesitancy is among the top ten threats to global public health and was reported to be a significant problem by majority of the WHO member countries.[12] Vaccination programs have contributed significantly to the decline in mortality and morbidity from various infectious diseases. Worldwide, including India, the immunization coverage rate is on an increasing trend as per the immunization data resources.[13,14]

Vaccine hesitancy lies between high vaccine demand and complete vaccine refusal. Vaccine hesitancy issues can be explained based on the Health Belief Model (HBM) and 3 Cs model (Confidence, Complacency, Convenience model) by WHO.[15] According to the HBM, the likelihood of an individual adopting a particular health behavior (e.g., getting vaccinated) is determined by the perceived susceptibility and severity of the disease along with the belief in the effectiveness of the vaccine. In the 3Cs model by WHO, "Confidence" is defined as trust in the effectiveness and safety of vaccines. The state of Jharkhand was created in India in November 2000 and thereupon it has markedly improved in many spheres of child health. In the National Family Health Survey NFHS 3 (2005–2006), the percentage of children having fully immunized status was 34.2%.[16] This drastically increased to 61.9% in NFHS 4 (2015–2016) which further improved to 73.2% as per NFHS 5 (2020–2021).[13,17] Although there is better coverage of vaccines in urban areas of other parts of the country, in Jharkhand, rural areas fare better than urban areas in terms of vaccination. This low coverage may be associated with vaccine hesitancy and there has been no study on vaccine hesitancy in urban areas pertaining to urban areas to date in Jharkhand, although there have been studies on vaccine hesitancy in different parts of the country and world.[7,18,19]

With the advent of the National Rural Health Mission in 2005, rural areas have shown good progress in vaccination coverage but urban slums have been an area of concern. These populations have diverse socio-medical issues such as overcrowding, inadequate sanitation, atypical mindset, and poor healthcare access making them susceptible to infectious diseases. Hence, it becomes all the more important to target these vulnerable populations for better vaccination coverage. The strategies of communication in these areas must be tailor-made to better address the issues. The current study attempts to assess the vaccine hesitancy among the beneficiaries of routine immunization and the delay in receiving different vaccines under routine immunization in the urban areas of a tribal state in eastern India.

Material and Methods

A community-based cross-sectional study was conducted during the period from October 2019 to June 2021 in the urban slums of Ranchi, Jharkhand. Ethical approval was obtained from the Institutional Ethics Committee (IEC) of Rajendra Institute of Medical Sciences, Ranchi, and informed written consent from the parents of each household having children under five years in the study area was taken before including them in our study. The total population of the study area (Doranda, Ranchi) was 42,904 and has 30 mohallas (streets) as per the census 2011. The sampling method used was cluster random sampling in the study. Each mohalla was considered as one cluster and from each cluster sample population was drawn. Consecutive households were visited to recruit the participants until the sample size for each cluster was achieved. Based on a previous study (Dubé *et al.*, 2016),[19] where vaccine hesitancy (VH) was found to be 40.2%, the sample size was calculated to be 210 with a confidence level of 95%, power of 80%, precision of 10%, along with a design effect of two and adding a non-response error of 10%. Out of the total clusters/mohallas, seven clusters were randomly selected from the list of the mohallas obtained from the Municipal Corporation of Ranchi and a total of 210 samples were drawn from the study area. In each cluster/mohalla, 30 households having children less than 5 years were randomly selected starting from the first home. One child per home was chosen, and parents/caregivers were interviewed using

a pretested, semi-structured questionnaire. If a household did not have children under five years, the next consecutive house was considered. If more than one child under five years was present in a home, the younger child was considered. The total sample size covered during the period of the study was 210 households. The questionnaire was prepared from the tools and indicators of vaccine hesitancy developed by WHO. The questionnaire contained a sociodemographic profile of the study population, immunization status of the child, and questions related to vaccine hesitancy. The data collected were compiled in Microsoft Excel 2017 and were analyzed using the Statistical Package for Social Science (SPSS) Version 20.0 (SPSS Inc. IBM, NY, US). Multivariate analysis was done using binary logistic regression to determine the predictors of vaccine hesitancy and reasons for the delay of DPT booster among the population in the urban areas. Adjusted odds ratio (AOR) with 95% CI was calculated and *P* value of < 0.05 was considered to be statistically significant in this study.

Results

A total of 210 children whose parents had given consent were included in our study. Majority of the families, 188 (89.5%), were not hesitant while only 22 (10.5%) were vaccine hesitant. Majority of the study subjects were females (55.7%), belonging to joint families (68.6%), second and higher birth order (52.9%), and from lower socioeconomic status (56.7%). About 19% of the mothers were illiterate or had a primary level of education [Table 1]. The education level of mothers and socio-economic status was considered to be statistically significant in multivariate analysis. The AOR for vaccine hesitancy was 7.897 (95% CI: 2.655–23.491) in households having illiterate and primary-level educated mothers. Parents belonging to lower and lower-middle socio-economic status were more hesitant compared to other middle and upper classes, after adjusting for all other variables, and *P* value was 0.04 which was statistically significant [Table 1].

In our study, the majority of parents believed that vaccines can protect children from serious diseases and they should vaccinate their children with all the recommended vaccines. While studying delays in receiving vaccines, it was found that the proportion of children receiving delayed vaccination increased as age progressed. Hence, the delay was commoner in vaccines given at a later age. It was maximum in DPT B1/OPVB1 (38.1%) which is given at 16–24 months of age as per the National Immunization Schedule in India. This was followed by $JE_{1,2}$ and $MR_{1,2}$ doses combined as events which were delayed in 24.9% and 23% children-events, respectively. In this study, the hesitancy for individual vaccines was almost similar except Japanese encephalitis (JE). The hesitancy was higher for JE due to some some rumors spread against the vaccine in the community. The least delay was found in case of BCG which was in around 7.6% of total vaccines. In OPV_0 and Hepatitis B birth dose, it was 11.4% and 31.4%, respectively because of missed doses at appropriate age. In OPV first, second, and third doses, the delay was found in 18.6% of total events. Approximately, the same proportion was also found in pentavalent and rotavirus vaccines [Table 2].

Since there was a maximum delay in the DPT booster dose, so in this study, we also tried to understand the sociodemographic predictors of this delay. Multivariate analysis of the different sociodemographic factors for the delay in DPT booster vaccination was done. Tribal children and unreserved category

Table 1: Sociodemographic factors affecting vaccine hesitancy

Variable	Vaccine hesitancy		Total	*P*	AOR	95% CI	
	Present	Absent				Lower	Upper
Gender							
Female	11 (9.4)	106 (90.6)	117 (55.7)	0.34	0.61	0.22	1.68
Male	11 (11.8)	82 (88.2)	93 (44.3)		1 (ref)		
Birth order							
First	9 (9.1)	90 (90.9)	99 (47.1)	0.53	1.41	0.47	4.25
Second and higher	13 (11.7)	98 (88.3)	111 (52.9)		1 (ref)		
Place of delivery							
Institutional	20 (10.3)	174 (89.7)	194 (92.4)	0.49	1.82	0.32	10.28
Home	2 (12.5)	14 (87.5)	16 (7.6)		1 (ref)		
Ethnicity							
Tribal	11 (13.6)	70 (86.4)	81 (38.6)	0.99	1.01	0.35	2.84
Non-tribal	11 (8.5)	118 (91.5)	129 (61.4)		1 (ref)		
Type of Family							
Nuclear	10 (15.2)	56 (84.8)	66 (31.4)	0.42	0.66	0.24	1.79
Joint	12 (8.3)	132 (91.7)	144 (68.6)		1 (ref)		
Mother's Education							
Illiterate and Primary	13 (32.5)	27 (67.5)	40 (19)	<0.001*	7.89	2.65	23.49
Middle and Higher	9 (5.3)	161 (94.7)	170 (81)		1 (ref)		
SES							
Upper and Middle	3 (3.3)	88 (96.7)	91 (43.3)	0.04*	0.24	0.06	0.94
Lower	19 (16.0)	100 (84.0)	119 (56.7)		1 (ref)		

*P** (Significant), AOR: Adjusted Odd's ratio, Percentages are in parentheses

children had AOR 4.41 (95% CI, 1.61–45.46) and 7.75 (95% CI, 1.07–56.08) for delay as against their reference category [Table 3].

Discussion

Achieving good vaccination coverage has always been a major concern for the Indian population. It has always faced slow reception, disinclination, and even disapproval by the people at times. In order to bolster immunization coverage, the government has tried many policies time to time such as the Mission Indradhanush and Intensified Mission Indradhanush to address the leftouts/dropouts in immunization. Despite these painstaking initiatives, the outcome in the expected rise in vaccination coverage is lacking resulting in delays in vaccination. This may be attributed to vaccine hesitancy which may be an underlying factor among the beneficiaries. Although there has been continuous improvement in vaccination coverage since the rollout of the Universal Immunization Program, vaccine hesitancy has always been a hurdle in achieving vaccination at appropriate age. In our study, we have tried to assess the vaccine hesitancy and delays in vaccination among the study population in the urban areas of a tribal state.

Table 2: Delay in receiving different vaccination among beneficiaries (*n*=210)

Vaccine	Total events *n*	No delay *n* (%)	Delayed *n* (%)	Not known *n* (%)
BCG	210	192 (91.4)	16 (7.6)	2 (1)
Hep B_0	210	142 (67.6)	66 (31.4)	2 (1)
OPV_0	210	184 (87.6)	24 (11.4)	2 (1)
$OPV_{1,2,3}$	498	387 (77.7)	93 (18.6)	18 (3.6)
$Penta_{1,2,3}$	498	389 (78.1)	91 (18.3)	18 (3.6)
$Rota_{1,2,3}$	454	356 (78.4)	86 (18.9)	12 (2.7)
$IPV_{1,2}$	339	261 (77)	66 (19.5)	12 (3.5)
$MR_{1,2}$	178	127 (71.4)	41 (23)	10 (5.6)
$JE_{1,2}$	177	123 (69.5)	44 (24.9)	10 (5.6)
DPTB1/OPVB1	63	36 (57.1)	24 (38.1)	3 (4.8)

Socioeconomic condition and vaccine hesitancy

In our study, majority of subjects were females, belonging to lower socioeconomic status and joint families. In our study we found mothers who had higher education and those belonging to upper and middle class were relatively less hesitant. A study done by Dasgupta *et al.*[18] in the eastern region of India also supports our findings. Since the government has made routine

Table 3: Predictors of delay in DPT booster (1) among the study population (*n*=63)

Variable	DPT booster delay		AOR	*P*	95% CI	
	Yes (%)	No (%)			Lower	Upper
Gender						
Male	41.7	58.3	0.92	0.90	0.26	3.18
Female	44.4	55.6	1 (ref)			
Ethnicity						
Tribal	39.4	60.6	4.81	0.03*	1.61	45.46
Non-tribal	46.7	53.3	1 (ref)			
Religion						
Hindu	83.3	16.7	0.24	0.29	0.02	3.31
Non-Hindu	38.6	61.4	1 (ref)			
Category						
UR	29.4	70.6	7.75	0.04*	1.07	56.08
Reserved	47.8	52.2	1 (ref)			
Type of Family						
Joint	48.8	51.2	0.42	0.20	0.11	1.57
Nuclear	31.8	68.2	1 (ref)			
Mother's Education						
Illiterate and Primary	33.3	66.7	1.01	0.98	0.12	8.18
Middle and Higher	43.9	56.1	1 (ref)			
Father's Education						
Illiterate and Primary	36.4	63.6	1.42	0.68	0.26	7.71
Middle and Higher	44.2	55.8	1 (ref)			
Birth Order						
1-2	42.1	57.9	1.18	0.86	0.16	8.75
>2	50	50	1 (ref)			
Birth Interval						
2–5 Years	47.8	52.2	0.34	0.13	0.08	1.37
>5 Years	29.4	70.6	1 (ref)			
SES						
Upper and Middle	50	50	0.428	0.23	0.11	1.72
Lower	39.5	60.5	1 (ref)			

P: * (Significant), AOR: Adjusted Odd's ratio, Percentages are in parentheses

immunization free in government hospitals, people from lower socioeconomic classes can easily avail those facilities but the upper socioeconomic class still prefers private hospitals where they have to pay money to get their children vaccinated. The fees of the pediatrician, medicines, and vaccines are all separate costs, which is a financial burden for parents which lead to complacency. This may delay vaccination or even missed doses in the future. This has been explained explicitly in literature pertaining to vaccine hesitancy.[9,20] Vaccine hesitancy was relatively more in the nuclear families and tribal population but it was statistically insignificant in our study. Srividya *et al.*[21] conducted a study in Indian rural settings which also supported this finding. This is because joint families have an advantage of other caregivers like grandparents who help remember the due dates and help mothers in taking care of the children.

Delay in vaccination and vaccine hesitancy

Delay in vaccination is a major issue in areas where immunization is done in peripheral health facilities, particularly at Anganwadi centers on Village Health Nutrition Day. Even in urban areas, vaccination is carried out at specific centers these days but due to various factors pertaining to the health system, service providers, beneficiaries, and other associated factors vaccination gets delayed in children.[22,23] In our study, there was a delay in the administration of the BCG vaccine (7.6%), Hepatitis B (31.4%), and OPV0 (11.4%) of the total study population. Hepatitis B vaccine (zero dose/birth dose) being the only vaccine which has shortest time interval for its administration and this is the reason why 31.4% children missed the doses. It was observed that BCG was given within a month irrespective of the place of delivery. In all these observations, the maximum delay was in the first doses. Attending immunization at tenderage of 6 months in community might be the cause of the delay of 1st dose. Consequently, the delay was also found in successive doses. It may be because mothers become reluctant due to the observed side effects of immunization like fever and pain with previous vaccination and minor health issues. In a study done by Srividya *et al.*, there was a greater delay in the birth dose of BCG (66%), Hepatitis B (40%), and OPV (9%).[21] They inferred that the delay was due to the irritability of children on successive vaccinations leading to reluctance of the caregivers to get their children immunized at appropriate time.[20] In our study, vaccination was found delayed in MR vaccine (23%), DPT Booster/OPV booster dose (38.1%), and JE vaccine (24.9%). Delays were more common in booster doses as it is harder for the caregivers to remember dates compared to primary doses, which are administered in succession. After measles vaccination, there is a huge gap for the next dose of vaccines leading to complacency in families in getting their children immunized with appropriate vaccines. In addition, many mothers stay at their parents' place for delivery, and when they move to their husband's home after a few months of delivery, they are more likely to miss vaccination on due dates. This was supported by the studies done by other researchers in different parts of India.[21-23] The delay in taking vaccines can also be due to COVID-19 pandemic lockdowns leading to difficulty in reaching out to health workers for timely immunization. There was a significant delay in taking the MCV which was 23% (cumulative of MCV1 and MCV2). According to a study done by Panda *et al.*[24] on secondary analysis of NFHS -4 data, it was found that around 15% of eligible children for measles vaccine were not vaccinated at the recommended age.

Other factors leading to vaccine hesitancy

According to a study by the most common cause for vaccine hesitancy is the consideration of risks and benefits associated with the vaccines. In addition, there is a lack of trust in newer vaccines.[23] As reported by studies conducted in different parts of the world, a variety of reasons were reported for hesitancy, with the most frequent being the presence of porcine components in the vaccine, doubts regarding vaccine effectiveness, and concerns about side effects.[25] Other reasons reported in a study in Guatemala include factors like the distance of the clinic from the residing place, the clinic timings, waiting time, and expenses to get to the clinic, all of which influence hesitancy in that population.[26] Mckee and Bohannon[27] in their study explained that hesitancy is not only yielded by the lack of awareness or knowledge but it stemmed from the core beliefs of an individual's or group's religious conviction which makes it difficult to convince them otherwise. A majority of this delay can be due to the lockdown imposed during the pandemic. As there was strict actions to halt the spread, many Anganwadis across the nation were closed. As a result many beneficiaries were unable to avail the facilities provided by the government which included routine immunization. The fear of the pandemic and its vulnerability led mothers to become additionally protective of the wellbeing of their children. In view of these facts, it is quite likely that the delays were undoubtedly due to the lockdown imposed during COVID-19.

The major limitation of the study is that although we considered external factors for vaccine hesitancy, lockdowns due to the pandemic *per se* cannot be taken as the factor for hesitancy, which may be perceived as a limitation of the study. In some cases where immunization card was not available, information was gathered based on the mother's recall which may be a cause of recall bias in this study. Despite the above limitations, the study has strength in depicting the data from the slums of tribal states that are unprivileged in many spheres. Understanding the vaccine hesitancy in these areas and addressing them holistically may be a boost for immunization program and the learning may be used for further research in these avenues.

Conclusion

Consequently, the study concluded that there is vaccine hesitancy (VH) amongst the urban population regarding routine immunization. The factors responsible for VH such as poor utilization of immunization services and lack of awareness or motivation needs to e addressed through professionally designed behavior change communication interventions.[28-30] Moreover, this was the time of National lockdown due to COVID-19 which hampered public movement and data collection. In

some cases, an immunization card was not available with the mother which led to a recall bias. In our study, we found that there were many reasons that led to vaccine hesitancy such as parents being doubtful about the vaccines administered, lack of awareness among the caregivers, fears about adverse events following vaccines, discouragement from elders of the family, and forgetting about the due dates. Many factors cumulatively lead to vaccine hesitancy which ultimately leads to delays in vaccination or incomplete vaccination. Furthermore, due to lockdowns imposed during the pandemic, caregivers could not get access to immunization services and also were fearful about the new virus that was causing havoc at that time. It was also observed that the vaccines administered while in the initial age were comparatively more on time as compared to vaccines delivered after the child had grown. Uniformity in vaccination schedules across different health facilities in slum areas, providing appropriate antenatal information and counseling regarding childhood vaccinations, raising widespread awareness, and improving mother's education can help address the issue of vaccine hesitancy.

Contribution details

KAK and SS conceived the idea of the research, DK and VS supervised in data collection. PA, SS and SKS collected the data. AK, MK and KJR prepared the first draft of manuscript. DK, KAK and VS edited the manuscript. All the authors read, reviewed and approved the final draft of manuscript.

Ethical policy and institutional review board statement

The study was approved by IEC, RIMS Ranchi.

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Conflicts of interest

There are no conflicts of interest.

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