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ORIGINAL RESEARCH ARTICLE

Factors influencing the hesitancy and refusal of vaccines in India: A study-using tool developed by WHO SAGE Working Group

Mohamed Bilal Moosa[1], Devayani Josh[1], Reshma Bobby[1], Besty Biju[1], Juny Sebastian[2,*], Sheba Baby John[1], Mandyam Dhati Ravi[3]

[1] *Department of Pharmacy Practice, JSS College of Pharmacy, JSS Academy of Higher Education and Research, Mysuru 570015, India*

[2] *Department of Pharmacy Practice, College of Pharmacy, Gulf Medical University, Ajman 4184, UAE*

[3] *Department of Pediatrics, JSS Medical College and Hospital, JSS Academy of Higher Education and Research, Mysuru 570015, India*

*** Corresponding author:** Juny Sebastian, dr.junysebastian@gmu.ac.ae

ABSTRACT

Objectives: This study aimed to assess the hesitancy towards vaccination and to identify the factors and predictor variables within the study population. **Methodology:** This was a cross-sectional study conducted via a web-based platform where a validated questionnaire was circulated among the public to understand their hesitancy towards vaccination. WHO SAGE Working Group Questionnaire was used to collect the data. The predictors for hesitancy were determined by using bivariate logistic regression analysis and the prevalence of vaccine hesitancy was identified. **Results:** A total of 353 subjects enrolled in the study during the 6 months of the study. Among them, 133 (37.67%) subjects showed vaccine hesitancy. On performing the bi-variate analysis, it was found that among the subsets studies those who were more hesitant to receive vaccines were females (OR: 1.476); individuals who are widowed/separated/divorced (OR: 3.109), age 40–49 yrs (OR: 3.710); from a rural (OR: 1.277) and not graduated (OR: 1.077). These subsets were predictors identified for vaccine hesitancy. Among the vaccines, maximum hesitancy was observed for the chicken pox vaccine [47 (13.31%)], followed by TCV [25 (7.08%)] and Rota [24 (6.79%), whereas the minimum hesitancy was observed for BCG [2 (0.56%)], OPV [4 (1.13%)] and IPV [8 (2.26%)]. Reasons provided for the hesitancy observed were mainly (i) Did not think it was needed [163 (46.17%)], (ii) Did not think the vaccine was safe [41 (11.61%)] and (iii) Did not know where to get vaccinated [24 (6.79%)]. **Conclusion:** The study observed less vaccine hesitancy among vaccines included in the EPI program. A major contributing factor for VH among the study population was their wrong perception about vaccines as that is not needed and not safe. Hence, there is a real need for education to the population to improve vaccine confidence among the general population.

Keywords: vaccine; vaccine hesitancy; WHO SAGE working group model

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1. Background

Vaccines underpin global health security by addressing emerging communicable infectious diseases, limiting the spread of infection, and combating the spread of antimicrobial resistance. The records show that between the period of 2010–2018, 23 million deaths were averted with the measles vaccine alone. Unfortunately, the benefits of immunization are unevenly shared, because of low access to immunization services. The fact surprising is, that each year, 20 million infants do not receive a full course of even basic vaccines, and many more miss out on newer vaccines. Of these, over 13 million receive no vaccines through immunization programs—

the “zero dose” children[1]. The idea that vaccination programs are losing their momentum concerns public health agencies throughout the world[2]. There is a growing global recognition that infant and childhood vaccine uptake rates are not where they need to be for adequate control of vaccine-preventable diseases[3]. Failure of less coercive methods to motivate people to vaccinate, an outbreak of one or more vaccine-preventable diseases, and low vaccine coverage resulting in the low achievement of global vaccine-preventable diseases goals are the main triggers that historically have prompted calls for a shift to mandatory immunization[4].

In 2011, the Strategic Advisory Group of Experts (SAGE) on Immunization noted the impact of reluctance to simply accept immunization in both developed and developing countries[5], and led to the establishment of a functional group on vaccine hesitancy. They came up with the model of determinants of vaccine hesitancy (VH) which is structured around three domains: ‘Contextual influences’ which include influential leaders and individuals; ‘Individual/social group influences’ which include a personal experience with and certainty in the health system and provider or suppliers; and ‘Vaccine and vaccination-specific issues’ which comprise the role of health-care professionals[6]. Through a survey of SAGE members in 2011, communication with vaccine-hesitant populations was identified together with the new priority topics for SAGE[7]. If the broad uptake rates needed for herd immunity are to be achieved and uninterrupted, individual and community hesitancy and reluctance to be immunized must be better interpreted and addressed. SAGE also observed that the problem did not appear to be restricted to one region or subset of the population. For example, reluctance to accept the measles vaccine in parts of Europe, the Human Pappiloma Virus (HPV) vaccine in Japan and India, polio vaccine in parts of Nigeria and Pakistan, were the sample of the episodes that are appearing around the world[8,9]. Because the basic causes of these issues are tangled and not always straightforward, SAGE also declared concern that the path of progress to address hesitancy was not clear[10]. Acceptance of vaccination is the norm in most countries. A smaller number of the population reject some vaccines but agree to others and some hold up vaccination or accept vaccination but are unsure about doing so. Hesitancy is thus set on a scale between those that accept all vaccines with no worries, to absolute refusal with no doubts, with vaccine-hesitant individuals being the heterogeneous group between these two extremes[11,12]. Hence the study of VH is mandatory in any population. It helps to educate people about the importance of immunization in the community and to eradicate certain types of contagious diseases by getting herd immunity. India’s immunization program has annual cohorts of around 26.7 million infants and 30 million pregnant women[13]. Government data shows that the number of children and mothers who missed the immunization has not dropped drastically[14]. In 2016, an estimated 35%–40% of children failed to receive all basic vaccines in the first year of their life[15–17]. The gains of the four phases of ‘Mission Indradhanush’ both in urban and rural areas, and the goal of 90 percent vaccination is not being achieved[14]. Few of the possible reasons for the hesitancy towards a vaccine and the factors limiting vaccination coverage include a) parents often thinking about the vaccines that are unnecessary because their children appear healthy; b) parents feel children may fall sick but may recover by normal treatment; c)parents lack awareness about immunization (45%); d) the service gap of the health workers who may not have visited some families or vaccines may not have been delivered (4%); e) the large mobile and isolated populations that are difficult to reach in the immunization sites (8%); f) ill-informed population who fear side effects (24%) and are biased by false information and anti-vaccination messages[18,19,20]. Hence, this study aimed to assess the hesitancy towards vaccination and to identify the predictors associated with VH among the Indian Population.

2. Methodology

The study was designed as cross-sectional and conducted from December 2020 to June 2021 including descriptive elements (determining the prevalence and socioeconomic differences in VH), quantitative

elements (finding predictors), and qualitative analysis (determining determinants). World Health Organization (WHO) SAGE working group's Vaccine Hesitancy questionnaire was used as the study tool. VH questionnaire developed by the WHO SAGE WG (2015)[21,22] was composed of acore vaccine hesitancy survey (close-ended questions), vaccine hesitancy 5-point Likert scale questions, and vaccine hesitancy open-ended survey questions. The study tool also had sections to collect the demographic and socio-demographic details[23] from the study population. VH details of all the vaccines endorsed for use among the Indian population by the Indian Academy of Pediatrics (IAP) were included in the questionnaire. The vaccines included were Bacillus Calmette–Guérin (BCG), Oral Polio Vaccine (OPV), Hepatitis B (HB), Diphtheria, Tetanus and Pertussis vaccine (DTP), Inactivated Polio Vaccine (IPV), Pentavalent vaccine (DTP + Hib + Hepatitis B), Rotavirus Vaccine (Rota), Measles, Rubella (MR)/Measles, Mumps, and Rubella (MMR), Tetanus reduce the dose of Diphtheria (acellular) Pertussis (Tdap) and Tetanus-Diphtheria (Td) while the ones that are not included in EPI schedule are: Pneumococcal Conjugate Vaccine (PCV), Typhoid Conjugate Vaccine (TCV), Hepatitis A (Hep A), Japanese Encephalitis (JE), Meningococcal conjugate vaccine (MCV), Varicella vaccine (Chickenpox) and Human Papillomavirus (HPV).

The study tool was circulated among the study population through social media platforms such as WhatsApp, Facebook, Instagram, and LinkedIn. To avoid the potential bias of excluding individuals who do not have access to social media platforms, some hard copies of the questionnaire were circulated among the common population from public spaces such as parks and supermarkets to collect the data. Individuals over 18 years of age, who were willing to participate, were enrolled to participate in the study after informed consent. The collected data were compiled and analyzed to measure the overall vaccine hesitancy and to understand the specific areas among the study population leading to vaccine hesitancy. The questionnaire was designed in such a way that all questions/statements were made mandatory for submission to avoid missing data. Similar way, researchers reviewed the completeness of the questions and requested the study population to complete the missed sections for those who were enrolled in public spaces.

Analyzing Vaccine Hesitancy: Out of the 10 questions in the core vaccine hesitancy survey, questions number 3 (Have you ever been reluctant or hesitant to get a vaccination for your child?) and 4 (Have you ever refused a vaccination for your child?) emphasize on the vaccine hesitancy. The study population answering 'Yes' to these questions was grouped as vaccine hesitant. The study required a minimum of 350 participants to estimate vaccine hesitancy as explained by previous studies with a 95% confidence level and a 3% margin of error.

Statistical analysis was performed using the IBM Statistical Package for the Social Sciences (SPSS) version 22 (licensed to JSS University). Frequencies and proportions were calculated to summarize categorical variables. Means and standard deviations were used to summarize continuous variables. A comparison of mean scores obtained on the 5-point Likert scale was analyzed using an independent sample *t*-test. A Chi-square test for determining the association of demographic variables with VH and Bi-variate analysis was performed to calculate the predictors of VH.

Patient and public involvement

The research question and the outcome measures were informed to the patients during the informed consent process. Patients were involved in the design, recruitment, and conduct of the study. However general population was enrolled as the study participants. The result of the study was disseminated to the study participants through email updates and the clinical pharmacy newsletters.

3. Results

Out of the 353-study population enrolled in the study, 62.03% (n = 219) were females. Most of the study population belonged to the age group of less than 40 years including 29.17% (n = 103) from the age

group of 18–29 years and 28.32% (*n* = 100) in the age group of 30–39 years. The population who were married constituted another major subgroup [320 (82.1%)]. While stratifying participants based on their religion, the maximum responses were from Hindu [152 (43.05%)] religion followed by Christians [136 (38.52%)] religion. If one were to classify based on the type of family, those from the nuclear family [244 (69.12%)] were in the majority. The majority of the study population [287 (81.30%)] were from urban residential areas. In terms of educational background, graduates and above graduated constituted 73.08% (*n* = 258) of the study population and 59.77% (*n* = 211) belonged to the socio-demographic background of the upper middle class.

3.1. Core vaccine hesitancy

A total of 37.67% (*n* = 133) of the study population was identified to have vaccine hesitancy based on their answers to questions number 3 and 4 in the core vaccine hesitancy survey. Interestingly, 25.25% of study participants (*n* = 89) preferred not to answer the question that classified them as vaccine hesitant. The answers to the core vaccine hesitancy questionnaire have been depicted in **Figure 1**.

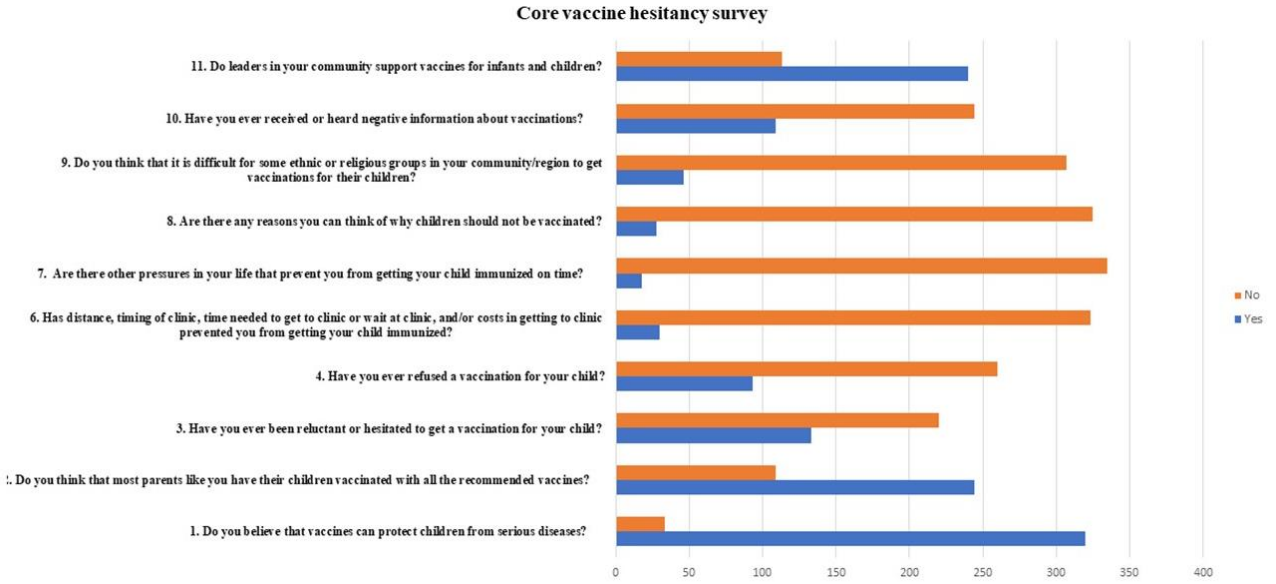

Figure 1. Core vaccine hesitancy survey.

3.2. Confidence in vaccines

The high vaccine confidence was perceived for OPV [*n* = 345 (97.73%)] followed by BCG [*n* = 341 (96.60%)], whereas the least confidence was perceived for Td [*n* = 104 (29.46%)] and Tdap [*n* = 186 (52.69%)] among the study population for the mandatory vaccines administered through the expanded program of immunization (EPI). Among the optional vaccines which were not included in the EPI, high vaccine confidence was perceived for Hep A [*n* = 260 (73.65%)] followed by TCV [*n* = 249 (70.53%)], whereas the least confidence was perceived for JE [*n* = 58 (16.43%)] and HPV [*n* = 104 (29.46%)] among the study population. Among the EPI vaccines, the maximum hesitancy was perceived for Rota [*n* = 24 (6.79%)] followed by MR/MMR [n = 19 (5.38%)], whereas the least hesitance was perceived for BCG [*n* = 2 (0.56%)] and OPV [*n* = 4 (1.13%)]. And among the optional vaccines, the maximum hesitancy was perceived for chicken pox [*n* = 47 (13.31%)] followed by TCV [*n* = 25 (7.08%)], whereas the least hesitance was perceived for JE [*n* = 16 (4.53%)] and Hep A [*n* = 16 (4.53%)]. The details of vaccine confidence and hesitancy of vaccines are depicted in **Figure 2**.

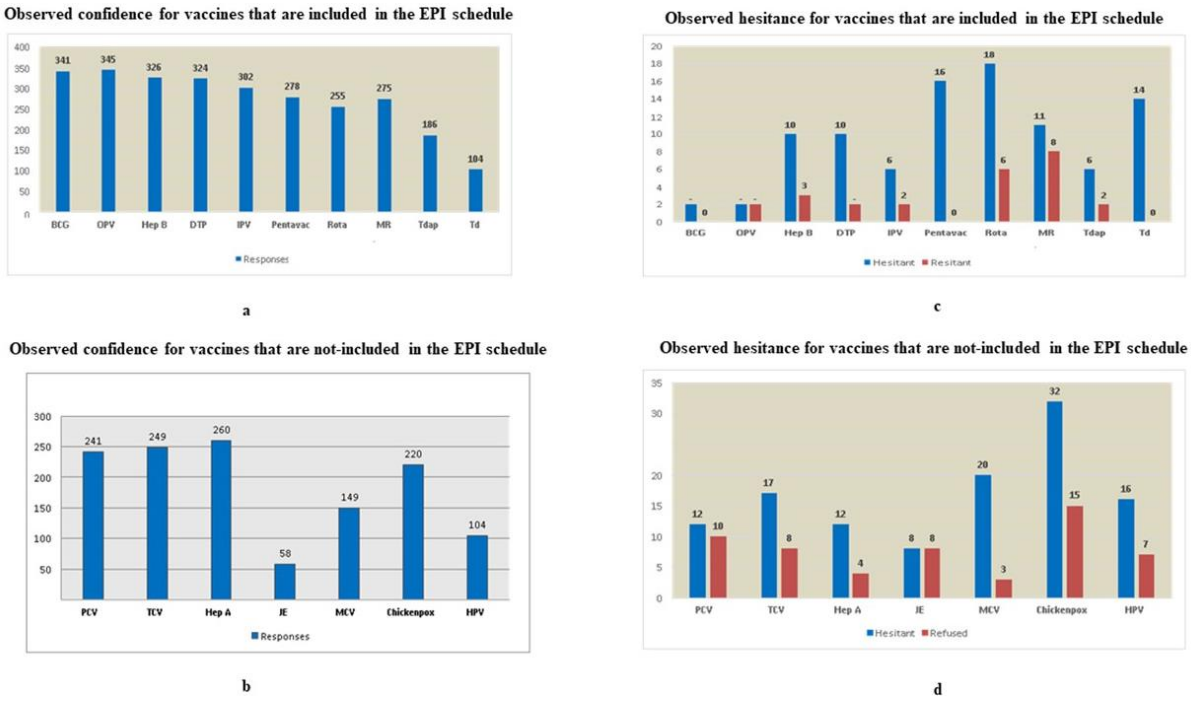

Figure 2. Responses on each vaccines.

3.3. Association of demographic characteristics and vaccine hesitancy

Analyzing the demographics as mentioned in **Table 1** with regards to vaccine confidence and hesitance, it was observed that females [*n* = 90 (24.29%)] gender, people falling under the age group 40–49 years [*n* = 44 (12.46%)], Christian religion [*n* = 57 (16.14%)], people staying as nuclear families, [*n* = 90 (25.49%)], from an urban [*n* = 105 (29.7%)] background with an Indian [*n* = 123 (34.84%)], married population [*n* = 96 (27.19%)], couples with a graduate or post-graduate education [*n* = 96 (27.19%)] and population belonged to an upper middle class [*n* = 96 (27.19%)] have shown a greater hesitancy than the rest. After performing the Chi-Square test on the given data, the type of family (*P* 0.019), marital status (*P* 0.001), and socio-economic classification (*P* 0.000) of the study population were found to have a significant association with VH.

Table 1. Demographic characteristics of the study participants with regards to vaccine confidence and hesitancy.

Subject demographics		**Vaccinated**	**Hesitant**	***P* value**
Gender	Male	91 (25.77%)	43 (12.18%)	0.09
	Female	129 (36.54)	90 (24.49%)	
Age group (in years)	18–29	78 (22.09%)	25 (7.08%)	0.001
	30–39	62 (17.56%)	38 (10.76%)	
	40–49	37 (10.48%)	44 (12.46%)	
	50–59	35 (9.91%)	25 (7.08%)	
	>60	8 (2.26%)	1 (0.28%)	
Religion	Hindu	97 (27.47%)	55 (15.58%)	0.105
	Muslim	27 (7.64%)	10 (2.83%)	
	Christian	79 (22.37%)	57 (16.14%)	
	Sikh	10 (2.83)	7 (1.98)	
	Buddhism	2 (0.56%)	0 (0%)	
	Others	1 (0.28%)	4 (1.13%)	
	Prefer not to say	4 (1.13%)	0 (0%)	

Table 1. (*Continued*).

Subject demographics		Vaccinated	Hesitant	*P* value
Type of family	Nuclear family	154 (43.62%)	90 (25.49%)	0.019
	Joint family	57 (16.14%)	37 (10.48%)	
	3rd generation family	9 (2.54%)	6 (1.69%)	
Place of origin	Urban	182 (51.55%)	105 (29.7%)	0.377
	Rural	38 (10.76%)	28 (7.93%)	
Marital status	Single	17 (4.81%)	13 (3.68%)	0.001
	Married	194 (54.95%)	96 (27.19%)	
	Widowed/separated/ divorced	13 (3.68%)	20 (5.66%)	
Education	Professional degree	0 (0%)	0 (0%)	0.765
	Graduate or postgraduate	162 (45.89%)	96 (27.19%)	
	Intermediate or diploma	34 (9.63%)	25 (7.08%)	
	High school certificate	24 (6.79%)	6 (1.69%)	
	Middle school certificate	0 (0%)	6 (1.69%)	
	Primary school certificate	0 (0%)	0 (0%)	
Kuppuswamy socio-economic classification	Illiterate	0 (0%)	0 (0%)	0.00
	Upper	48 (13.59%)	29 (8.21%)	
	Upper middle	142 (40.22%)	69 (19.54%)	
	Lower middle	24 (6.79%)	25 (7.08%)	
	Upper lower	6 (1.69%)	10 (2.83%)	
	Lower	0 (0%)	0 (0%)	

Many of the study participants believed that the vaccines were not safe and not needed. Different reasons listed by the study population for vaccine hesitancy to each of the vaccines are described in **Figure 3**.

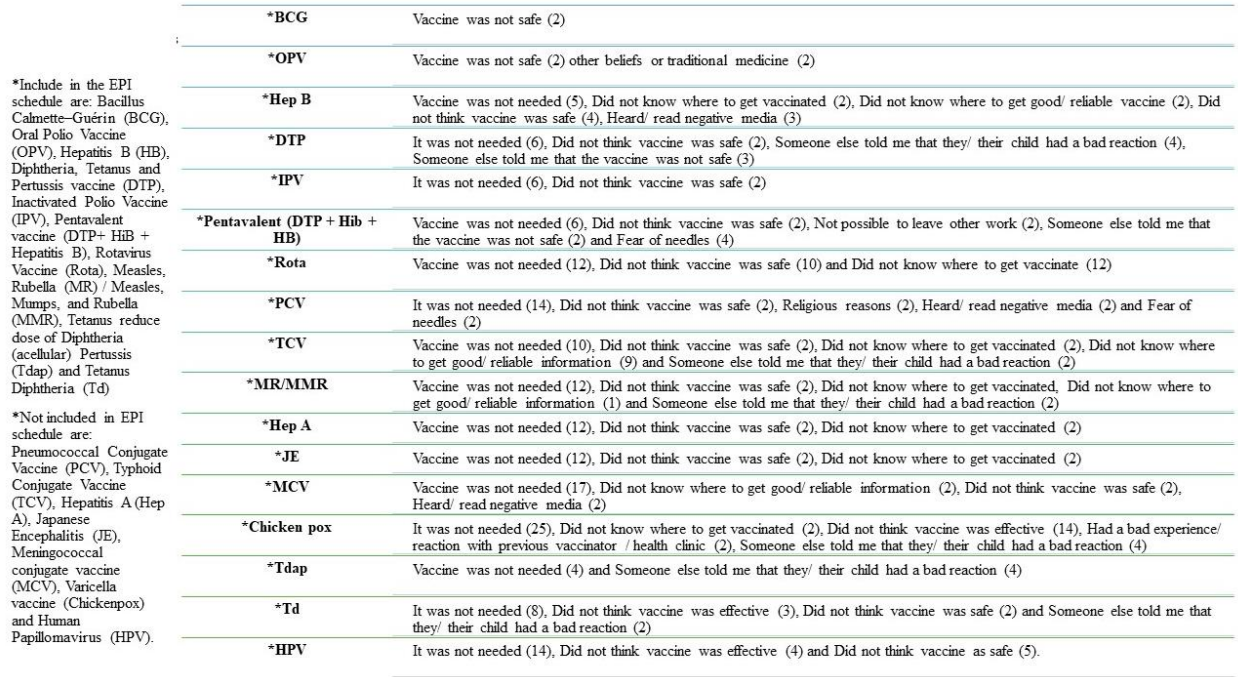

Figure 3. Vaccine hesitancy/Refusal reasons for each vaccines.

3.4. Vaccine hesitancy assessment using a 5-point Likert scale

In the section, 10 statements on vaccine hesitancy were provided for which the study population needed to grade each of them based on disagreement or agreement. For example, for the statement, "Childhood vaccines are important for my child's health", 139 of the subjects strongly agreed indicating confidence towards vaccination while 12 of them strongly disagreed to indicate hesitancy towards vaccination. For the statement, "Childhood vaccines are effective", 126 of the subjects strongly agreed indicating confidence towards vaccination while 47 of them strongly disagreed indicating hesitancy towards vaccination. **Figure 4** depicts the responses provided to vaccine hesitancy 5-point Likert scale questions.

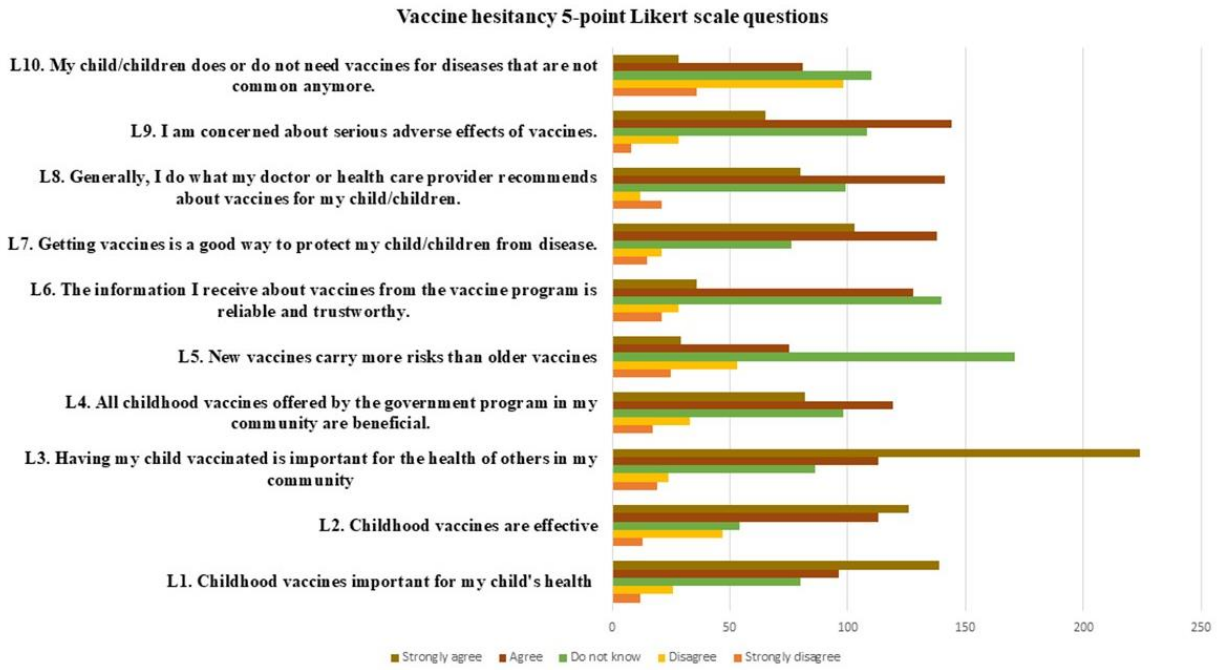

Figure 4. Vaccine hesitancy 5-point Likert scale questions.

3.5. Predictors of vaccine hesitancy

Female gender (OR: 1.476); age groups 40–49 yrs (OR: 3.710), 50–59 yrs (OR: 2.229) and 30–39 yrs (OR: 1.912); religion—population categorized as other religions (OR: 7.055), Christians (OR: 1.272) and Sikh (OR: 1.235); Type of family—3rd generation family (OR: 1.141) and Joint family (1.111); Place of origin—rural (OR: 1.277); Marital status—Widowed/separated/ divorced (OR: 3.109) and educational status of below graduate (OR: 1.077) were the identified predictors for vaccine hesitancy. On performing Independent Sample *T*-test for Vaccine hesitancy 5-point Likert scale questions concerning confidence and hesitancy among the male (n = 134, M = 36.40 ± 5.78) and female (n = 219, M = 35.20 ± 7.02) population, *P* value (0.098) was found to be statistically insignificant with a mean difference of 1.19751 and standard error of mean being 0.72169 at a 95% confidence interval ranging from −0.22188 to 2.61689.

Predictors of vaccine hesitancy and Chi-square tests were applied on different vaccines, regarding confidence and hesitancy concerning gender and various age groups that the study population belonged to as depicted in the tables below (**Table 2**). Concerning gender and their *P*-values identified only OPV (P = 0.047); JE (P = 0.019) and HPV (P = 0.005) were significantly associated with vaccine hesitancy. And concerning age groups, Hep B 30–39 (P = 0.00), Rota 50–59 (P = 0.015), PCV 30–39 (P = 0.013), Hep A 40–49 (P = 0.00) and MCV 40–49 (P = 0.015) were significantly associated with vaccine hesitancy.

Table 2. Predictors for vaccine hesitancy.

Subject demographics	Odds ratio	CI—Lower limit	CI—Upper limit
Gender			
Male	-	-	-
Female	1.476	0.94	2.3119
Age-group			
18–29	-	-	-
30–39	1.912	1.044	3.502
40–49	3.71	1.981	6.951
50–59	2.229	1.126	4.412
>60	0.39	0.046	3.272
Religion			
Hindu	-	-	-
Muslim	0.653	0.294	1.45
Christian	1.272	0.791	2.046
Sikh	1.235	0.445	3.427
Buddhism	0.638	0.566	0.719
Others	7.055	0.769	64.703
Prefer not to say	0.638	0.566	0.719
Type of family			
Nuclear family	-	-	-
Joint family	1.111	0.681	1.811
3 generation family	1.141	0.393	3.31
Place of origin			
Urban	-	-	-
Rural	1.277	0.741	2.201
Marital status			
Single	1.545	0.721	3.312
Married	-	-	-
Widowed/separated/ divorced	3.109	1.484	6.515
Education status			
Graduate and above	-	-	-
Below graduate	1.077	0.664	1.746

4. Discussion

The attitude and behavior of parents toward vaccination range from firmly accepting vaccination to refusing vaccination. Between these two extremes is the hesitant population[24]. According to the study, 37.6% of people are hesitant to get vaccinated, with 27.19% belonging to the educated class. Women from the educated middle class were found to be more hesitant. The explanation for their apprehension was that they did not believe the vaccinations were effective, and they had heard/read negative things about vaccines and vaccination. The population's hesitancy was discovered to be because of a lack of accurate knowledge about the vaccine. This agrees with the findings of Dutta et al., who found that a child with a working mother is almost half as likely to be vaccinated as a child whose mother is unemployed[25]. Our findings contradicted those of Deborah et al., who found that vaccine optimism increased as educational levels increased and safety concerns decreased[26]. Hesitancy has arisen as a result of a lack of time and the acquisition of only

partly accurate knowledge about vaccines. Concerns about vaccine safety and effectiveness have developed because of increased education.

Furthermore, people between the ages of 30 and 59 were more skeptical of vaccines. Vaccines against varicella, HPV, and MCV were often refused. They were found to be reluctant to try newer vaccines and had only received the necessary vaccines on time. Elderly parents have the propensity to shield their children from any potential harm following vaccination. They are more wary of newer, optional vaccines, meaning that they doubt the vaccine's effectiveness. Gust et al. shared common conclusions based on their research[26].

Many who practiced Christianity were the most averse to vaccination. A similar study was performed and implemented about the effect of faith on vaccine hesitancy[27]. Owing to insufficient awareness and perceptions of disease, as well as the power of religious leaders, the immunization rate was lower among some religious groups. Religious leaders' skepticism about immunization stems from health-related issues that spread through social networks within religious communities, rather than faith-based values.

According to the findings, the rural population was more reluctant. In a survey conducted by Karpaga et al., the main reasons for vaccine apprehension in this community were illiteracy or concern about losing a day's pay[28]. This group's hesitancy can be reversed if the fear of losing their job is removed from their minds. This could be accomplished by offering financial support or an opportunity to get immunized. Vaccine apprehension was also due to a lack of local immunization centers and adequate knowledge regarding vaccination. Increased physical access, facilities, and the quality of health care offered are all potential suggestions for improving coverage. The widowed/separated/divorcing population, followed by single parents were more reluctant. The study conducted by Heidi et al., obtained similar observations[29]. The reason for the hesitation is that there is not enough time to vaccinate your child. Single parents, as well as widows/separate/divorced individual parents, mentioned that they are the only caregivers, resulting in household or other employment delays or reluctance to take the vaccination. All these times, if the mother is sick, pregnant, or needs to look after other children, the dilemma often worsens. They were afraid to lose work or reduce wages by taking their children to the vaccine. The efficacy and safety of the vaccines were also a reason. Most of them have also gathered misinformation regarding vaccinations from friends and family and via media.

The association between joint family and vaccine hesitancy was not very significant, but vaccine hesitancy in a joint family (39.36%) was found to be more than nuclear family (36.88%). Our study contrasted with Agarwal et al.' study, where nuclear families were more hesitant because the mother was the only child-care provider[30]. However, in most joint families, the decision-making body is the eldest. Elderly people in most cases are concerned about the side effect of the vaccine and its efficacy. They prefer alternative medicinal products or believe in immunization. Parents were more hesitant about newer vaccines that are available in the market. A study conducted by Agarwal et al., came to similar conclusions[30]. Lack of proper valid information regarding the vaccine and its efficacy leads to hesitancy in the population. Most of the parents were hesitant to vaccinate their children for MR and varicella vaccines which were newer drugs, fearing the side effects associated with the vaccines. In lower-income families with less than 10,000 months' income, vaccine hesitancy was mainly observed. The study by Chiara et al., which explained that economic hardship was a determinant of vaccine hesitation, showed similar findings[31]. hesitancy was observed mainly in non-free vaccines. Vaccines like Pentavac and measles vaccines are expensive vaccines are parents with low monthly incomes delay the vaccination, but do not refuse the vaccine.

As per a study conducted by Christel et al., the adherence to EPI scheduled vaccines was strong, however, the coverage rate varied from the site and by the type of vaccines (BCG vaccine coverage was high across all the sites, whereas measles range fluctuated over sites). It was understood that a range of socio-

economic factors was associated with vaccination status in children, which agreed with our study as well[32]. OPV vaccines were widely accepted and have been confirmed not to have any kind of adverse events associated with them. The vaccine available for over 7 decades and the efficacy is self-explanatory. OPV successfully eliminated wild polio in India, with a very low level of polio incidence at the end of the year 2011. Similar studies were observed in a survey conducted by Emmanuel et al.[33]. Also, a large share of the population accepted BCG vaccines. The efficacy of the vaccine was appreciated. Although a tiny portion was hesitant as they were concerned about the scar that would be left behind once vaccinated as mentioned by a similar study conducted by Gite et al.[34]. Hesitancy towards the vaccines like IPV and Hepatitis A vaccines was associated with the lack of proper knowledge regarding the topic[33,35]. Many do not understand the severity of the condition. Lack of full knowledge about the vaccines and negative influence of media, friends, and society has led to this. The confidence in MR/MMR vaccines was low for an EPI vaccine. However, in the past, the vaccine had been subjected to numerous controversies regarding MMR vaccine-induced autism. Although there were no scientific studies to prove that the vaccine was the prime cause of autism, the general public concluded with the fragments of information collected from social networks and media. Despite this controversy, the attitude towards MMR vaccines is relatively positive. A study conducted by Ramsay et al., conveys that the use of vaccines hasn't dropped over the year, but it was still below the target levels needed for herd immunity[36]. Rotavirus vaccines were the next most hesitant vaccine as per the study. The hesitancy was related to the low knowledge regarding rotavirus infection, the mode of transmission, and the vaccines[37]. Since the vaccine is a newer one, parents were concerned about the side effects of the vaccine. Some parents were concerned about vaccinating their child at a such young age with numerous vaccines at a single time. Rotavirus vaccines unlike other vaccines should not be delayed and vaccinated as per schedule. Unlike the other EPI vaccines, which had higher confidence, the rotavirus vaccines are more hesitant because these vaccines were upgraded from optional vaccines to mandatory vaccines in the recent past. A handful of parents couldn't vaccinate their children once the vaccine was made mandatory, as the children would be older than the required age. Sjögren et al. had similar observations regarding the vaccine in their study[38].

Varicella vaccines are one of the least confident vaccines as per the survey conducted. Although it is one of the most common viral diseases in India, the public hesitates to vaccinate due to the high cost of the vaccine (about Rs.1350/- for one dose). A similar observation was made in the study conducted by Verma et al.[39]. Parents who couldn't afford the vaccine, would wait until the adolescent period, to see if they get infected by the virus and attain immunity naturally. If not, then they would prefer to take a vaccination, as varicella infections in adults were more severe. The observations made in our study were similar to those obtained by Swathi et al. in their study[40]. Very poor parents cannot afford any of the newer vaccines including the chicken pox vaccines and attempts must be made to see that at least all the free accessible EPI vaccines are taken.

JE was yet another most hesitant vaccine from the study. JE is a leading pediatric health issue but is endemic. The infection is predominantly found in the Northern parts of India and a small portion of south India. Much of the population is unaware of such a disease and the vaccine available for the same. The population believed that JE is an infectious disease that does not require vaccination. Similar observations were found in a study conducted by Zhang et al., where they mentioned that the caregivers had the attitude that there was a low risk of the child getting sick after a JE outbreak[41]. Although the major reason for the hesitancy is because the infectious disease is not pre-dominant in the geographic locality.

HPV vaccines are adolescent vaccines given to girls. The confidence towards this vaccine is lower than expected, unlike a study conducted by Tozzi et al., where parents showed a positive attitude towards vaccination. The lack of confidence is associated with the knowledge about HPV, and the beliefs and attitudes toward the vaccines. It was understood from Tozzi et al. study that a small fraction did not favor

HPV vaccination and the fear to encouraging sexual promiscuity of their children through vaccination[42]. Few parents believed that vaccines were for children and not grownups and hence were reluctant to use the vaccines.

5. Conclusion

The major factors influencing vaccine hesitancy were identified as fear of side effects, lack of awareness of where to get vaccinated, and negative perception that the vaccines are not needed. Vaccine confidence is to be developed in the population to eradicate the misinformation related to vaccination. As per the study, it was understood that EPI vaccines were more accepted among the public than non-EPI vaccines. This was because the population believed that EPI vaccines were globally accepted and were more reliable and safer when compared to non-EPI vaccines, which are optional. To ease their hesitation, the general public needs to be educated about the importance of both mandatory and optional vaccinations, their advantages, and potential side effects.

Author contributions

Conceptualization, JS and SBJ ; methodology, MBM, DJ, RB, BB, JS and SBJ; software, MBM, DJ, RB, BB, JS and SBJ; validation, MBM, DJ, RB, BB, JS, SBJ and MDR; formal analysis, MBM, DJ, RB, BB, JS and SBJ ; investigation, MBM, DJ, RB and BB; resources, MBM, DJ, RB, and BB; data curation, MBM, DJ, RB and BB; writing—original draft preparation, MBM, DJ, RB and BB; writing—review and editing, JS, SBJ and MDR; visualization, MBM, DJ, RB, BB, JS and SBJ; supervision, JS and MDR; project administration, MBM, DJ, RB, BB and JS. All authors have read and agreed to the published version of the manuscript.

Limitation of the study

As the study followed a cross-sectional design, it captured the VH at a specific point in time and prevented the assessment of any potential changes or trends in attitudes and behaviors of the study population over time. Additionally, relying solely on the WHO SAGE VH study tool Might have overlooked certain nuanced factors or local contexts that could impact individuals' decisions regarding vaccination.

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Ethics approval statement

Ethical approval of the study was obtained from the localized institutional Ethics Committee (Ref No: JSSMC/IEC/141020/43 NCT/2020-21).

Patient consent

Obtained before enrolment.

Conflict of interest

The authors declare no conflict of interest.

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