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Original Research Article

Determinants of vaccine hesitancy among caregivers of children in rural South India: a comprehensive cross-sectional framework analysis

Maddineni Sowmya*, G. M. Pranam, Usha Hirevenkanagoudar, Sanjeev Chetty

Department of Paediatrics, Navodaya Medical College, Hospital and Research Centre, Raichur, Karnataka, India

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***Correspondence:**
Dr. Maddineni Sowmya,
E-mail: sowmyamaddineni9@gmail.com

ABSTRACT

Background: Vaccine hesitancy-the delay in acceptance or refusal of immunization despite availability-poses an important challenge to immunization programmes. This study investigated the behavioral pattern and determinants of vaccine hesitancy among caregivers of children in rural South India using the WHO-SAGE Vaccine Hesitancy framework.
Methods: A descriptive cross-sectional questionnaire-based survey was conducted among 360 caregivers registered in Anganwadi demographic records in Zaheerabad, Raichur, over a three-month period from June 2025 to August 2025. The structured questionnaire assessed caregiver characteristics, childhood vaccination profiles and behavioral variables mapped to SAGE domains. Pearson's chi-square test was used for categorical associations.
Results: Safety concerns were the most frequently reported reason for hesitancy (30.0%, n=108), followed by lack of awareness (25.0%, n=90). Hesitancy was concentrated in HPV (n=121), COVID-19 (n=112) and PCV (n=98), while routine EPI vaccines accounted for 29 responses. Significant associations were observed for primary hesitancy reason (χ^2=132.381, p<0.001), vaccine type (χ^2=33.785, p<0.001) and SAGE domain (χ^2=55.445, p<0.001).
Conclusions: Vaccine hesitancy in this setting was predominantly product-specific and associated with safety concerns, awareness gaps and confidence-related factors. Communication-focused, context-specific interventions may help improve vaccine confidence and acceptance.

Keywords: Vaccine hesitancy, Anganwadi, Children

INTRODUCTION

Vaccination is among the most successful public-health interventions, substantially reducing morbidity and mortality from vaccine-preventable diseases. Nevertheless, vaccine hesitancy can result in delayed or refused vaccination and may undermine vaccination programmes.[1,2]

The WHO strategic advisory group of experts (SAGE) describes vaccine hesitancy as a context-specific phenomenon that varies across time, place and vaccines and is influenced by confidence, complacency and convenience. Studies have shown that the reasons for hesitancy are heterogeneous and may include concerns about vaccine safety and effectiveness, limited knowledge, mistrust, social and cultural influences, and practical barriers.

In India, published evidence indicates that safety concerns, doubts about the need for vaccination, suspicion regarding newer vaccines, lack of awareness and access barriers can contribute to parental vaccine hesitancy. Several studies have also reported that hesitancy may differ according to the vaccine being considered, with newer or less familiar vaccines generating distinctive concerns.[3-7]

The SAGE working group developed a determinant matrix and a survey-question compendium to support assessment of vaccine hesitancy across contextual, individual/group and vaccine-specific domains.[2,8] However, the available evidence base remains heterogeneous, and contextually relevant assessment is important because determinants vary across populations and settings.[8]

Therefore, the present study aimed to describe the determinants and behavioral patterns of vaccine hesitancy among caregivers of children in an Anganwadi catchment area of Zaheerabad, Raichur, using a structured questionnaire mapped to the SAGE framework.

Vaccine hesitancy is a multidimensional and context-dependent phenomenon rather than a simple binary choice between acceptance and refusal.[2,8] The SAGE framework organizes determinants around contextual influences, individual and group influences, and vaccine- or vaccination-specific issues.[2,8]

Validated instruments such as the parent attitudes about childhood vaccines (PACV) have demonstrated associations between caregiver attitudes and childhood immunization behavior.[9] A scoping review of vaccine-hesitancy tools emphasized the need for validated and contextually relevant measures, particularly in settings where local determinants may differ from those in high-income countries.[8]

METHODS

Study design and setting

This was a descriptive, cross-sectional, questionnaire-based study conducted within the Anganwadi centres of Zaheerabad, Raichur, Karnataka, India over a three-month period from June 2025 to August 2025.

Study population and sampling

The study population comprised parents or primary caregivers responsible for medical and immunization decisions for at least one child aged 12 years or younger. Households were eligible when they were permanent residents of the designated Anganwadi survey zones and were registered in the local Anganwadi demographic records under the Integrated Child Development Services (ICDS) system. A total of 360 eligible caregivers were recruited using systematic sampling of registered households.

Inclusion criteria

Parents or primary legal caregivers of at least one child aged ≤12 years, residing permanently in the designated Anganwadi catchment area and registered in the local Anganwadi demographic records, were included in the study.

Exclusion criteria

Caregivers who were not the primary decision-makers for the child's healthcare, households outside the designated Anganwadi catchment area, individuals not registered in the sampling frame, caregivers unable to complete the interview/questionnaire, and those who declined participation were excluded from the study.

Data collection instrument

A structured interviewer-administered questionnaire adapted from the WHO-SAGE vaccine hesitancy survey compendium was used. The questionnaire included socio-demographic characteristics, childhood vaccination history, vaccine-specific concerns and behavioral questions corresponding to SAGE determinants.[2]

The instrument was translated and back-translated into Kannada and pilot-tested for comprehension before final administration.

Operational definitions

Delay was defined as postponement of a recommended vaccine beyond the scheduled timeline.

Doubt referred to persistent concern or uncertainty regarding vaccine safety, efficacy or necessity without outright refusal.

Refusal referred to active rejection of a specific vaccine or the immunization schedule.

Statistical analysis

Data were checked for completeness, coded and entered into an electronic database. Cross-tabulations were performed for delay, doubt and refusal against primary hesitancy reasons, vaccine type and SAGE domains. Pearson's chi-square test was used for categorical associations, with statistical significance set at $p<0.05$.

RESULTS

A total of 360 caregivers were included in the analysis. Safety concerns were the most frequently reported primary reason for hesitancy (30.0%, n=108), followed by lack of awareness (25.0%, n=90). Efficacy doubts and mistrust in healthcare each accounted for 15.0% (n=54), religious/cultural factors for 10.0% (n=36) and other practical barriers for 5.0% (n=18).

Safety concerns were the leading reason (30.0%, n=108), followed by lack of awareness (25.0%, n=90).

Efficacy doubts and mistrust in healthcare each accounted for 15.0% (n=54), religious/cultural reasons for 10.0% (n=36), and other practical barriers for 5.0% (n=18).

Table 1: Socio-demographic characteristics of participating caregivers, (n=360).

Variables	Category	N	Percentage
Caregiver sex	Female	184	51.1%
	Male	176	48.9%
Education level	Secondary	124	34.4%
	Primary	122	33.9%
	Illiterate	63	17.5%
	Graduate	51	14.2%
Child age group (in years)	1-3	125	34.7%
	3-6	102	28.3%
	6-12	74	20.6%
	0-1	59	16.4%

Table 2: Behavioral distribution by primary reason, vaccine type, and SAGE domain.

Category groups	Specific category	Delay	Doubt	Refusal	Total/ stat
Primary hesitancy reason	Safety concerns	72 (66.7%)	36 (33.3%)	0 (0.0%)	108 χ^2=132.381 (p<0.001)
	Lack of awareness	63 (70.0%)	27 (30.0%)	0 (0.0%)	90
	Efficacy doubts	19 (35.2%)	35 (64.8%)	0 (0.0%)	54
	Mistrust in healthcare	23 (42.6%)	13 (24.1%)	18 (33.3%)	54
	Religious/cultural	16 (44.4%)	8 (22.2%)	12 (33.3%)	36
	Other practical barriers	18 (100.0%)	0 (0.0%)	0 (0.0%)	18
Vaccine type	COVID-19	61 (54.5%)	43 (38.4%)	8 (7.1%)	112 χ^2=33.785 (p<0.001)
	HPV	70 (57.9%)	42 (34.7%)	9 (7.4%)	121
	PCV	68 (69.4%)	27 (27.6%)	3 (3.1%)	98
	Routine EPI	12 (41.4%)	7 (24.1%)	10 (34.5%)	29
SAGE domain	Confidence	114 (52.8%)	84 (38.9%)	18 (8.3%)	216 χ^2=55.445 (p<0.001)
	Confidence/ complacency	63 (70.0%)	27 (30.0%)	0 (0.0%)	90
	Context	16 (44.4%)	8 (22.2%)	12 (33.3%)	36
	Convenience	18 (100.0%)	0 (0.0%)	0 (0.0%)	18

There was a significant association between primary hesitancy reason and behavioral response (χ^2=132.381, p<0.001). Safety concerns and lack of awareness were associated predominantly with delay and doubt, whereas mistrust in healthcare and religious/cultural factors showed the highest proportions of refusal. Practical barriers were associated entirely with delay in the present dataset.

Vaccine specific distribution

Hesitancy was concentrated among HPV (n=121), COVID-19 (n=112) and PCV (n=98), while routine EPI vaccines accounted for 29 hesitant responses.

The proportion of refusal was highest for routine EPI vaccines (34.5%, n=10), compared with HPV (7.4%), COVID-19 (7.1%) and PCV (3.1%).

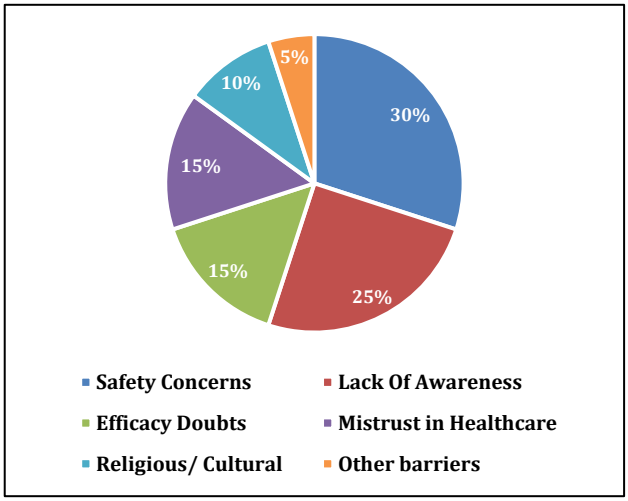

Figure 1: Percentage distribution of primary reasons driving vaccine hesitancy among caregivers, (n=360).

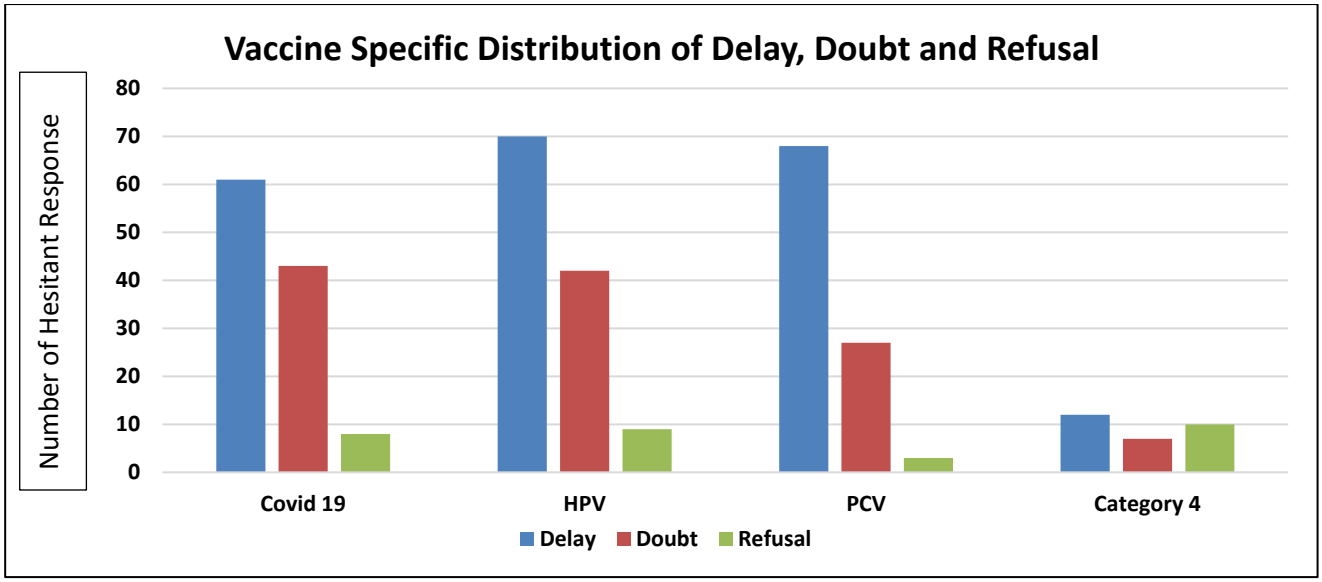

Figure 2: Distribution of delay, doubt and refusal across vaccine categories.

DISCUSSION

The present study demonstrates that vaccine hesitancy among caregivers in this rural South Indian setting was heterogeneous and strongly influenced by vaccine-specific and confidence-related factors. This is consistent with the SAGE framework, which emphasizes that hesitancy varies across time, place and vaccines rather than representing a uniform population-level attitude.[2]

Safety concerns were the leading determinant in the present study (30.0%). This finding is consistent with Indian literature identifying vaccine safety as a recurrent driver of parental hesitancy.[3] Thapar et al reported that safety was the most common reason among the small group of mothers who had refused vaccination in a coastal South Indian study, supporting the importance of safety perceptions even in settings with generally high acceptance.[4]

Lack of awareness accounted for 25.0% of hesitancy in the present study. Reviews of vaccine hesitancy in India have similarly identified inadequate awareness and communication gaps as important determinants.[3] Recent community-based evidence from South India has also identified lack of awareness regarding vaccines and schedules among reasons for incomplete immunization, supporting the interpretation that information gaps may coexist with otherwise favorable attitudes toward vaccination.

Efficacy doubts accounted for 15.0% of responses and were more frequently expressed as doubt than refusal in the present study. This pattern is compatible with the broader SAGE concept that confidence includes trust in vaccine safety and effectiveness and that uncertainty does not necessarily translate into outright refusal.[2,8]

Mistrust in healthcare accounted for 15.0% of responses and was associated with a relatively high refusal proportion (33.3%). The finding is clinically and programmatically important because trust in healthcare providers and the healthcare system is repeatedly identified as a determinant of vaccine acceptance. In an Indian national survey of parental COVID-19 vaccination intentions, trust in the healthcare system was specifically evaluated alongside vaccine confidence and sociodemographic factors, highlighting the relevance of institutional trust to vaccine decision-making.[7]

Religious or cultural factors accounted for 10.0% of hesitancy and, like healthcare mistrust, were associated with a substantial proportion of refusals (33.3%). Indian literature has described cultural, religious and socio-economic influences as contextual determinants of vaccine hesitancy. The present finding therefore supports the need for locally adapted communication that involves trusted community and healthcare stakeholders rather than relying solely on generic information campaigns.[3,6]

Practical barriers represented 5.0% of responses and produced delay rather than refusal in the present dataset. This is consistent with the SAGE distinction between convenience-related barriers and confidence-related concerns. In rural South India, caregivers have also reported preferences for familiar government hospitals and Anganwadi centres, emphasizing the importance of accessible and trusted vaccination points.

Hesitancy was concentrated in HPV, COVID-19 and PCV, whereas routine EPI vaccines had fewer hesitant responses but a higher proportion of outright refusal. The concentration around newer or less familiar vaccines is consistent with Indian reviews describing suspicion toward new vaccines as an important vaccine-specific determinant.[3] For HPV vaccination specifically, a rural

Mysore study found that parental willingness was strongly related to beliefs about vaccine safety, disease severity and family support, demonstrating how vaccine-specific beliefs shape acceptance.[10] For COVID-19 vaccination, Indian studies have reported parental concerns about safety, side effects, effectiveness and lack of information, which closely parallels the confidence-related pattern observed in the present study.[5]

Confidence was the largest SAGE-related category in the present study (n=216; 60.0% of hesitancy responses), followed by confidence/complacency (n=90), context (n=36) and convenience (n=18). This distribution reinforces the central role of trust and perceived vaccine value in the study population. The observed pattern also supports the SAGE recommendation that interventions should be tailored to the specific determinants identified within a population rather than treating all hesitant caregivers as a homogeneous group.[2,8]

The findings suggest that interventions should prioritize transparent explanation of vaccine safety and effectiveness, anticipatory counselling before administration of newer vaccines, and strengthening the communication skills of frontline workers. Such approaches are consistent with evidence from India emphasizing education, awareness and context-specific communication as opportunities to improve vaccine confidence.[3,4,6]

Limitations

This study has several limitations. First, the cross-sectional design limits causal inference and captures attitudes at a single point in time. Second, the study was conducted within a defined Anganwadi catchment area of Raichur and therefore may not be generalizable to other rural, urban or regional populations. Third, responses were caregiver-reported and may be affected by recall or social-desirability bias. Fourth, the study period spanned June 2025 to August 2025, which reflects attitudes during those specific months. Finally, the study used chi-square analyses of categorical variables and did not include multivariable modelling to assess independent predictors of hesitancy.

CONCLUSION

Vaccine hesitancy in this rural South Indian population was a context-dependent and vaccine-specific phenomenon. Safety concerns and lack of awareness were the leading reported determinants, while mistrust and religious/cultural factors were associated with a greater proportion of outright refusal. Hesitancy was concentrated in newer vaccine categories, particularly HPV, COVID-19 and PCV. The findings support communication-centred, context-specific interventions that improve vaccine information, address safety and efficacy concerns, and strengthen trust between caregivers, frontline workers and the healthcare system.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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