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Knowledge, Attitude, and Practice Towards Childhood Immunization Among Pregnant Women: A Prospective Interventional Study in Karnataka

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ABSTRACT

Background: Childhood immunization remains a cornerstone of preventive medicine, yet vaccination coverage continues to be suboptimal in many developing regions due to maternal knowledge gaps, misconceptions, and healthcare access barriers. Pregnant women, as future caregivers, play a decisive role in shaping vaccination adherence.

Methods: A six-month prospective interventional study was conducted at Gulbarga Institute of Medical Sciences, Kalaburagi, Karnataka. A total of 302 pregnant women were enrolled after ethics approval. A structured pretested questionnaire assessed baseline awareness, attitude, and practice (KAP) scores regarding childhood immunization. Pharmacist-led education was delivered through counselling, information leaflets, and audiovisual aids. One month later, a post-test was administered. Data were analyzed using paired *t*-tests, chi-square, and ANOVA.

Results: Baseline awareness, attitude, and practice scores were 22.5%, 32.9%, and 30.1%, respectively. Post-intervention, scores significantly improved to 76.5% ($p<0.001$), 87.7% ($p<0.001$), and 79.4% ($p<0.001$). Socio-demographic factors such as maternal education, parity, and socioeconomic status strongly influenced knowledge levels ($p<0.05$). Educational interventions eliminated misconceptions, improved vaccine timeliness, and reinforced positive attitudes.

Conclusion: Pharmacist-led education substantially improved pregnant women's knowledge and attitudes towards immunization, indicating that incorporating pharmacists into immunization campaigns may enhance vaccine uptake and reduce preventable morbidity.

Keywords: *Childhood immunization, KAP, pregnant women, pharmacist education, vaccine awareness, public health intervention.*

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1. INTRODUCTION

Immunization has long been recognized as one of the most effective and cost-efficient public health interventions for preventing infectious diseases. The development and widespread administration of vaccines have dramatically reduced global morbidity and mortality associated with diseases such as measles, diphtheria, pertussis, and polio (Orenstein & Ahmed, 2017). According to global estimates, vaccination prevents 4–5 million deaths annually, underscoring its central role in advancing public health and extending life expectancy (World Health Organization [WHO], 2023). Despite these remarkable successes, vaccine-preventable diseases continue to persist in regions where coverage remains incomplete, particularly in low- and middle-income countries.

India, as one of the world's largest producers of vaccines, plays a significant role in global supply and distribution (Siddiqui & Alam, 2021). However, immunization coverage within the country continues to display variability across states and districts, influenced by socioeconomic, cultural, and infrastructural disparities. According to the National Family Health Survey (NFHS-5), full immunization coverage among children aged 12–23 months improved to 76% from 62% in NFHS-

4, reflecting notable progress but still leaving millions of children at risk of vaccine-preventable diseases (International Institute for Population Sciences [IIPS] & ICF, 2021). The persistence of coverage gaps illustrates the challenges of reaching hard-to-access populations and sustaining consistent adherence to immunization schedules.

Maternal knowledge, attitudes, and practices (KAP) have emerged as critical determinants of vaccination uptake and completion. Mothers, often serving as the primary caregivers, play a decisive role in whether children receive timely and complete vaccination (Mishra et al., 2020). Furthermore, antenatal care visits present a unique opportunity to integrate vaccine education, as pregnant women frequently engage with healthcare services during this period. However, inadequate awareness, misconceptions about vaccine safety, cultural and religious beliefs, and socioeconomic constraints often act as barriers to optimal vaccine uptake. Such challenges result in delayed, partial, or missed vaccinations, undermining herd immunity and perpetuating the risk of outbreaks, as observed with recent resurgences of measles in parts of India (Patel et al., 2023).

Globally, vaccine hesitancy has been identified as a pressing concern. In 2019, the WHO listed vaccine hesitancy among the top ten threats to global health, highlighting the urgency of addressing misinformation and strengthening trust in immunization programs (WHO, 2019). The phenomenon of vaccine hesitancy is multifactorial, encompassing complacency, convenience, and confidence, often referred to as the "3Cs" model (MacDonald, 2015). In India, barriers include a lack of awareness about immunization schedules, misconceptions about adverse events following immunization, distrust in health systems, and the circulation of misinformation, especially through social media platforms (Dasgupta et al., 2018; Larson et al., 2022). These factors disproportionately affect rural and semi-urban populations, where health infrastructure may be weaker and reliance on informal sources of information is greater.

Evidence from interventions indicates that targeted educational strategies addressing these gaps can significantly improve maternal acceptance and compliance with vaccination schedules. For instance, Abraham et al. (2020) reported that structured health education sessions tailored to pregnant women increased both knowledge scores and subsequent vaccination adherence in community settings. Similar findings have been documented in other contexts, where maternal counseling and reinforcement during antenatal visits improved the timeliness and completeness of child immunization (Yadav et al., 2019).

Pharmacists, by virtue of their accessibility and increasing involvement in patient counselling, are strategically positioned to enhance vaccine awareness and uptake. Globally, pharmacists have been recognized as frontline health professionals capable of delivering immunization services, as evidenced in countries such as the United States, United Kingdom, and Australia (Drozd et al., 2017). The International Pharmaceutical Federation (FIP, 2019) has emphasized the need for expanding pharmacists' roles in immunization to improve vaccine access, particularly in underserved communities. In India, although pharmacists are not yet authorized to administer vaccines widely, their integration into health education initiatives presents a promising avenue for strengthening public understanding and trust in immunization. Through pharmacist-led educational programs, misconceptions can be clarified, awareness of immunization schedules reinforced, and maternal empowerment enhanced, ultimately contributing to improved vaccine coverage.

The present study was designed to assess the baseline knowledge, attitudes, and practices of pregnant women regarding childhood immunization and to evaluate the impact of pharmacist-led educational interventions on these parameters. By examining socio-demographic correlates and intervention outcomes, this research aims to generate insights into strategies for enhancing immunization coverage, particularly within semi-urban and rural populations of Karnataka. This approach is consistent with India's broader public health priorities under the Universal Immunization Programme (UIP), which emphasizes equity and outreach in vaccine delivery (Ministry of Health and Family Welfare [MoHFW], 2022). The findings are expected to inform policy and practice by highlighting the potential of pharmacist-led health education as a scalable, cost-effective intervention for strengthening maternal engagement and improving childhood immunization rates.

2. RESEARCH METHODOLOGY

Study Design and Duration

A prospective, hospital-based interventional study was carried out at the Gulbarga Institute of Medical Sciences (GIMS), Kalaburagi, Karnataka, over a six-month period from March to August. The study adopted a pre-test/post-test design in order to evaluate changes in awareness, attitudes, and practices (KAP) regarding childhood immunization among pregnant women following pharmacist-led educational sessions. This design was selected to allow measurement of baseline KAP scores, implementation of a targeted educational intervention, and reassessment of outcomes after a fixed interval to capture the effect of the intervention.

Ethical Approval

Prior to initiation, approval was obtained from the Institutional Ethics Committee (IEC) and the Institutional Review Board (IRB) of GIMS, ensuring that the study adhered to the principles of the Declaration of Helsinki (2013). Written informed consent was obtained from each participant after providing clear explanations of the study purpose, procedures, potential benefits, and risks in the local language. Participants were informed that participation was voluntary and that they could

withdraw at any stage without affecting the healthcare services they received. Confidentiality and anonymity were strictly maintained by assigning unique identification codes to all data, which were stored securely with restricted access.

Study Site

The study was conducted in the Department of Obstetrics and Gynecology (both outpatient and inpatient wards) of GIMS Hospital. As a tertiary care teaching hospital, GIMS caters to a large and diverse patient population drawn from both urban and rural settings of Kalaburagi district and neighbouring regions. This setting was chosen to provide a representative cross-section of socio-demographic backgrounds, allowing the findings to reflect real-world maternal perspectives from varied educational, cultural, and socioeconomic contexts.

Study Population

Pregnant women attending routine antenatal clinics or admitted to obstetric wards during the study period were approached consecutively. They were provided with an overview of the study and invited to participate.

Inclusion criteria:

- Pregnant women in any trimester.
- Willingness to participate and provide written informed consent.
- Residents of urban or rural settings in Kalaburagi district.

Exclusion criteria:

- Pregnant women with professional backgrounds in medicine, nursing, or pharmacy, as their knowledge of immunization could bias baseline KAP scores.
- Women unwilling or unable to complete both pre- and post-test assessments.

Sample Size

A total of 302 participants were enrolled through convenience sampling. The sample size was calculated based on an expected effect size of 20% improvement in awareness following intervention, with a 95% confidence level and 80% statistical power. The sample size estimation also accounted for a potential dropout rate of 10%, ensuring adequate statistical robustness for subgroup analyses such as education, socioeconomic status, and parity.

Data Collection Tool

Data were collected using a structured, pre-tested questionnaire developed specifically for the study. The tool consisted of four major domains:

1. **Socio-demographic profile:** Age, education, occupation, parity, socioeconomic status (assessed using the modified BG Prasad classification), family type, religion, trimester of pregnancy, and primary source of information about immunization.
2. **Awareness:** Questions focused on knowledge of vaccines, diseases prevented, awareness of government programs, free availability of vaccines under the Universal Immunization Programme (UIP) and understanding of vaccine schedules.
3. **Attitude:** Items assessed favourability towards childhood immunization, concerns about adverse effects, trust in vaccine safety, and perceived barriers to vaccine uptake (e.g., distance to facility, cultural beliefs).
4. **Practice:** Questions examined real-life vaccination behaviours, including adherence to schedules for older children, timeliness of vaccine administration, and record-keeping practices such as use of the Mother and Child Protection (MCP) card.

The questionnaire was initially developed in English, then translated into Kannada and Hindi by bilingual experts. A forward-backward translation method was employed to ensure conceptual equivalence and content validity. Pilot testing was conducted on 30 antenatal women outside the study sample to refine clarity and reliability, yielding a Cronbach's alpha of 0.82, indicating good internal consistency.

Intervention

Following baseline data collection (pre-test), participants received a pharmacist-led educational intervention. The intervention was designed to address knowledge gaps, correct misconceptions, and reinforce positive attitudes towards vaccination.

- **Mode of delivery:** Educational sessions were conducted in small groups (10–15 women per session) in designated counselling areas of the outpatient and inpatient wards. Individual reinforcement was provided where necessary.
- **Content:** The sessions covered: (a) importance of immunization, (b) common vaccine-preventable diseases, (c)

recommended national immunization schedule, (d) clarification of safety concerns and myths, and (e) the role of timely vaccination in child health.

- **Educational materials:** Leaflets with immunization schedules, posters depicting vaccine-preventable diseases, PowerPoint slides, and short animated videos in Kannada and Hindi were used to enhance comprehension.
- **Format:** Each session lasted 30–40 minutes and was followed by open interactive discussions, allowing participants to raise doubts and seek clarifications. Educational content was standardized to ensure uniform delivery across sessions.

After one month, participants were reassessed with the same questionnaire (post-test) to measure changes in awareness, attitude, and practice.

Data Management and Analysis

All responses were coded numerically to facilitate statistical analysis. Data were entered into Microsoft Excel, cross-verified for accuracy, and imported into SPSS version 25.0 (IBM Corp., Armonk, NY, USA) for analysis.

- **Descriptive statistics:** Continuous variables such as age were expressed as mean ± standard deviation (SD), whereas categorical variables (e.g., education, parity) were presented as frequencies and percentages.
- **Inferential statistics:**
    - Paired t-tests were applied to compare pre-test and post-test mean KAP scores, evaluating the effect of the intervention.
    - Chi-square tests were used to assess associations between categorical variables (e.g., education level and vaccination awareness).
    - One-way ANOVA with post hoc analysis was conducted for subgroup comparisons to identify socio-demographic predictors of improved KAP.
- **Significance threshold:** A p-value <0.05 was considered statistically significant.

To minimize bias, the same set of trained pharmacists conducted both pre- and post-test assessments, and participants were reassured that their responses would not influence the care they received. Missing data were handled using listwise deletion for analyses requiring complete cases, though the proportion of missing values remained below 5%.

3. RESULTS

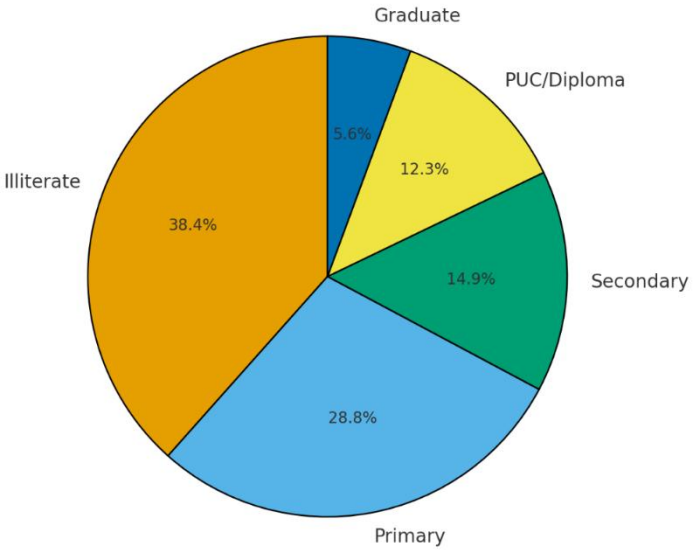
Socio-demographic Characteristics

A total of 302 pregnant women participated. The mean age was 26.15 ± 4.23 years. The majority (44%) were aged 23–27 years. Most women were illiterate (38.4%), housewives (51.3%), and from lower-middle socioeconomic backgrounds (41.4%). Detailed characteristics are presented in **Table 1**.

Table 1. Socio-demographic profile of study participants (n=302).

Variable	Categories	Frequency	Percentage (%)
Age (years)	18–22	68	22.5
	23–27	133	44.0
	28–32	77	25.5
	33–37	21	7.0
	38–42	3	1.0
Education (mother)	Illiterate	116	38.4
	Primary	87	28.8
	Secondary	45	14.9
	PUC/Diploma	37	12.3
	Graduate	17	5.6
Occupation	Housewife	155	51.3

	Self-employed	81	26.8
	Agriculture	31	10.3
	Pvt. Service	23	7.6
	Student	12	4.0
Socioeconomic status	Middle class	90	29.8
	Lower middle	125	41.4
	Lower class	87	28.8



Figures 1: Maternal Education Distribution (n=302)

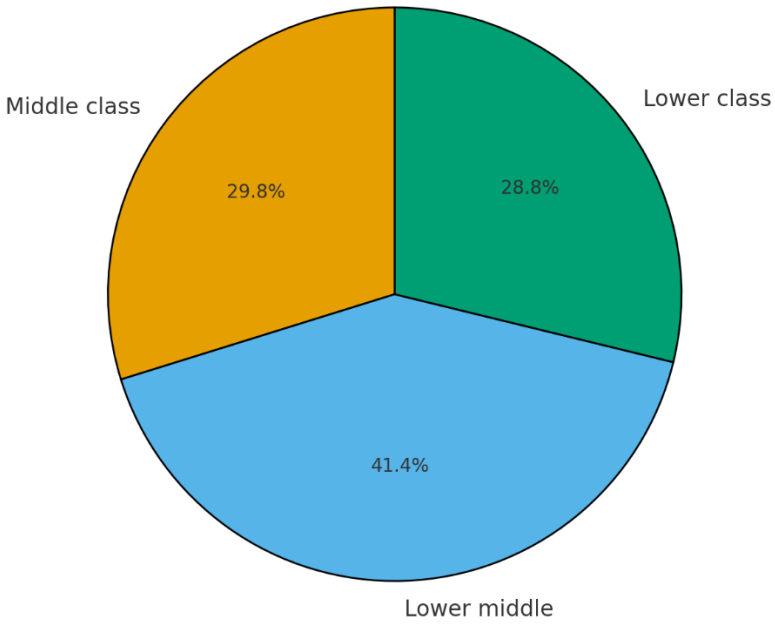


Figure 2: Socioeconomic Status Distribution (n=302)

Baseline vs. Post-intervention Awareness

At baseline, only 22.5% of participants were aware of correct vaccination schedules. Post-intervention, this improved to 76.5% ($p<0.001$). Awareness of vaccine-preventable diseases improved from 26.8% to 82.5% ($p<0.001$).

Table 2. Awareness scores before and after pharmacist intervention.

Awareness Parameter	Pre-test (%)	Post-test (%)	p-value
Knowledge of birth vaccines	40.3	92.7	<0.001
Knowledge of free vaccines	77.8	93.0	<0.001
Awareness of multiple vaccines	13.6	67.9	<0.001
Knowledge that unvaccinated child may contract disease	26.8	90.1	<0.001
Overall awareness score	22.5	76.5	<0.001

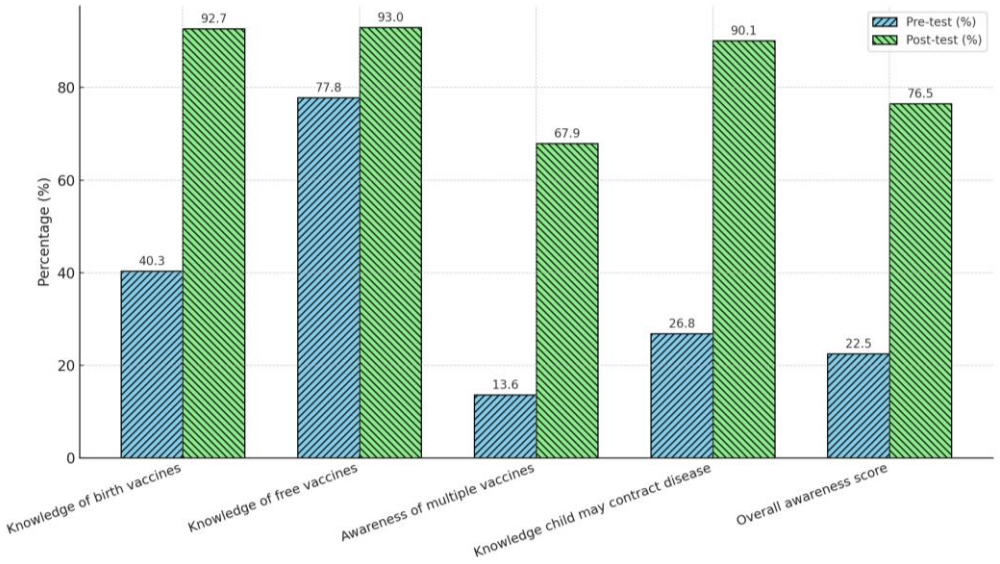


Figure 3: Bar chart comparing awareness scores pre vs. post-intervention

Attitude Changes

Attitude significantly improved following intervention. Initially, only 32.9% favored vaccination unequivocally; this rose to 87.7%. Misconceptions regarding vaccine harm dropped from 65.2% to 9.1% ($p<0.001$).

Table 3. Attitude responses among pregnant women (pre vs. post).

Attitude Question	Pre-test (%)	Post-test (%)	p-value
In favor of vaccination	32.9	87.7	<0.001
Perceived harmful effects	65.2	9.1	<0.001
Vaccination prevents disease	25.8	86.4	<0.001
Reported hurdles (awareness gap, fear, funds)	45.6	13.4	<0.05

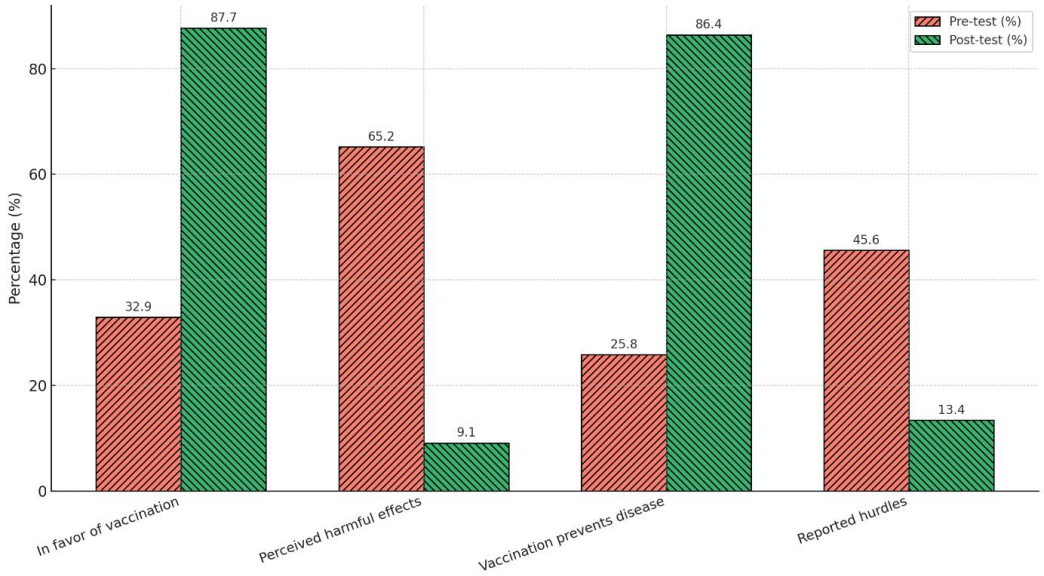


Figure 4: Multiple bar chart showing shift in attitudes

Practices Related to Immunization

At baseline, 30.1% maintained immunization records (MCP card), which improved to 79.4% post-intervention. Timeliness of vaccination improved from 34% to 82%.

Table 4. Practice changes post-intervention.

Practice Indicator	Pre-test (%)	Post-test (%)	p-value
Possession of MCP card	30.1	79.4	<0.001
Compliance with schedule	34.0	82.0	<0.001
Attending follow-up vaccination sessions	37.2	84.3	<0.001

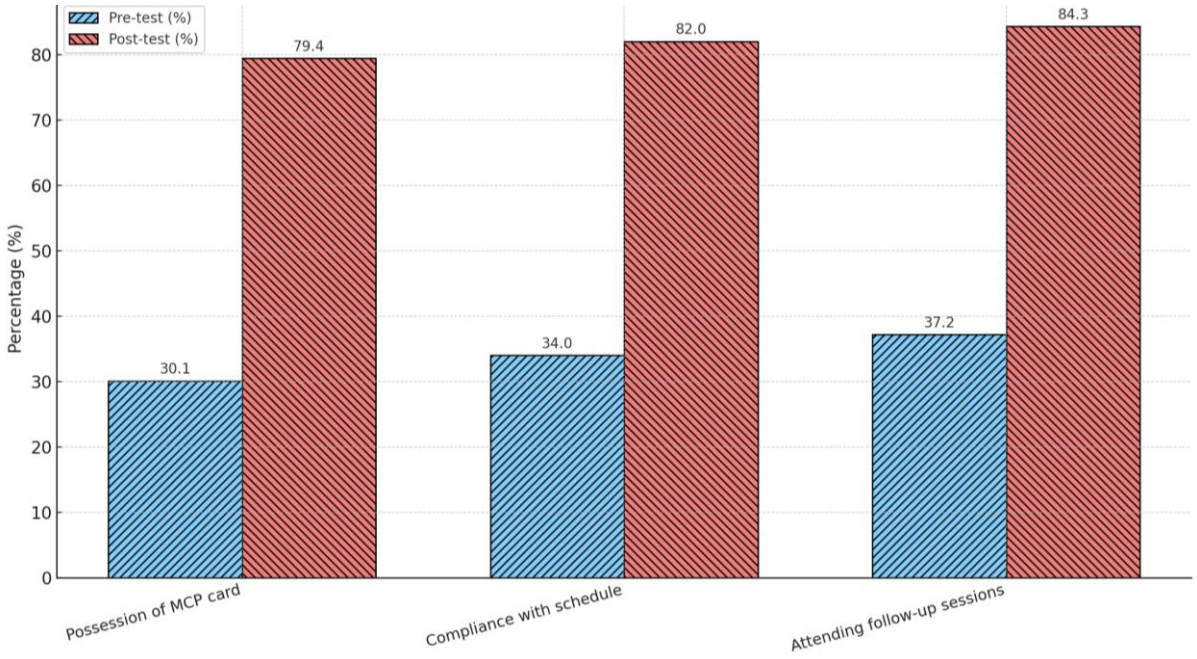


Figure 5: showing practice improvements

Subgroup Analysis

Education significantly influenced improvements. Graduates showed higher post-test awareness ($p<0.001$) compared to illiterate participants, though all groups improved. Socioeconomic status also correlated with awareness and practices ($p<0.05$).

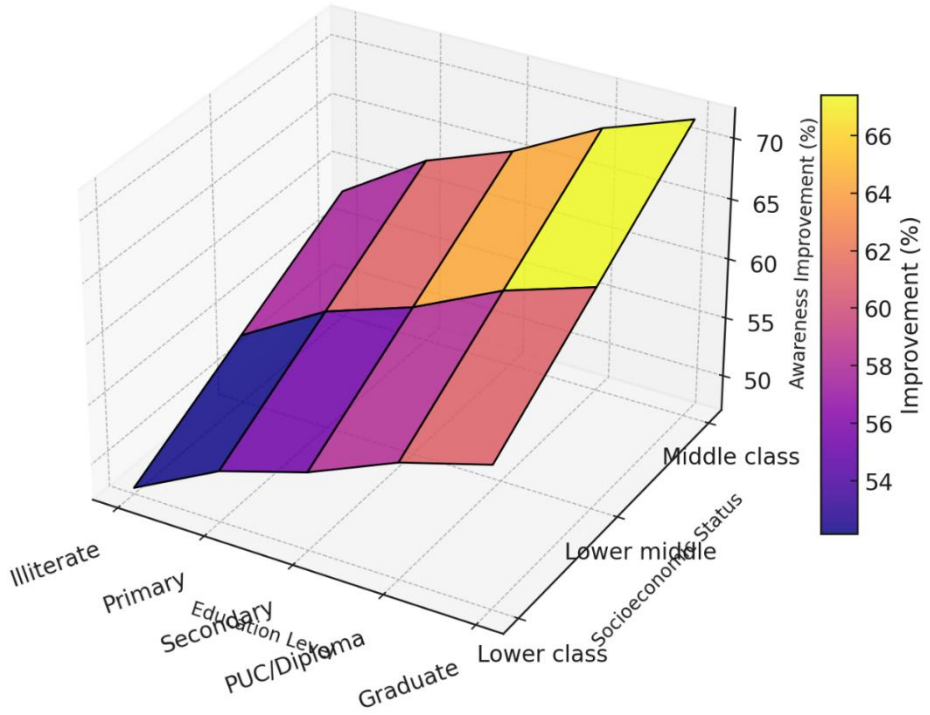


Figure 6: Response surface plot showing effect of maternal education and socioeconomic status on awareness improvement

4. DISCUSSION

The present study demonstrated that pharmacist-led education significantly improved maternal knowledge, attitudes, and practices (KAP) regarding childhood immunization. At baseline, substantial gaps were identified: only about one-fourth of mothers were aware that unvaccinated children were at high risk of contracting preventable diseases, and misconceptions surrounding the perceived harms of vaccines were widespread. These findings underscore persistent challenges in maternal understanding, which may compromise adherence to vaccination schedules. Post-intervention improvements in overall KAP scores highlight the effectiveness of structured educational programs in bridging these gaps.

Comparison with Previous Studies

The observed improvements in maternal awareness and practices following the intervention are consistent with evidence from other settings in India and abroad. For instance, Abraham et al. (2020) demonstrated that structured community-based health education significantly improved maternal knowledge scores regarding immunization, reporting an increase from 6.45 to 9.72 on a 12-point scale. Similarly, D'Souza et al. (2018) found that informational pamphlets distributed to antenatal women improved their knowledge and vaccine-related attitudes, highlighting the role of simple, low-cost educational tools in rural communities. International findings also corroborate these outcomes. Larson et al. (2014) reported that health education interventions in sub-Saharan Africa and Southeast Asia substantially reduced vaccine hesitancy and improved uptake, particularly when delivered through trusted community health workers. More recently, Ndirangu et al. (2021) demonstrated in Kenya that maternal group counselling improved adherence to the national immunization schedule, while Tran et al. (2020) observed similar results in Vietnam. These parallels emphasize the universal relevance of maternal education as a strategy to strengthen vaccine coverage.

Role of Pharmacists in Vaccine Education

A notable strength of this study lies in its pharmacist-led approach. Pharmacists are among the most accessible healthcare providers, often interacting with patients more frequently than physicians. Globally, their role as vaccine advocates, administrators, and educators has expanded considerably (Drozd et al., 2017; FIP, 2019). In countries such as the United States, United Kingdom, and Canada, pharmacist-led immunization services have not only improved vaccination rates but also increased public trust in vaccines (Isenor et al., 2016). In India, pharmacists' roles have traditionally been limited to

storage, supply-chain management, and dispensing of vaccines under the Universal Immunization Programme (UIP) (Siddiqui & Alam, 2021). However, the findings of this study provide empirical evidence that pharmacists can also be effective in delivering maternal health education. This dual role is particularly valuable in resource-constrained settings, where physicians and nurses are often overburdened with curative responsibilities. By complementing the work of other healthcare professionals, pharmacists can play a key role in achieving the WHO's global immunization targets.

Influence of Socio-Demographic Factors

Socio-demographic analysis in this study revealed that maternal education and socioeconomic status were strongly associated with baseline knowledge, echoing the findings of Pandey et al. (2019). Illiterate or low-literate mothers consistently recorded lower pre-test scores, while those with higher education exhibited better awareness and attitudes. This gradient reflects broader inequities in health literacy, which influence health-seeking behavior and access to preventive services (Nutbeam, 2008).

Encouragingly, the intervention benefitted all groups regardless of literacy level, demonstrating the adaptability of pharmacist-led education. For women with limited formal education, audiovisual aids, vernacular translations, and interactive discussions proved particularly effective. Such tailored strategies are critical to reducing disparities and ensuring that health education is inclusive and equitable.

Improvements in Practices and Behavioural Outcomes

One of the most encouraging findings was the improvement in vaccination practices, particularly with respect to timeliness and record-keeping. Prior to the intervention, a significant proportion of participants were unaware of the importance of maintaining the Mother and Child Protection (MCP) card. Post-intervention, a marked increase in record maintenance was observed, which is vital for monitoring vaccine adherence. Delayed or missed vaccinations prolong the window of susceptibility to infections, increasing the likelihood of outbreaks (Mishra et al., 2020). By reinforcing the significance of timely vaccination, the pharmacist-led intervention contributed not only to improved maternal awareness but also to sustainable behavioural change. Similar outcomes were reported by Yadav et al. (2019), who found that antenatal counselling significantly improved on-time vaccine uptake among infants in rural India.

Strengths of the Study

Several strengths merit acknowledgment. First, this is among the few studies in India to evaluate the role of pharmacists in maternal immunization education, thereby contributing novel insights into expanding their scope of practice. Second, the pre-test/post-test design allowed for robust measurement of change attributable to the intervention. Third, the use of validated, pre-tested questionnaires and standardized educational materials minimized measurement bias and enhanced internal validity.

Limitations

Nonetheless, some limitations must be considered when interpreting the results. Being a single-center study conducted at a tertiary care hospital, the findings may not be fully generalizable to other regions, particularly remote rural areas with limited healthcare access. The short follow-up duration of one month restricted the ability to evaluate long-term sustainability of improved practices or actual vaccine uptake for children after birth. Future studies with longer follow-up periods could ascertain whether the behavioural improvements observed translate into higher immunization coverage rates. Additionally, reliance on self-reported practices introduces the possibility of recall or social desirability bias, where participants may have overstated positive behaviours during post-test assessments. Triangulating data with immunization records of delivered children could mitigate this limitation in future studies. Finally, the use of convenience sampling may have introduced selection bias, although efforts were made to recruit women from both outpatient and inpatient settings to ensure diversity.

Implications for Policy and Practice

Despite these limitations, the findings have important implications for public health policy. The WHO (2019) has identified vaccine hesitancy as one of the top ten global health threats, emphasizing the need for innovative, community-based solutions. In India, where the government is striving to achieve >90% full immunization coverage under the Intensified Mission Indradhanush (IMI 3.0), incorporating pharmacists into maternal and child health programs could be a cost-effective strategy to close existing gaps.

Given their accessibility, pharmacists could be systematically trained and deployed as immunization educators, particularly in semi-urban and rural areas where physician density is low. Integrating pharmacist-led education into routine antenatal care could normalize vaccine literacy and foster greater maternal empowerment. Moreover, scaling such interventions through government health schemes, professional pharmacy bodies, and collaborations with community health workers could amplify their impact. In inference, the present study provides compelling evidence that pharmacist-led education is an effective intervention for improving maternal KAP regarding childhood immunization. It highlights the feasibility of leveraging pharmacists as frontline health educators in India, a role that aligns with international trends in pharmacy

practice. Addressing maternal knowledge gaps, dispelling myths, and reinforcing positive practices through structured educational programs could significantly contribute to India's immunization goals. Future research should explore multi-center trials, longer-term follow-up, and integration of pharmacists into national immunization campaigns to sustain and expand these benefits.

5. CONCLUSION

This prospective interventional study demonstrated that pharmacist-led education significantly enhanced pregnant women's knowledge, attitudes, and practices regarding childhood immunization in Kalaburagi, Karnataka. The baseline assessment revealed substantial deficiencies, including widespread misconceptions about vaccine safety, limited awareness of immunization schedules, and poor documentation practices such as irregular use of the Mother and Child Protection card. These gaps mirror national challenges, where vaccine hesitancy, misinformation, and socioeconomic disparities continue to hinder the achievement of optimal immunization coverage. Following the pharmacist-led intervention, considerable improvements were documented across all domains of KAP. Awareness scores increased more than threefold, and positive changes were observed in attitudes and practices, including greater acceptance of vaccines, improved adherence to recommended schedules, and better maintenance of immunization records. These results emphasize the transformative potential of structured, targeted education in empowering mothers as key decision-makers for child health. A notable strength of this study lies in its pharmacist-driven model. Pharmacists, as highly accessible healthcare professionals, are uniquely positioned to deliver community-based health education. Their integration into maternal and child health programs could complement the work of physicians and nurses, especially in resource-limited settings where healthcare providers are often overburdened. By leveraging their accessibility and trust within communities, pharmacists can play a pivotal role in reducing vaccine hesitancy and strengthening confidence in immunization programs. The findings highlight the need for policy frameworks that formally recognize and expand pharmacists' roles in public health initiatives. Future research should focus on multi-center studies to improve generalizability, long-term follow-up to assess sustained behavioural outcomes, and the incorporation of digital platforms to scale education. Such strategies will be critical for achieving universal vaccine coverage and safeguarding child health in India.

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