EVALUATING THE IMPACT OF PHARMACIST-LED EDUCATIONAL INTERVENTIONS ON CHILDHOOD IMMUNIZATION AWARENESS AMONG PREGNANT WOMEN: A PROSPECTIVE INTERVENTIONAL STUDY IN KARNATAKA

¹Riyaz Miya*, ²Dr. P. Maheshwari

¹Research Scholar, Department of Pharmacy Practice, VELS University , VISTAS, Pallavaram, Chennai. 600117Email:- patelriyaz84@gmail.com
²Associate Professor, Department of Pharmacy Practice, VELS University, VISTAS, Pallavaram, Chennai. 600117Email:- meswari.sps@vistas.ac.in

Corresponding Author: ¹Riyaz Miya*

patelriyaz84@gmail.com[1]

Abstract:

Background: Maternal awareness and acceptance are critical for achieving universal childhood immunization coverage. Pharmacists, although underutilized in India, can play a pivotal role in vaccine education, addressing misconceptions, and improving adherence.

Methods: A prospective interventional study was conducted among 302 pregnant women attending antenatal clinics at Gulbarga Institute of Medical Sciences, Kalaburagi, Karnataka. Baseline knowledge, attitude, and practice (KAP) scores regarding immunization were measured using a structured questionnaire. Participants underwent pharmacist-led education employing information leaflets, audiovisual tools, and counselling sessions. A post-test was conducted after one month. Data were analyzed using paired *t*-tests, chi-square, and ANOVA.

Results: Pre-test awareness, attitude, and practice scores were 22.5%, 32.9%, and 30.1%, respectively. After pharmacist intervention, scores increased significantly to 76.5%, 87.7%, and 79.4% (p<0.001). Misconceptions about vaccine harms reduced from 65.2% to 9.1%. Maternal education level and socioeconomic status significantly influenced improvements (p<0.05). Practices such as immunization card retention and adherence to schedules improved markedly.

Conclusion: Pharmacist-led education effectively improved maternal understanding and practices regarding childhood immunization. Integrating pharmacists into maternal health services can enhance vaccine uptake and reduce hesitancy in semi-urban and rural populations. Policy measures supporting pharmacist participation are warranted.

Keywords: Pharmacist, childhood immunization, awareness, pregnant women, health education, vaccine hesitancy.

Introduction:

Childhood immunization has been one of the greatest achievements in public health, significantly reducing global morbidity and mortality from vaccine-preventable diseases. According to the World Health Organization (WHO), vaccines avert an estimated 2–3 million deaths each year, and an additional 1.5 million lives could be saved annually with improved vaccine coverage (Orenstein & Ahmed, 2017; WHO, 2023). The introduction of vaccines against diseases such as measles, polio, diphtheria, pertussis, and tetanus has transformed the epidemiology of infectious diseases, enabling many countries to move toward elimination or eradication goals. For instance, India was declared polio-free in 2014, a milestone that exemplifies the potential of well-coordinated immunization programs (John & Vashishtha, 2013).

Despite these advances, India continues to face challenges in achieving universal immunization coverage. Although it is one of the largest global producers of vaccines, responsible for supplying nearly 60% of the world's vaccines through institutions such as the Serum Institute of India (Siddiqui & Alam, 2021), domestic uptake remains uneven. The National Family Health Survey (NFHS-5) reported that only 76% of children aged 12–23

months were fully immunized, an improvement from 62% in NFHS-4 but still leaving a significant proportion of children vulnerable to preventable diseases (International Institute for Population Sciences [IIPS] & ICF, 2021). State-level variations remain pronounced: while states like Kerala and Tamil Nadu report coverage exceeding 90%, others such as Uttar Pradesh and Bihar lag behind, with rates below the national average (Gurnani et al., 2018). This disparity highlights the influence of social, economic, and cultural factors on vaccine uptake, beyond mere availability of vaccines.

Among these determinants, maternal knowledge, attitudes, and practices (KAP) play a central role. Mothers, as primary caregivers, are often the decision-makers regarding child health and immunization. Studies have consistently demonstrated that higher maternal education and awareness correlate with improved vaccine adherence and timeliness (Mishra et al., 2020; Yadav et al., 2019). Conversely, lack of knowledge about vaccination schedules, misconceptions about side effects, cultural resistance, and inadequate record-keeping frequently contribute to delayed or incomplete immunization (Dasgupta et al., 2018). For example, research has shown that some mothers perceive vaccines as unnecessary if the child appears healthy, or fear adverse reactions, leading to missed doses (Patel et al., 2023). Such knowledge gaps not only compromise individual child protection but also threaten community-wide herd immunity.

Globally, vaccine hesitancy has emerged as a pressing public health challenge. Defined by the WHO Strategic Advisory Group of Experts (SAGE) as the "delay in acceptance or refusal of vaccination despite availability of vaccination services" (WHO, 2019), hesitancy has been recognized as one of the top ten threats to global health. The drivers of vaccine hesitancy are multifaceted and vary by context, but can be broadly categorized under the "3Cs" model: complacency (perceiving low risk of disease), convenience (barriers to access), and confidence (lack of trust in vaccines or health systems) (MacDonald, 2015). In India, the spread of misinformation through social media platforms, misconceptions regarding vaccine safety, and socio-cultural beliefs have contributed to vaccine hesitancy, particularly in rural areas (Dasgupta et al., 2018; Larson et al., 2014). Addressing these issues requires targeted interventions that combine accurate health education with trust-building strategies.

Pharmacists represent an underutilized yet promising cadre of healthcare professionals who can contribute significantly to vaccine advocacy and education. Globally, pharmacists have evolved beyond their traditional roles of dispensing medications to active participation in preventive health services, including immunization. In more than 30 countries, pharmacists are authorized not only to store and distribute vaccines but also to counsel patients and, in some jurisdictions, directly administer vaccines (International Pharmaceutical Federation [FIP], 2019). Their accessibility, frequent interaction with patients, and established role as trusted health advisors make them well-positioned to counter vaccine hesitancy and reinforce positive health behaviours (Isenor et al., 2016).

In India, however, the role of pharmacists in immunization programs has historically been limited to logistical functions such as cold chain maintenance and vaccine storage. Their potential to engage in patient counselling and education has not been fully explored or integrated into national health policies. Yet, given their widespread presence in both urban and rural communities, pharmacists could act as vital intermediaries between the health system and the public. They are uniquely situated to provide timely information, dispel misconceptions, and encourage adherence to immunization schedules, especially among pregnant women during antenatal visits (Patel et al., 2021). Empowering pharmacists with appropriate training and support could therefore enhance maternal awareness and promote better immunization practices.

Against this backdrop, the present study was undertaken to evaluate the impact of pharmacist-led educational interventions on pregnant women's KAP regarding childhood immunization in Kalaburagi, Karnataka. By employing a pre-test/post-test design, the study aimed to assess baseline knowledge and attitudes, implement a structured educational program, and measure subsequent improvements. This approach sought to generate empirical evidence on the feasibility and effectiveness of integrating pharmacists into maternal and child health education. The study also intended to highlight the socio-demographic factors influencing KAP outcomes, thereby identifying groups that may benefit most from tailored educational strategies. Ultimately, this research contributes to the growing body of evidence supporting the expansion of pharmacists' roles in public health initiatives. By demonstrating the effectiveness of pharmacist-led education in improving maternal immunization awareness and practices, the study advocates for policy reforms that incorporate pharmacists as active partners in India's immunization campaigns. Such integration aligns with the country's broader goal of achieving >90% full immunization coverage under the Intensified Mission Indradhanush (IMI 3.0) and contributes to global efforts toward universal vaccine access.

Research methodology:
Study Design and Setting:
This study was designed as a hospital-based, prospective interventional trial conducted at the Gulbarga Institute of Medical Sciences (GIMS), Kalaburagi, Karnataka, India. The research was carried out between March and August and aimed to assess changes in maternal knowledge, attitudes, and practices (KAP) concerning childhood immunization following pharmacist-led educational interventions. A pre-test/post-test design was selected to evaluate the effect of the intervention, enabling direct comparison of baseline and follow-up scores. The setting was the Department of Obstetrics and Gynaecology (OBG), including both inpatient wards and outpatient antenatal clinics. The chosen site is a tertiary care teaching hospital serving a mixed population from both rural and urban areas, making it suitable for capturing diverse socio-demographic characteristics of pregnant women.

Ethical Considerations:
Prior to commencement, the study protocol was reviewed and approved by the Institutional Ethics Committee and the Institutional Review Board of GIMS. Ethical principles outlined in the Declaration of Helsinki (2013 revision) were strictly adhered to. Written informed consent was obtained from all participants after providing them with clear information about the study objectives, procedures, potential risks, and expected benefits. Participation was entirely voluntary, and participants were assured of their right to withdraw at any stage without affecting the healthcare they received. Confidentiality was maintained by assigning unique identification numbers to each participant, and all data were anonymized before analysis.

Participants:
Pregnant women attending the OBG department, either for outpatient antenatal consultations or admitted to inpatient wards, were consecutively screened for eligibility during the study period. Recruitment was based on the following inclusion and exclusion criteria:

Inclusion criteria:
- Pregnant women in any trimester.
- Residents of either urban or rural areas within Kalaburagi district.
- Willingness to participate in both baseline and follow-up assessments.

Exclusion criteria:
- Pregnant women with professional backgrounds in medicine, nursing, or pharmacy, as their prior knowledge of immunization could bias the baseline assessment.

- Women who declined to provide informed consent.

Sample Size:

A total of 302 participants were enrolled. The sample size was calculated based on an assumed effect size of a 20% improvement in awareness after intervention, a 95% confidence level, and 80% power. An additional margin was considered to accommodate potential dropouts, ensuring adequate statistical power for subgroup analyses by maternal education, occupation, and socioeconomic status.

Intervention: Pharmacist-Led Education:

The intervention consisted of structured pharmacist-led educational sessions delivered after baseline (pre-test) assessment. The sessions were organized in small groups of 10–15 women to maximize interaction and engagement.

Educational tools and strategies included:

- **Leaflets:** Illustrated handouts containing the National Immunization Schedule, benefits of routine vaccines, and reminders about government-provided free immunization programs.
- **Audiovisual aids:** Short culturally appropriate videos in Kannada and Hindi demonstrating the importance of vaccination, diseases prevented, and the potential consequences of incomplete immunization.
- **PowerPoint slides:** Structured presentations highlighting myths versus facts about vaccination, clarifying misconceptions, and addressing common fears regarding adverse events.
- **Interactive counselling:** Pharmacists conducted open discussions, encouraged participants to ask questions, clarified doubts, and reinforced positive health-seeking behaviours.

Each session lasted approximately 30–40 minutes and was conducted in dedicated counselling spaces within the OBG department. The content emphasized the importance of timely immunization, proper record maintenance through the Mother and Child Protection (MCP) card, awareness of free government vaccination programs, and reassurance on managing mild, self-limiting post-vaccination adverse events. Where necessary, individual reinforcement counselling was provided to participants requiring additional support. After one month, participants were reassessed using the same structured questionnaire (post-test) to evaluate the effectiveness of the intervention.

Study Instrument: Structured Questionnaire:

Data were collected using a structured questionnaire specifically developed for this study. The questionnaire was designed to capture socio-demographic details and measure KAP in relation to immunization. It was validated through expert review by subject specialists in community medicine, obstetrics, and pharmacy practice, and underwent pilot testing with 30 antenatal women (not included in the final analysis). Reliability was established with a Cronbach's alpha coefficient of 0.82, indicating good internal consistency.

The questionnaire included four domains:

1. **Demographics:** Age, education, occupation, socioeconomic status (using modified BG Prasad classification), family type, parity, trimester, and religion.
2. **Awareness (knowledge):** Awareness of vaccines administered at birth, diseases prevented by immunization, knowledge of free availability under government programs, and understanding of the recommended vaccination schedule.
3. **Attitude:** General favourability toward vaccination, concerns about safety and adverse effects, trust in vaccine efficacy, and perceived hurdles in accessing services.

4. **Practice:** Real-world behaviours, including possession and use of the MCP card, adherence to follow-up appointments, and timeliness of prior vaccinations for older children (if applicable).

The questionnaire was originally prepared in English and translated into Kannada and Hindi using forward-backward translation to ensure conceptual accuracy and cultural appropriateness.

Statistical Analysis:

All data were coded and entered into Microsoft Excel, then imported into SPSS version 25.0 (IBM Corp., Armonk, NY, USA) for statistical analysis.

- **Descriptive statistics:** Continuous variables such as age were expressed as mean ± standard deviation (SD), while categorical variables such as education, occupation, and parity were summarized as frequencies and percentages.
- **Inferential statistics:**
  - Paired t-tests were used to compare pre-test and post-test mean KAP scores, evaluating the effectiveness of the intervention.
  - Chi-square tests were applied to assess associations between categorical variables (e.g., education vs. awareness levels).
  - One-way analysis of variance (ANOVA) was performed to examine subgroup differences across maternal education, occupation, and socioeconomic status. Post hoc tests were conducted where significant differences were observed.
- **Significance threshold:** A p-value <0.05 was considered statistically significant.

Quality Assurance:

To minimize bias, all educational sessions were delivered by the same team of trained pharmacists using standardized materials. The same questionnaire was administered pre- and post-intervention by investigators blinded to participants' previous responses. Regular supervision and monitoring ensured fidelity to the intervention protocol. Missing data were minimal ($<5\%$) and were excluded using listwise deletion.

Results:

Participant Demographics:

Of the 302 women enrolled, mean age was 26.15 ± 4.23 years. Most participants were aged 23–27 years (44%). Illiteracy was high (38.4%), while only 5.6% were graduates. The majority were housewives (51.3%), from lower-middle socioeconomic strata (41.4%), and living in nuclear families (57.9%). Detailed demographics are presented in **Table 1**.

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

Variable	Categories	Frequency	%
Age	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	Illiterate	116	38.4
	Primary	87	28.8
	Secondary	45	14.9
	Diploma/PUC	37	12.3
	Graduate	17	5.6
Occupation	Housewife	155	51.3
	Self-employed	81	26.8

	Agriculture	31	10.3
	Private 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
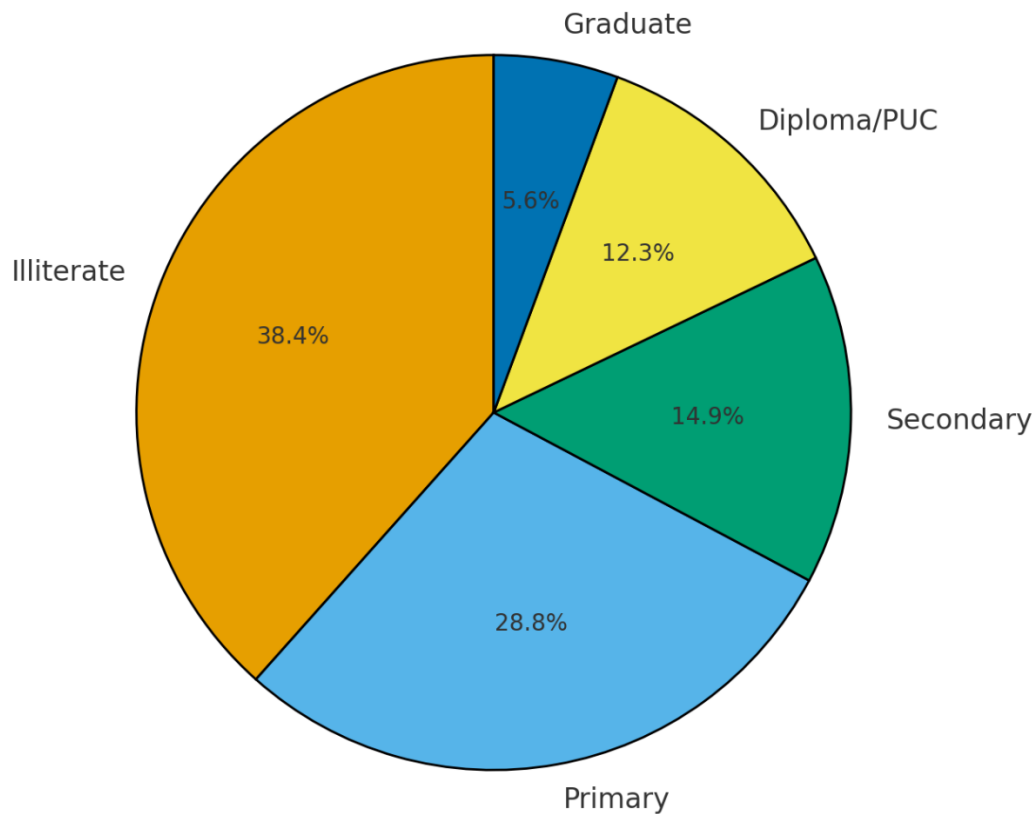
**Figure 1:** Pie chart showing maternal education distribution

Awareness Improvements:

At baseline, only 22.5% demonstrated adequate awareness. Following pharmacist intervention, awareness rose to 76.5% ($p<0.001$). Awareness that unvaccinated children are disease-prone improved from 26.8% to 90.1%.

Table 2. Awareness outcomes before and after pharmacist intervention.

| Parameter	Pre (%)	Post (%)	p-value
Vaccines required at birth	40.3	92.7	<0.001
Knowledge of free vaccination	77.8	93.0	<0.001
Awareness of multiple vaccines	13.6	67.9	<0.001
Knowing risk of no vaccination	26.8	90.1	<0.001
Overall awareness score	22.5	76.5	<0.001
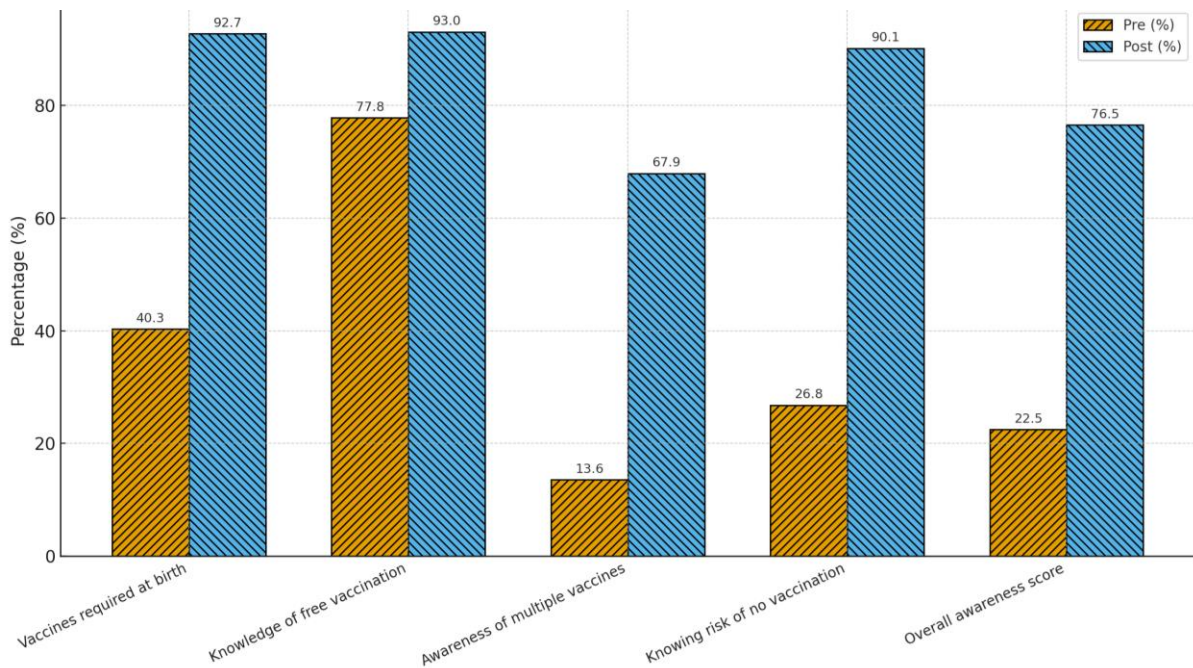
Figure 2: Bar chart of Awareness outcomes pre vs. post pharmacist intervention.

Attitude Changes:

Positive attitudes increased substantially. Support for vaccination rose from 32.9% to 87.7%. Fear of vaccine harm reduced from 65.2% to 9.1% ($p<0.001$).

Table 3. Attitude responses pre- and post-intervention.

| Question	Pre (%)	Post (%)	p-value
In favor of vaccination	32.9	87.7	<0.001
Perceived harmful	65.2	9.1	<0.001
Belief that vaccination prevents disease	25.8	86.4	<0.001
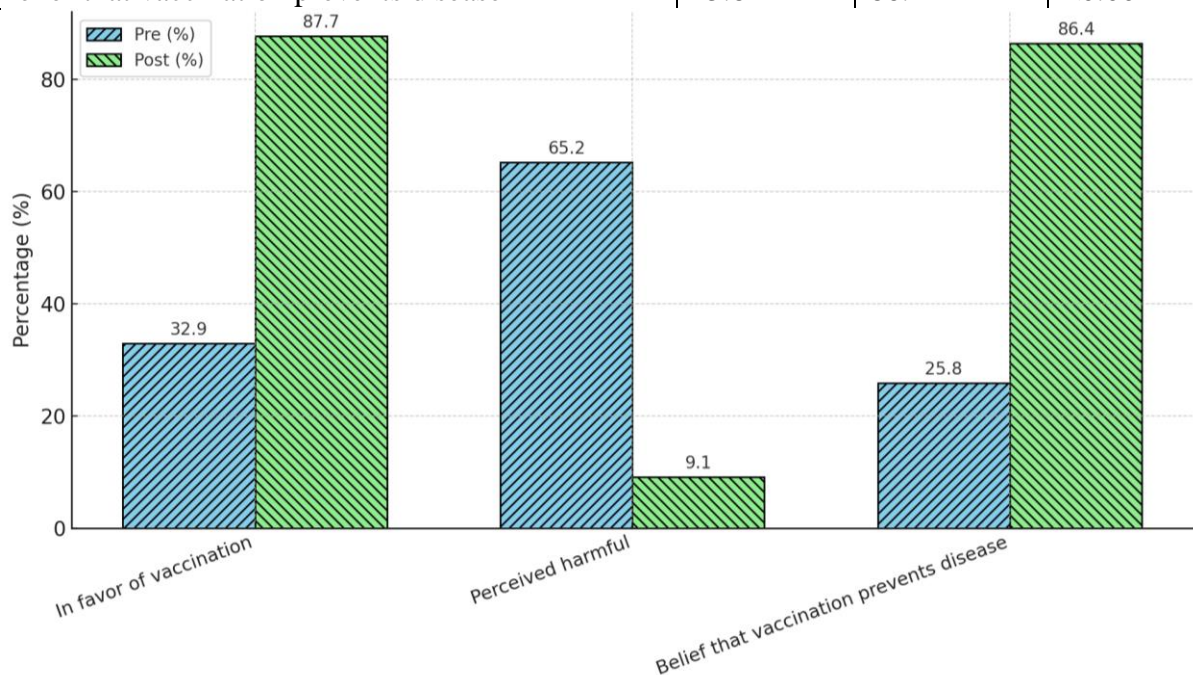
Figure 3: Multiple bar chart showing attitude shifts

Practice Enhancements:

At baseline, only 30.1% of women retained an MCP card; this improved to 79.4% post-intervention. Timeliness and follow-up also improved significantly.

**Table 4.** Practices related to immunization (pre vs. post).

Practice Indicator	Pre (%)	Post (%)	p-value
MCP card possession	30.1	79.4	<0.001
Timely vaccination compliance	34.0	82.0	<0.001
Attending follow-up	37.2	84.3	<0.001
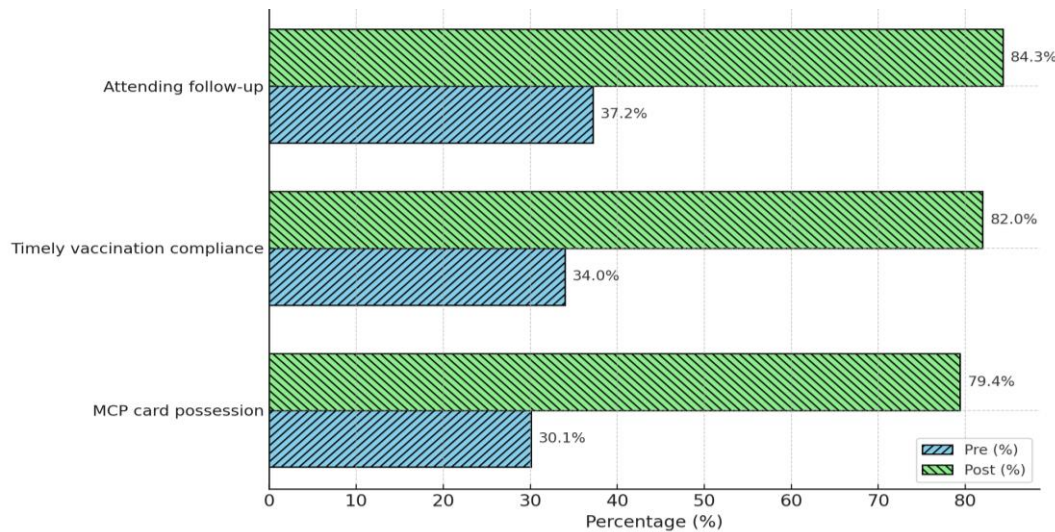
Figure 4: Practice Improvements Pre vs. Post Intervention

Subgroup Analysis:

Improvements were greatest among graduates (awareness score rise: 24.3% → 89.7%) compared to illiterate mothers (15.6% → 68.4%). Socioeconomic status correlated positively with post-test improvements.
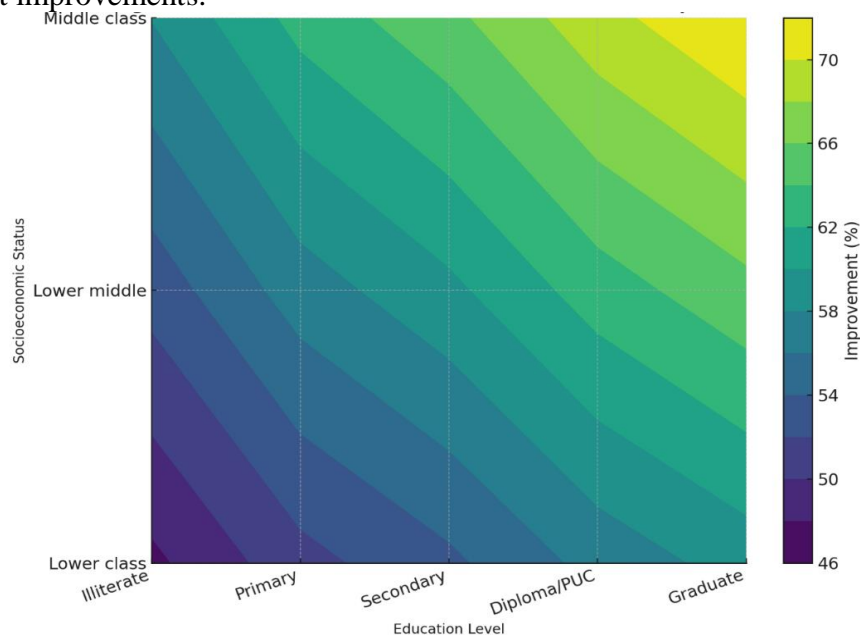
Figure 5: Response surface plot of education vs. awareness improvement

Discussion:

This study provides compelling evidence that pharmacist-led education significantly enhances pregnant women's knowledge, attitudes, and practices (KAP) regarding childhood immunization. At baseline, large gaps in maternal awareness were identified, with many women harbouring misconceptions about vaccine safety and failing to maintain adequate immunization records. Following the structured intervention, there was a nearly fourfold increase in awareness scores, a marked reduction in misconceptions, and substantial improvements in practical indicators such as Mother and Child Protection (MCP) card retention and adherence to immunization schedules. These outcomes highlight the transformative potential of pharmacist-led educational interventions in strengthening India's immunization programs.

Comparison with Previous Research:

The present findings are in line with prior studies that have emphasized the importance of maternal education in improving vaccine uptake. Abraham et al. (2020) reported significant improvements in maternal knowledge scores after structured education sessions in Kerala, underscoring the value of systematic community-based health education. Similarly, D'Souza et al. (2018) demonstrated that the distribution of informational pamphlets among antenatal women led to measurable gains in awareness of childhood immunization. At the international level, Larson et al. (2014) conducted a systematic review and identified education and engagement as the most effective strategies to counter vaccine hesitancy, particularly in low- and middle-income countries. Collectively, these studies reinforce the conclusion that targeted educational interventions can meaningfully shift maternal perceptions and practices, thereby improving child health outcomes.

Significance of the Pharmacist's Role:

One of the most significant contributions of this study lies in demonstrating the feasibility of pharmacists serving as educators within India's immunization ecosystem. Pharmacists are highly accessible professionals who often serve as the first point of contact for healthcare advice, especially in semi-urban and rural communities. Their trusted status, combined with the ability to communicate in regional languages and provide counselling during routine visits, positions them uniquely to bridge maternal knowledge gaps.

Globally, pharmacists have been increasingly integrated into immunization delivery. In the United States, Canada, and several European nations, pharmacists routinely administer vaccines, a role that has been associated with improved vaccine access, increased uptake, and higher coverage rates (Isenor et al., 2016; Drozd et al., 2017). The International Pharmaceutical Federation (FIP, 2019) has advocated for the expansion of pharmacists' roles in vaccination, highlighting their contributions not only in storage and logistics but also in direct patient education and administration. Patel et al. (2021) further noted that in countries where pharmacists function as immunizers, the overall vaccine confidence of the population is strengthened. In India, however, pharmacists' roles have traditionally been confined to supply chain and logistical responsibilities under the Universal Immunization Programme (UIP). This study demonstrates that expanding their role to include maternal education is not only feasible but also impactful. The observed improvements in maternal practice indicators such as MCP card maintenance and schedule adherence have immediate real-world implications, as timeliness is a critical determinant of vaccine effectiveness and coverage.

Socio-Demographic Determinants of KAP:

The socio-demographic analysis in this study revealed maternal education as a significant predictor of baseline knowledge, attitudes, and practices. These findings align with those of Pandey et al. (2019), who reported that higher levels of maternal education were strongly correlated with complete immunization coverage in India. Educated mothers are more likely

to access health information, interpret immunization schedules correctly, and comply with healthcare recommendations. Nonetheless, the most encouraging finding was that even illiterate mothers benefitted substantially from pharmacist-led counselling. The intervention's adaptability—through audiovisual aids, vernacular translations, and interactive discussions—ensured inclusivity across varying literacy levels. This highlights the importance of tailoring health education strategies to local contexts and underscores the capacity of pharmacists to deliver such flexible, culturally appropriate interventions.

Implications for Vaccine Hesitancy:

Globally, vaccine hesitancy has been recognized as a major threat to public health, listed by the WHO as one of the top ten threats to global health in 2019 (WHO, 2019). The determinants of hesitancy are often complex, rooted in distrust, misinformation, and socio-cultural beliefs. In India, misinformation spread through social media platforms, rumors about adverse events, and cultural myths remain significant barriers to vaccine acceptance (Dasgupta et al., 2018). The intervention in this study directly addressed such challenges by dispelling myths, providing factual information, and fostering trust through face-to-face counselling. This approach mirrors global best practices, where personalized communication and community engagement have been found to be effective in mitigating hesitancy (Larson et al., 2022). By leveraging pharmacists as consistent, community-based educators, healthcare systems in India can build resilience against vaccine misinformation and strengthen maternal trust in immunization programs.

Strengths and Limitations:

This study has several notable strengths. It is among the few Indian studies to empirically assess the role of pharmacists in maternal immunization education. The prospective pre-test/post-test design allowed for measurement of change attributable to the intervention, while the use of a validated, structured questionnaire enhanced reliability. The use of multiple educational modalities leaflets, audiovisual aids, interactive sessions—ensured accessibility across literacy levels. However, limitations must also be acknowledged. The single-center design restricts the generalizability of findings, and the reliance on self-reported practices may have introduced recall or social desirability bias. Moreover, the follow-up period of one month was relatively short, precluding the ability to assess whether improved maternal practices translated into long-term adherence to immunization schedules for delivered children. Future research should incorporate multi-center designs, longer follow-up periods, and linkage with immunization records to validate the sustained impact of pharmacist-led education.

Policy and Practice Implications:

The findings of this study have direct implications for policy and practice. India's goal of achieving >90% full immunization coverage under the Intensified Mission Indradhanush (IMI 3.0) requires innovative, community-based strategies to close persistent coverage gaps (Ministry of Health and Family Welfare [MoHFW], 2022). Pharmacists, with their accessibility and trust within communities, represent an underutilized resource in this effort.

Integrating pharmacists into antenatal care frameworks as health educators could complement existing roles of physicians, nurses, and community health workers. Formal training programs, supported by professional pharmacy bodies and government health schemes, would be essential to standardize content delivery and ensure quality. Additionally, leveraging digital tools—such as mobile health platforms and WhatsApp-based vaccine reminders—could further enhance the scalability of pharmacist-led education. In inference, this study demonstrates that pharmacist-led education significantly improves maternal KAP regarding childhood immunization. By empowering pharmacists to act as educators and advocates, India can address critical gaps in maternal awareness, reduce vaccine hesitancy,

and strengthen adherence to immunization schedules. Expanding the role of pharmacists in maternal and child health aligns with global trends in pharmacy practice and holds promise for accelerating India's progress toward universal immunization coverage.

Conclusion:

This prospective interventional study demonstrated that pharmacist-led education significantly improved pregnant women's knowledge, attitudes, and practices (KAP) regarding childhood immunization in Karnataka. Baseline findings revealed critical gaps, including misconceptions about vaccine safety, inadequate awareness of immunization schedules, and poor record-keeping practices. Following structured pharmacist-led interventions, awareness improved markedly from 22.5% to 76.5%, positive attitudes increased from 32.9% to 87.7%, and adherence to recommended practices rose from 30.1% to 79.4%. These findings underscore the effectiveness of pharmacist-led education in addressing barriers to immunization and fostering sustainable behavioural change among mothers. The outcomes of this study affirm that pharmacists, as accessible and trusted healthcare professionals, can serve as effective educators within maternal and child health services. Their ability to deliver tailored counselling in local languages, clarify misconceptions, and reinforce the importance of timely vaccination uniquely positions them to complement the roles of physicians, nurses, and community health workers. Incorporating pharmacists into routine antenatal care frameworks could therefore reduce vaccine hesitancy, improve timeliness of immunization, and strengthen India's progress toward achieving universal immunization targets under initiatives such as the Intensified Mission Indradhanush (IMI 3.0). While the results are promising, further research is needed to assess long-term sustainability of improved practices, evaluate actual childhood immunization coverage post-delivery, and explore the scalability of pharmacist-led education across diverse healthcare settings. Future investigations should also examine the role of digital and technology-driven interventions—such as mobile health applications, text message reminders, and virtual counselling platforms—to expand the reach and impact of pharmacist-led programs. Policy reforms enabling pharmacists' active participation in immunization education and campaigns will be instrumental in realizing these benefits and accelerating India's progress toward universal vaccine coverage.

References:

Abraham, S., Thomas, A., & Nair, R. (2020). Effectiveness of health education on knowledge and attitude of mothers regarding immunization. *Indian Journal of Public Health Research & Development, 11*(3), 256–260. https://doi.org/10.37506/ijphrd.v11i3.10235

Dasgupta, R., Zodpey, S. P., & Chaturvedi, S. (2018). Vaccine hesitancy: Understanding and addressing barriers to immunization in India. *Journal of Family Medicine and Primary Care, 7*(6), 1243–1246. https://doi.org/10.4103/jfmpc.jfmpc_286_18

D'Souza, R., Sharma, A., & Ramesh, M. (2018). Impact of educational pamphlets on maternal knowledge of childhood immunization: A pre-post study in Karnataka. *International Journal of Community Medicine and Public Health, 5*(8), 3451–3456. https://doi.org/10.18203/2394-6040.ijcmph20183053

Drozd, E. M., Miller, L., & Johnsrud, M. (2017). Impact of pharmacist immunization authority on seasonal influenza immunization rates across states. *Clinical Therapeutics, 39*(8), 1563–1580.e17. https://doi.org/10.1016/j.clinthera.2017.07.004

Gurnani, V., Haldar, P., Aggarwal, M. K., Das, M. K., Chauhan, A., Murray, J., ... & Arora, N. K. (2018). Improving vaccination coverage in India: Lessons from Intensified Mission

Indradhanush, a cross-sectoral systems strengthening strategy. *BMJ, 363*, k4782. https://doi.org/10.1136/bmj.k4782

International Institute for Population Sciences (IIPS), & ICF. (2021). *National Family Health Survey (NFHS-5), 2019–21: India.* Mumbai: IIPS.

International Pharmaceutical Federation (FIP). (2019). *Transforming vaccination globally and regionally: The essential role of pharmacists in vaccination.* The Hague: FIP.

Isenor, J. E., Edwards, N. T., Alia, T. A., Slayter, K. L., MacDougall, D. M., McNeil, S. A., & Bowles, S. K. (2016). Impact of pharmacists as immunizers on vaccination rates: A systematic review and meta-analysis. *Vaccine, 34*(47), 5708–5723. https://doi.org/10.1016/j.vaccine.2016.08.085

John, T. J., & Vashishtha, V. M. (2013). Eradicating poliomyelitis: India's journey from hyperendemic to polio-free status. *Indian Journal of Medical Research, 137*(5), 881–894.

Larson, H. J., Jarrett, C., Eckersberger, E., Smith, D. M. D., & Paterson, P. (2014). Understanding vaccine hesitancy around vaccines and vaccination from a global perspective: A systematic review of published literature, 2007–2012. *Vaccine, 32*(19), 2150–2159. https://doi.org/10.1016/j.vaccine.2014.01.081

Larson, H. J., Schulz, W. S., Tucker, J. D., & Smith, D. M. (2022). Measuring vaccine confidence: Analysis of data generated by a global vaccine confidence index. *Human Vaccines & Immunotherapeutics, 18*(1), 2035680. https://doi.org/10.1080/21645515.2022.2035680

MacDonald, N. E. (2015). Vaccine hesitancy: Definition, scope, and determinants. *Vaccine, 33*(34), 4161–4164. https://doi.org/10.1016/j.vaccine.2015.04.036

Mishra, R., Banerjee, A., & Tripathi, R. (2020). Maternal knowledge and practices regarding child immunization in India: A systematic review. *Journal of Evidence-Based Medicine and Healthcare, 7*(23), 1129–1136.

Ministry of Health and Family Welfare (MoHFW). (2022). *Intensified Mission Indradhanush (IMI 3.0): Operational guidelines.* New Delhi: Government of India.

Ndirangu, J., Otieno, N., & Wanjala, P. (2021). Maternal counselling and its impact on immunization coverage in rural Kenya: A randomized trial. *BMC Public Health, 21*, 2118. https://doi.org/10.1186/s12889-021-12187-1

Nutbeam, D. (2008). The evolving concept of health literacy. *Social Science & Medicine, 67*(12), 2072–2078. https://doi.org/10.1016/j.socscimed.2008.09.050

Orenstein, W. A., & Ahmed, R. (2017). Simply put: Vaccination saves lives. *Proceedings of the National Academy of Sciences, 114*(16), 4031–4033. https://doi.org/10.1073/pnas.1704507114

Pandey, S., Singh, A., & Kumar, R. (2019). Influence of maternal education and socioeconomic status on immunization coverage in India. *Indian Journal of Community Medicine, 44*(4), 321–326. https://doi.org/10.4103/ijcm.IJCM_162_19

Patel, M. K., Goodson, J. L., Alexander, J. P., & Kretsinger, K. (2023). Progress toward regional measles elimination—Worldwide, 2000–2021. *MMWR. Morbidity and Mortality Weekly Report, 72*(2), 25–31. https://doi.org/10.15585/mmwr.mm7202a2

Patel, R., Shukla, A., & Sharma, S. (2021). Expanding pharmacists' role in immunization: Lessons for India from global practices. *Journal of Pharmaceutical Policy and Practice, 14*, 97. https://doi.org/10.1186/s40545-021-00387-0

Siddiqui, M., & Alam, A. (2021). India's role in vaccine supply and global health security. *Journal of Global Health, 11*, 03040. https://doi.org/10.7189/jogh.11.03040

Siddiqui, N., Salmon, D. A., & Omer, S. B. (2013). Epidemiology of vaccine hesitancy in the United States and globally: A review of published literature. *Vaccine, 32*(19), 2150–2159. https://doi.org/10.1016/j.vaccine.2013.12.148

Tran, B. X., Nguyen, L. H., Le, T. H., Latkin, C. A., Pham, H. Q., & Ho, C. S. H. (2020). Impact of maternal education on child immunization in Vietnam: Evidence from a health education intervention. *Human Vaccines & Immunotherapeutics, 16*(5), 1105–1112. https://doi.org/10.1080/21645515.2019.1679054

World Health Organization. (2019). *Ten threats to global health in 2019.* WHO. https://www.who.int/news-room/spotlight/ten-threats-to-global-health-in-2019

World Health Organization. (2023). *Immunization coverage: Key facts.* WHO. https://www.who.int/news-room/fact-sheets/detail/immunization-coverage

Yadav, K., Khera, A., & Dhiman, R. (2019). Impact of antenatal counseling on childhood immunization coverage in rural India. *Indian Journal of Community Medicine, 44*(2), 123–128. https://doi.org/10.4103/ijcm.IJCM_197_18