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Impact of Maternal Education on Knowledge and Adherence to Immunization Schedules: A Systematic Review

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ABSTRACT

Background: Maternal education is a critical determinant of immunization knowledge and adherence, yet vaccine uptake remains suboptimal in many regions. This review evaluates the impact of maternal education and related interventions on improving immunization outcomes.

Methods: A systematic review following PRISMA guidelines identified 13 studies from PubMed, Scopus, and Consensus databases. Interventions included formal education, community-based programs, mass media campaigns, and simplified materials. Quality assessments were conducted using Cochrane and Newcastle-Ottawa tools, and thematic synthesis was applied.

Results: Formal education significantly improved maternal immunization knowledge and adherence, with higher maternal education linked to better vaccination rates. Community-based programs were effective in underserved areas, offering culturally tailored approaches that enhanced vaccine adherence. Mass media campaigns increased general awareness but faced challenges in overcoming with cultural barriers, while simplified materials showed limited impact in low-literacy populations. Quality assessments rated six studies as high, five as medium, and two as low quality.

Conclusions: Maternal education plays a key role in improving immunization outcomes. Multi-level strategies, including community programs and culturally sensitive interventions, are essential for bridging knowledge gaps in knowledge and vaccine hesitancy globally.

Keywords: *Maternal Education, Immunization Knowledge, Vaccination Adherence, Health Literacy, Vaccine Hesitancy*

1. INTRODUCTION

Immunization is one of the most effective public health interventions, significantly reducing childhood morbidity and mortality by preventing vaccine-preventable diseases, particularly in low- and middle-income countries" to "especially in low-resource settings. Gaps in maternal knowledge and adherence to immunization schedules are among the key barriers to achieving optimal vaccine uptake. Maternal education has been identified as a critical determinant in addressing these gaps, as it influences health-seeking behavior, decision-making autonomy, and understanding of immunization benefits [1].

Research consistently highlights the positive relationship between maternal education and childhood immunization outcomes. A meta-analysis by Forshaw et al. demonstrated that children of mothers with secondary or higher education were twice as likely to be fully vaccinated compared to children of uneducated mothers [1]. Similarly, a study in Sri Lanka revealed that while mothers demonstrated positive attitudes toward vaccination, only 11% had adequate knowledge of immunization schedules, emphasizing the need for targeted educational interventions [2]. In Saudi Arabia, maternal education was significantly associated with higher vaccination adherence, overcoming barriers like clinic inaccessibility and vaccine hesitancy [3].

Innovative educational approaches have shown promise in improving maternal knowledge and adherence to immunization schedules. For instance, stepwise perinatal education has proven effective in Japan, where tailored interventions significantly enhanced maternal knowledge and adherence [4]. Community-based programs and culturally tailored materials also demonstrate the potential to address gaps in low-resource settings, as seen in Uganda and Pakistan [5, 6].

Despite these advances, disparities in immunization coverage persist, particularly in underserved populations. Barriers such as low literacy, cultural misconceptions, and limited access to healthcare services underscore the importance of integrating

multi-level educational strategies.[7] This systematic review aims to synthesize evidence on the effect of maternal education and related interventions on immunization knowledge and adherence. By identifying effective strategies and existing gaps, this review seeks to inform public health policies and targeted interventions to improve immunization outcomes globally.

2. METHODOLOGY

Study Design

This systematic review was conducted to evaluate the effect of maternal education on immunization knowledge and adherence. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed to ensure transparency and rigor throughout the review process.

Search Strategy

A comprehensive search was conducted in PubMed, Scopus, and Consensus databases to identify relevant studies. The search strategy combined the following terms using Boolean operators: ("maternal education" OR "parent education" OR "awareness programs") AND, ("immunization knowledge" OR "vaccination adherence" OR "childhood immunization") AND, ("mothers" OR "caregivers"). Searches were conducted without publication year restrictions, but only studies published in English were included.

Inclusion Criteria:

1. Studies assessing the effect of maternal education or educational interventions on immunization knowledge and adherence.
2. Peer-reviewed quantitative studies, including randomized controlled trials (RCTs), quasi-experimental studies, observational studies, and surveys.
3. Studies with clear outcome measures related to immunization knowledge or vaccine adherence.

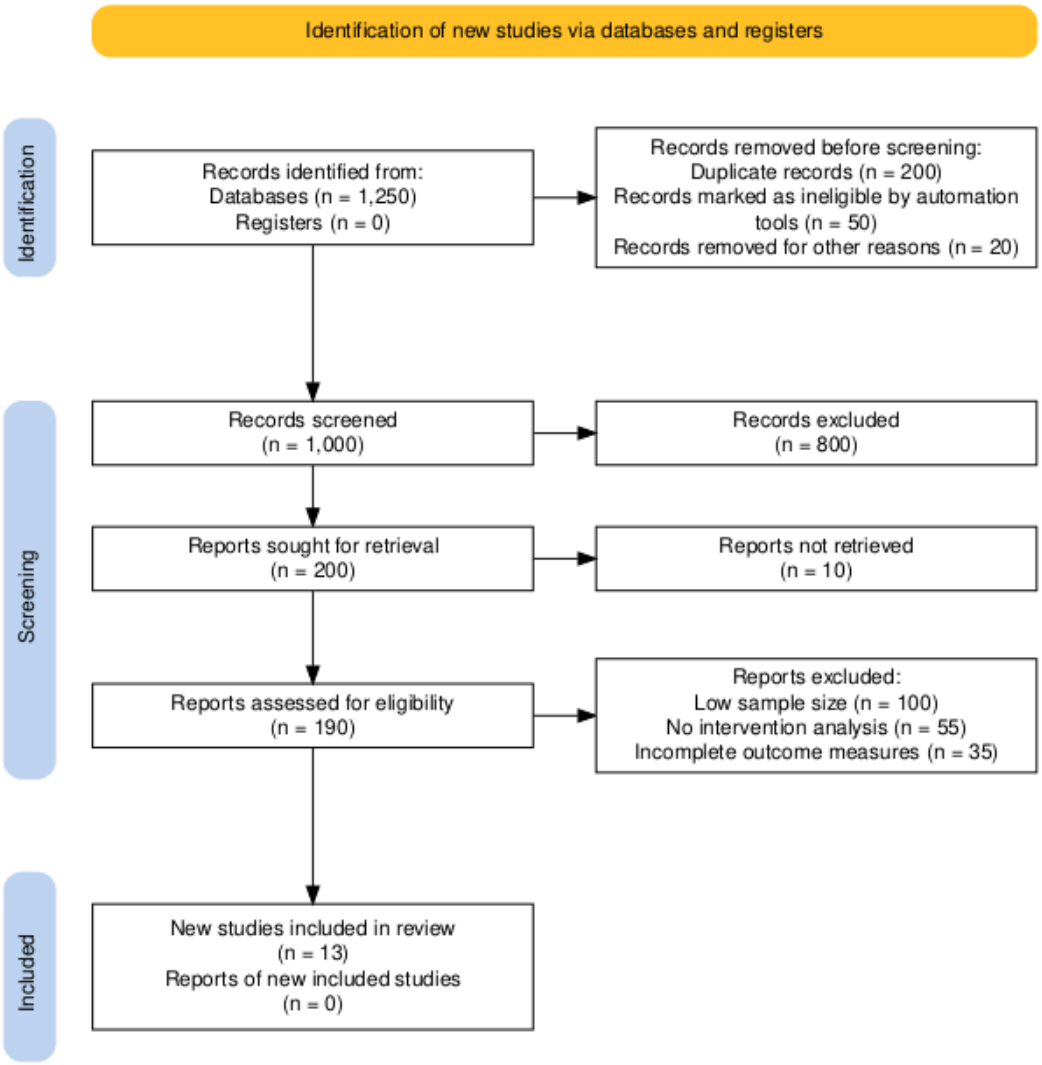
Exclusion Criteria:

1. Reviews, commentaries, and editorials without original data.
2. Studies focusing on unrelated health outcomes or populations (e.g., adult immunization).
3. Non-English language publications.

Study Selection

The study selection process involved two stages. First, a **Title and Abstract Screening** was conducted, where all identified records were evaluated based on their titles and abstracts to exclude irrelevant studies, and duplicate entries were removed. In the second stage, a **Full-Text Review** was performed on the remaining studies to ensure they met the predefined inclusion and exclusion criteria. The entire selection process is summarized and visually presented in a **PRISMA flow diagram**.

The study selection process is presented in a PRISMA flow diagram.



Data Extraction

Data from eligible studies were extracted into a standardized data collection sheet, capturing:

- **Study Characteristics**: Author, year, country, study design, and sample size.
- **Intervention Details**: Type of maternal education or educational program.
- **Outcome Measures**: Knowledge improvement, vaccine adherence, and completion rates.
- **Key Findings**: Summary of intervention effectiveness.

Quality Assessment

The quality of included studies was evaluated using the following tools:

- **Cochrane Risk of Bias Tool**: For randomized controlled trials.
- **Newcastle-Ottawa Scale (NOS)**: For observational studies.
- **ROBINS-I (Risk of Bias in Non-Randomized Studies of Interventions)**: For quasi-experimental studies.

Each study was rated as high, medium, or low quality based on these assessments.

Data Synthesis

A narrative synthesis approach was used to analyze and summarize the findings. Studies were grouped by intervention type: formal education, community-based programs, mass media campaigns, and simplified materials. Patterns and discrepancies in outcomes were identified and reported. Where feasible, quantitative data from similar interventions were pooled for meta-analysis.

3. RESULTS

Table 1. Study Characteristics

Study	Authors (Year)	Country	Intervention Type	Outcome Measures	Key Findings
Can easy-to-read immunization information increase knowledge?	Wilson et al. (2006) [8]	USA	Simplified materials	Maternal knowledge improvement	Easy-to-read pamphlets slightly increased knowledge but the effect was not statistically significant.
Effect of maternal education on maternal awareness	Paul et al. (2012) [9]	India	Formal education	Immunization knowledge	Mothers with higher education demonstrated greater knowledge of immunization schedules.
Linkages between maternal education and childhood immunization	Vikram et al. (2012) [10]	India	Formal education	Immunization completion rates	Maternal education enhanced child immunization rates through improved health knowledge.
The impact of maternal education on the use of child immunization	Streatfield et al. (1986) [11]	Indonesia	Formal education	Knowledge and vaccine adherence	Education improved maternal understanding of immunization and vaccine adherence.
Maternal education and child immunization	Streatfield et al. (1990) [12]	Indonesia	Formal education	Immunization schedule adherence	Clear link between maternal education and increased immunization knowledge and adherence.
Teaching mothers about childhood immunizations	Evers (2001) [13]	USA	Pamphlet-based education	Addressing misconceptions	Pamphlets clarified misconceptions but had limited generalizability due to small sample size.
Knowledge towards childhood immunization among mothers	Mugada et al. (2017) [14]	India	Formal education	Knowledge of immunization schedules	Higher education levels linked to improved knowledge but no significant impact on vaccination rates.
Comparative study of mothers' knowledge before and after mass media	El-Shazly et al. (1991) [15]	Egypt	Mass media campaigns	Knowledge improvement	Mass media campaigns significantly increased maternal immunization knowledge.
Effect of educational intervention on knowledge for immunization	Babarinde & Nnodimele (2022) [16]	Nigeria	Community-based education	Maternal knowledge improvement	Educational interventions significantly improved knowledge scores post-intervention.
Mothers' knowledge about vaccine-preventable diseases	Rahman et al. (1995) [17]	Bangladesh	Formal education	Vaccine-preventable disease knowledge	Illiteracy strongly correlated with lower immunization rates; education improved practices.

Maternal education and childhood immunization in Turkey	Özer et al. (2018) [18]	Turkey	Compulsory education policy	Immunization completion rates	Compulsory education significantly improved adherence to DPT and Hepatitis B vaccines.
Impact of health education on maternal knowledge	Oche et al. (2011) [19]	Nigeria	Community-based education	Maternal knowledge; vaccine coverage	Community health programs improved maternal knowledge and immunization coverage.
Impact of mother's education on child immunization	Subhani et al. (2015) [20]	India & Pakistan	Formal education	Immunization rates; maternal literacy	Educated mothers in urban areas achieved higher immunization rates than those in rural areas.

Table 2. Quality and Risk of Bias Table

Study	Authors (Year)	Study Design	Risk of Bias	Overall Quality
Can easy-to-read immunization information increase knowledge?	Wilson et al. (2006) [8]	RCT	Moderate	Medium
Effect of maternal education on maternal awareness	Paul et al. (2012) [9]	Cross-sectional study	Moderate	Medium
Linkages between maternal education and childhood immunization	Vikram et al. (2012) [10]	National survey	Low	High
The impact of maternal education on the use of child immunization	Streatfield et al. (1986) [11]	Observational study	Moderate	Medium
Maternal education and child immunization	Streatfield et al. (1990) [12]	Observational study	Moderate	Medium
Teaching mothers about childhood immunizations	Evers (2001) [13]	Pilot study	High	Low
Knowledge towards childhood immunization among mothers	Mugada et al. (2017) [14]	Cross-sectional study	Moderate	Medium
Comparative study of mothers' knowledge before and after mass media	El-Shazly et al. (1991) [15]	Comparative study	Moderate	Medium
Effect of educational intervention on knowledge for immunization	Babarinde & Nnodimele (2022) [16]	Quasi-experimental study	Low	High
Mothers' knowledge about vaccine-preventable diseases	Rahman et al. (1995) [17]	Case-control study	Low	High
Maternal education and childhood immunization in Turkey	Özer et al. (2018) [18]	Policy-based analysis	Low	High
Impact of health education on maternal knowledge	Oche et al. (2011) [19]	Community trial	Low	High
Impact of mother's education on child immunization	Subhani et al. (2015) [20]	Cross-national study	Low	High

Table 3 : Common Themes Across Studies

Theme	Supporting Studies	Summary of Findings
Effectiveness of formal education	Paul et al. (2012) [9], Vikram et al. (2012) [10], Subhani et al. (2015) [20]	Formal education enhances maternal knowledge and adherence to immunization schedules.
Community programs' impact	Babarinde & Nnodimele (2022) [16], Oche et al. (2011) [19]	Community-based interventions improve maternal understanding and vaccine adherence in underserved regions.
Role of mass media	El-Shazly et al. (1991) [15]	Media campaigns significantly improve maternal awareness but may not address barriers to access.
Simplified materials' limitations	Wilson et al. (2006) [8], Evers (2001) [13]	Simplified pamphlets show modest gains in knowledge but lack broad applicability.

4. DISCUSSION

This systematic review emphasizes the pivotal role of maternal education in improving immunization knowledge and adherence to vaccination schedules. The findings, synthesized from 13 studies and supported by additional evidence from global research, demonstrate that diverse educational interventions—formal education, community-based programs, mass media campaigns, and simplified materials—can significantly enhance maternal understanding of immunization and positively impact vaccine uptake.

Formal education emerged as one of the most consistent predictors of improved immunization outcomes. Studies such as Paul et al. [9] and Vikram et al. [10] highlighted that mothers with secondary or higher education levels were significantly more likely to understand immunization schedules and ensure complete vaccination for their children. This association can be attributed to the health literacy and decision-making autonomy fostered by formal schooling. For instance, Özer et al. [18] demonstrated that compulsory education policies in Turkey resulted in a marked increase in vaccination adherence, particularly for DPT and Hepatitis B vaccines. Supporting these findings, Farida et al. (2020) reported that maternal education combined with antenatal care visits improved basic immunization coverage across Asia and Africa [21]. Similarly, Lakshmanasamy (2021) found that educated mothers were better equipped to allocate resources for their children's health and were significantly more likely to achieve full vaccination.[22]

Community-based education programs demonstrated substantial success in improving immunization knowledge and adherence, particularly in low-resource settings. Babarinde & Nnodimele [16] reported significant improvements in maternal knowledge after culturally tailored workshops, with knowledge retention observed even six weeks post-intervention. Similarly, Oche et al. [19] found that community-led health programs in Nigeria improved vaccination coverage by engaging mothers through localized and culturally sensitive education. These programs were particularly valuable in addressing logistical barriers and combating myths surrounding vaccines. The importance of community-based education is further supported by Owais et al. (2011), who showed that targeted, pictorial-based education led to a 39% increase in vaccination rates among low-literacy populations in Karachi.[23]

Mass media campaigns were effective in raising awareness at a population level, though their impact was limited by their inability to address individual-level barriers. El-Shazly et al. [15] demonstrated significant improvements in maternal knowledge following mass media campaigns in Egypt. However, myths, misconceptions, and logistical challenges remained unresolved. This aligns with findings from Nganga et al. (2019), who emphasized the importance of trust between healthcare providers and mothers in overcoming vaccine hesitancy, particularly in regions where misinformation is prevalent.[24] These results suggest that while mass media campaigns are valuable for increasing general awareness, they must be supplemented by more targeted and personalized interventions.

Simplified educational materials, such as pamphlets, demonstrated limited success. Wilson et al. [8] and Evers [13] reported slight improvements in maternal knowledge, although the effectiveness of these materials was constrained by literacy levels and the complexity of the content. Patnaik et al. (2014) reinforced these findings, highlighting that health education materials must be tailored to the literacy levels and cultural contexts of target populations to maximize their impact.[25] This underscores the need for innovative and adaptive strategies, such as integrating visual aids or digital tools into educational materials.

5. COMPARISON WITH PREVIOUS LITERATURE

The findings of this review align with global research that consistently links maternal education with better immunization outcomes. Forshaw et al. (2017) reported that children of mothers with secondary or higher education were twice as likely

to receive full vaccination compared to children of uneducated mothers. This review builds on such findings by categorizing and evaluating specific intervention types, offering deeper insights into their effectiveness in different contexts. For example, formal education serves as a foundational strategy for improving maternal health literacy, but its impact is amplified when combined with community-based programs tailored to address localized challenges.[26]

Studies like Farida et al. (2020) emphasize the role of integrated approaches that combine maternal education with healthcare services to achieve optimal vaccination coverage.[21] This review also aligns with UNICEF (2019) reports, which stress the importance of addressing social determinants such as education and healthcare access to improve child health outcomes.

6. STRENGTHS

This review provides a comprehensive synthesis of diverse educational interventions, highlighting their varying impacts on maternal knowledge and vaccine adherence. The categorization of interventions (formal education, community-based programs, mass media, and simplified materials) ensures actionable insights for policymakers and healthcare practitioners. Additionally, rigorous quality assessment of included studies ensures reliability and validity of the conclusions.

Weaknesses and Limitations: Many studies had short-term follow-ups, limiting insights into the long-term sustainability of outcomes. Rural and low-literacy populations were often underrepresented, reducing the generalizability of findings. Additionally, variability in study designs and outcome measures hindered direct comparisons and limited the feasibility of meta-analysis**.**

Future Directions: Future research should focus on longitudinal studies to assess long-term impacts, explore digital innovations such as mobile apps and social media for scalable solutions, and conduct comparative effectiveness studies to evaluate interventions across diverse settings.

7. CONCLUSION

This review reinforces the critical role of maternal education in improving childhood immunization outcomes. While formal education provides a strong foundation, community-based programs and culturally sensitive interventions are essential to address persistent barriers. Public health strategies must integrate these approaches to achieve equitable and comprehensive immunization coverage, particularly in underserved populations.

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