



Maternal Education and Behavioral Factors as Determinants of Immunization Completeness

A Cross-Sectional Study

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Abstract

Childhood immunization remains a fundamental public health intervention to prevent vaccine-preventable diseases and reduce child morbidity and mortality. Maternal characteristics, particularly educational attainment and behavioral factors, are considered important determinants of immunization uptake. This study aimed to analyze the association between maternal education, knowledge, and attitudes and childhood immunization completeness. A cross-sectional design was employed using secondary data from 362 mother-child pairs registered at a primary health care center in Indonesia in 2025. Immunization status was classified as complete or incomplete according to the national immunization schedule. Independent variables included maternal education, knowledge, attitude, age, employment status, parity, and the child's sex. Data were analyzed using SPSS version 26. Descriptive statistics were presented as frequencies and percentages, while associations were examined using Chi-square or Fisher's exact tests with a significance level of $p < 0.05$. Overall, 58.6% of children had complete immunization. Maternal education ($p < 0.001$), knowledge ($p = 0.003$), and attitude ($p = 0.003$) were significantly associated with immunization completeness. Strengthening maternal health education may enhance vaccination coverage in primary care settings.

Keywords: Childhood Immunization Completeness, Maternal Attitude, Maternal Education, Maternal Knowledge, Primary Health Care

Introduction

Childhood immunization continues to be recognized as one of the most economically efficient public health strategies for decreasing morbidity and mortality among children under five years of age. [1]. Through vaccination, children are protected against severe infectious diseases, including measles, diphtheria, pertussis, tetanus, poliomyelitis, and hepatitis B. The World Health Organization (WHO) estimates that routine immunization averts approximately 3.5–5 million deaths each year [2], [3], [4]. Nevertheless, despite these substantial gains, global vaccination coverage has shown signs of stagnation in recent years, with millions of children, particularly in low- and middle-income countries, missing essential vaccines. [5]. Such coverage gaps compromise herd immunity, increase the likelihood of outbreaks of vaccine-preventable diseases, and hinder progress toward achieving the Sustainable Development Goals (SDGs) related to child survival and well-being [6], [7], [8].

Within the Indonesian context, childhood immunization programs are administered under the authority of the Ministry of Health of the Republic of Indonesia and delivered through primary healthcare facilities and community-based services [9]. The national basic immunization schedule

includes Hepatitis B, BCG, DPT-HB-Hib, Polio, and Measles/MR vaccines during the first year of life. Although national reports indicate gradual improvements in coverage, disparities across provinces and districts remain evident [10]. These inequalities suggest that improving service availability alone is insufficient to ensure immunization completeness. Instead, household-level determinants, particularly maternal education and behavioral factors, substantially influence parental vaccination decisions [11], [12]. A growing body of literature consistently identifies maternal education as a strong predictor of child health outcomes, including immunization status [11], [13]. Higher educational attainment enhances health literacy, cognitive skills, and the ability to access and interpret health-related information effectively. Mothers with greater educational backgrounds are more likely to understand immunization schedules, appreciate vaccine benefits, and navigate health systems efficiently. Conversely, limited education may reduce comprehension of preventive health information and increase susceptibility to misinformation and vaccine hesitancy [14], [15].

Beyond formal education, behavioral determinants, particularly maternal knowledge and perceptions, play a decisive role in shaping immunization practices. Adequate knowledge about vaccine-preventable diseases, recommended schedules, and potential side effects directly influences health-related decision-making [16]. Perceptions shaped by cultural norms, social influences, and prior experiences may either encourage or discourage vaccine uptake. The Health Belief Model (HBM) provides a theoretical framework for understanding these mechanisms, positing that health behavior is influenced by perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy [17]. Mothers who perceive their children as vulnerable to serious diseases and who believe in the effectiveness of vaccines are more likely to complete immunization schedules. In contrast, fear of adverse events, religious considerations, and exposure to misinformation may act as perceived barriers that reduce compliance [14].

From global health and nursing perspectives, strengthening primary health care systems and addressing vaccine hesitancy through behaviorally informed strategies are international priorities [18], [19]. Nurses working in primary care settings play a central role in health promotion, risk communication, and family-centered education. Their ongoing engagement with mothers during antenatal, postnatal, and child health visits positions them strategically to identify knowledge gaps, correct misconceptions, and promote adherence to evidence-based immunization practices [20]. However, the effectiveness of nursing-led interventions depends on a nuanced understanding of contextual determinants influencing maternal decision-making at the community level. The significance of this study lies in the need for context-specific empirical evidence that clarifies how maternal education and behavioral determinants interact to influence immunization completeness. Although previous studies have demonstrated associations between education and vaccine uptake, findings regarding perception and behavioral constructs remain inconsistent across settings [12], [16]. Furthermore, limited research has explored these determinants within localized primary health care contexts in Indonesia, particularly in semi-rural or underserved areas.

Wayaloar Primary Health Care Center, Indonesia, represents a primary care setting where achieving optimal immunization coverage remains challenging. Understanding the educational and

behavioral influences within this context is essential for designing targeted, culturally appropriate, and sustainable interventions. Generating such evidence will not only strengthen national immunization strategies but also provide insights relevant to other low- and middle-income settings facing similar socio-behavioral barriers. Accordingly, this study aims to examine the association between maternal education and behavioral determinants and childhood immunization completeness among children aged 10–23 months at Wayaloar Primary Health Care Center, Indonesia.

Material and Methods

A. Study design and setting

This study employed an analytical cross-sectional design using secondary data obtained from immunization records at Wayaloar Primary Health Care Center, Indonesia. The data were collected and recorded routinely by the health center during the 2025 reporting period. The study aimed to examine the association between child and maternal characteristics and immunization status.

B. Study Population and Sample

The study population consisted of all infants registered at the primary health care center in 2025. A total of 362 mother–child pairs met the inclusion criteria and were included in the analysis. Inclusion criteria comprised complete records of child characteristics, maternal characteristics, maternal behavioral factors, and immunization status. Records with missing or incomplete key variables were excluded from the analysis.

C. Variables and Measurements

The dependent variable was immunization status, categorized as complete or incomplete based on the national immunization schedule recorded in the health center registry. Independent variables included child characteristics: sex and birth weight. Maternal characteristics: maternal age, education level, employment status, and parity. Maternal behavioral factors: knowledge about immunization and attitude toward immunization. Maternal age was grouped into three categories (<20 years, 21–35 years, and >35 years). Education level was classified as low (primary–junior high school), middle (senior high school), and higher education. Knowledge and attitude were categorized according to the assessment results documented in the health records.

D. Data Analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 26. Descriptive statistics were used to summarize the distribution of variables, presented as frequencies and percentages. Bivariate analysis was conducted to examine the association between independent variables and immunization status. The Chi-square test was applied for categorical variables. When expected cell counts did not meet Chi-square assumptions, Fisher's exact test was used. A p-value of <0.05 was considered statistically significant.

E. Ethical Considerations

This study was conducted using secondary data derived from routine health records that contained no personal identifiers. Ethical approval was obtained from the appropriate institutional review authority before the commencement of data analysis. Formal permission to access and use the data was

granted by Wayaloar Primary Health Care Center under reference number 440/83/PKM-WYL/2026.

Throughout the research process, strict measures were implemented to ensure confidentiality and data protection. All data were handled anonymously, stored securely, and used exclusively for research purposes in accordance with applicable ethical standards and regulations governing health research.

Results

Table 1 presents the distribution of child and maternal characteristics at Wayaloar Primary Health Care Center in 2025. Among 362 children included in the analysis, more than half were male (56,4%), while 43,6% were female. All infants had normal birth weight (≥ 2500 g). Regarding immunization coverage, 58.6% of children had received complete immunization, while 41.4% were incomplete. Maternal profiles shown in Table 1 indicate that the vast majority of mothers were aged 21–35 years (92,3%), with only a small proportion younger than 20 years (1,4%) or older than 35 years (6,4%). Most mothers had completed middle-level education (76,8%), while 15,2% had low education and 8,0% had higher education. The majority were unemployed (91,2%) and multiparous (94,8%). In terms of behavioral factors, nearly all mothers demonstrated good knowledge about immunization (96,7%) and a positive attitude toward immunization (97,0%).

Table 1. Characteristics of Mothers and Infants at Wayaloar Primary Health Care Center, Indonesia (n = 362).

Variable	Frequency (n)	Percent (%)
Child Characteristic		
Sex of the child		
• Male	204	56.4
• Female	158	43.6
Birth Weight		
• Normal birth weight (≥ 2500 g)	362	100.0
• Low birth weight (< 2500 g)	0	0.0
Immunization Status		
• Complete	212	58.6
• Incomplete	150	41.4
Maternal Characteristics		
Maternal Age		
• < 20 years	5	1.4
• 21-35 years	334	92.3
• > 35 years	23	6.4
Maternal Education Level		
• Low Education (SD-SMP)	55	15.2
• Middle (SMA)	278	76.8
• High Education	29	8.0
Employment Status		
• Employed	32	8.8
• Unemployed	330	91.2
Parity		
• Primigravida	19	5.2
• Multigravida	343	94.8
Maternal Behavioral Factors		
Knowledge about immunization		
• Good	350	96.7

Variable	Frequency (n)	Percent (%)
• Fair	11	3.0
• Poor	1	.3
Attitude toward Immunization		
• Positive attitude	351	97.0
• Negative attitude	11	3.0

Fig. 1 illustrates the distribution of childhood immunization completeness among 362 children at Wayaloar Primary Health Care Center, showing the proportion of children with complete and incomplete immunization status.

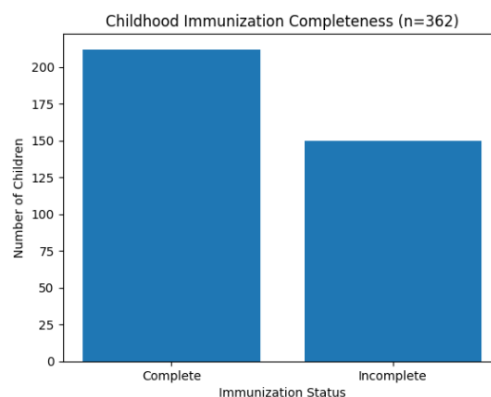


Fig. 1. Distribution of Childhood Immunization Completeness at Wayaloar Primary Health Care Center (n = 362).

Of the 362 children analyzed, 212 (58.6%) had complete immunization, while 150 (41.4%) had not completed the recommended schedule. Although more than half achieved full immunization, a substantial proportion remained incompletely immunized, indicating a continuing public health concern in the study area. Figure 1 illustrates the distribution of immunization completeness at Wayaloar Primary Health Care Center, highlighting the gap between complete and incomplete status. Despite generally favorable maternal knowledge and attitudes, incomplete coverage suggests that socioeconomic, behavioral, and service-related factors may also influence uptake. Overall, the findings underscore that achieving optimal immunization coverage requires sustained and context-specific interventions to ensure that all children receive complete and timely vaccination in accordance with national guidelines.

The association analysis between these characteristics and immunization status is summarized in Table 2. Child's sex was not significantly associated with immunization completeness ($p=0.742$). Similarly, maternal age ($p=0.345$), employment status ($p=0.303$), and parity ($p=0.676$) showed no statistically significant relationship with immunization status. In contrast, maternal education level was significantly associated with immunization status ($p<0.001$). A higher proportion of mothers with middle education had children with incomplete immunization compared to those with low or high education. Behavioral factors also demonstrated significant associations. Maternal knowledge about immunization was significantly related to immunization status ($p=0.003$), as was maternal attitude

($p=0.003$). Children of mothers with good knowledge and positive attitudes were more likely to have complete immunization.

Table 2. Association between Child and Maternal Characteristics and Immunization Status

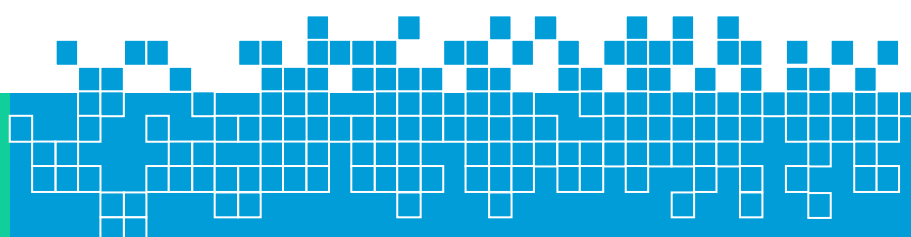
Variable	Immunization Status			
	Complete		Incomplete	
	n	%	n	%
Child Characteristic				
Sex of the child				
• Male	121	(33.4)	83	(22.9)
• Female	91	(25.1)	67	(18.5)
<i>p-value</i>				0.742
Maternal Characteristics				
Maternal Age				
• < 20 years	2	(0.6)	3	(0.8)
• 21-35 years	199	(55.0)	135	(37.3)
• > 35 years	11	(3.0)	12	(3.3)
<i>p-value</i>				0.345
Maternal Education Level				
• Low Education (SD-SMP)	51	(14.1)	4	(1.1)
• Middle (SMA)	136	(37.6)	142	(39.2)
• High Education	25	(6.9)	4	(1.1)
<i>p-value</i>				0.000*
Employment Status				
• Employed	16	(4.4)	16	(4.4)
• Unemployed	196	(54.1)	134	(37.0)
<i>p-value</i>				0.303
Parity				
• Primigravida	12	(3.3)	7	(1.9)
• Multigravida	200	(55.2)	143	(39.5)
<i>p-value</i>				0.676
Maternal Behavioral Factors				
Knowledge about immunization				
• Good	200	(55.2)	150	(41.4)
• Fair	11	(3.0)	0	(0.0)
• Poor	1	(0.3)	0	(0.0)
<i>p-value</i>				0.003*
Attitude toward Immunization				
• Positive attitude	201	(55.5)	150	(41.4)
• Negative attitude	11	(3.0)	0	(0.0)
<i>p-value</i>				0.003*

* Chi-square test was used to assess associations between variables. Fisher's exact test was applied when the assumptions for the chi-square test were not met.

** $p<0.005$

Discussion

This study explored the association between maternal educational background and behavioral determinants with the completeness of childhood immunization among children aged 10-23 months at Wayaloar Primary Health Care Center, Indonesia. The analysis revealed that both maternal education level and behavioral components, particularly knowledge and perception, were significantly linked to complete immunization status. These findings underscore that vaccination coverage is shaped not solely



by the availability of health services, but also by socio-educational conditions and behavioral processes operating within the household environment. Maternal education was identified as a prominent predictor of immunization completeness. Mothers who had attained higher levels of formal education were more likely to ensure that their children received all recommended vaccines according to schedule. This observation is consistent with multi-country evidence indicating that maternal schooling is closely related to improved child survival and greater utilization of preventive health services, including immunization. [21], [22]. Educational attainment contributes to stronger cognitive capacity, improved health literacy, and more informed decision-making, thereby enabling mothers to better comprehend vaccination schedules and assess the benefits of preventive care. Conversely, limited educational exposure may restrict understanding of essential health information and diminish confidence in interacting with health care providers.

In addition to education, behavioral determinants were shown to significantly influence immunization outcomes. Specifically, maternal knowledge concerning vaccine-preventable diseases, recommended immunization timelines, and anticipated side effects was positively associated with complete immunization. Prior research has demonstrated that caregiver awareness and understanding constitute critical determinants of vaccine uptake in low- and middle-income countries [23]. Knowledge functions as a direct determinant that shapes attitudes, informs risk assessment, and reinforces motivation to pursue preventive health services. Maternal perception likewise played a meaningful role in vaccination behavior. In line with established behavioral health theories, mothers who perceived their children as susceptible to severe infectious diseases and who acknowledged the protective efficacy of vaccines were more inclined to complete immunization schedules. In contrast, perceived obstacles such as concerns about adverse reactions, doubts regarding vaccine safety, or exposure to misinformation were associated with lower compliance. Contemporary global evidence highlights that vaccine confidence remains a key driver of immunization coverage and is profoundly influenced by social context and trust in health systems. [24], [25]. These patterns reinforce the relevance of applying behavioral frameworks, including the Health Belief Model, to better understand immunization-related decision-making within community settings.

From the standpoint of primary health care and nursing practice, these findings emphasize the critical role of frontline health professionals in enhancing immunization outcomes. Nurses working in primary care assume dual responsibilities as immunization providers and health educators. Empirical evidence suggests that meaningful community engagement and effective communication between providers and parents are fundamental to strengthening vaccine confidence and improving uptake [26]. In semi-rural contexts such as Wayaloar, context-sensitive educational initiatives integrated into routine maternal and child health services may yield substantial benefits. The continued presence of incomplete immunization despite accessible services points to the influence of broader social determinants. International analyses have demonstrated that disparities in vaccination coverage are closely associated with socioeconomic conditions, maternal education levels, and access to credible health information [27]. Consequently, efforts to enhance immunization completeness should adopt comprehensive

approaches that combine improvements in service delivery with targeted educational and behavioral strategies.

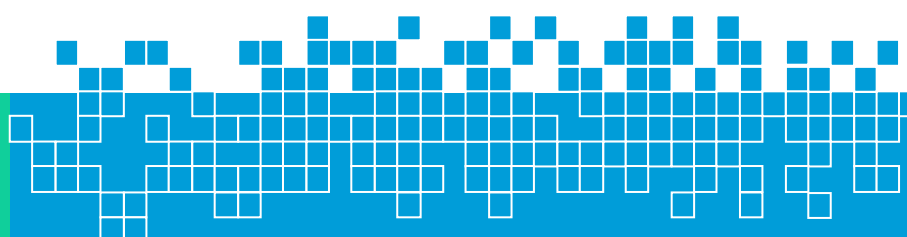
By providing context-specific data from a primary health care setting, this study adds to the existing body of literature by illustrating how maternal education and behavioral determinants jointly influence immunization completeness. The results suggest that initiatives aimed at improving maternal health literacy and addressing perceptual barriers through culturally responsive counseling may strengthen vaccine coverage. Nursing-led interventions that emphasize structured education, trust-building dialogue, and proactive community outreach appear particularly promising. Several limitations warrant consideration. The cross-sectional nature of the study precludes causal conclusions, and the use of self-reported measures may introduce reporting bias. Future studies employing longitudinal designs or intervention-based methodologies are recommended to clarify causal mechanisms and assess the effectiveness of behaviorally oriented nursing strategies. In summary, maternal education and behavioral determinants exert a significant influence on childhood immunization completeness at Wayaloar Primary Health Care Center. Strategies to improve vaccination coverage should therefore prioritize enhancing maternal education, strengthening vaccine-related knowledge, and addressing perceptual barriers through evidence-based, community-focused nursing interventions.

Conclusion

This study highlights key determinants of childhood immunization completeness among infants at Wayaloar Primary Health Care Center. Although most mothers demonstrated good knowledge and positive attitudes toward immunization, a considerable proportion of children did not complete the recommended immunization schedule, indicating a persistent gap between awareness and practice. Maternal education, knowledge, and attitude toward immunization were significantly associated with immunization completeness, with higher educational attainment, better knowledge, and positive attitudes increasing the likelihood of complete immunization. In contrast, maternal age, employment status, parity, and child sex were not significantly associated with immunization status. These findings indicate that immunization uptake is influenced by multiple interacting factors, including educational and behavioral dimensions. Therefore, improving immunization coverage requires more than information dissemination alone. Integrated strategies that strengthen maternal health education, improve vaccine-related awareness, and address behavioral barriers through community-based primary health care interventions are essential. Continuous follow-up through primary health care services is also important to ensure timely and complete immunization, thereby reducing the burden of vaccine-preventable diseases and improving child health outcomes.

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Conflict of Interest

The authors declare that there are no conflicts of interest related to this study. The research was conducted independently, and no financial or commercial relationships influenced the study design, data collection, analysis, interpretation, or manuscript preparation.

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