# The Correlation Between Behavioral and Psychological Factors with Booster Immunization Adherence for Children Aged <24 Months

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## ABSTRACT

***Background:*** *Immunization status is considered complete when children receive all antigens types as recommended, including booster immunization, ensuring optimal protection. The high level of non-adherence is the main obstacle to immunization programs, further added by the fact that the number of children who receive partial or no immunization remains high. This study aims to analyze the correlation between behavioral and psychological factors with booster immunization adherence in children aged <24 months.*
***Method:*** *A quantitative study with a cross-sectional approach. The population consists of parents with children aged 18-23 months, totaling a sample of 522 children. The data were collected through interviews using structured questionnaires, and observations using MCH-Book to measure booster immunization adherence. The collected data was analyzed through univariate, bivariate, and multivariate approaches with multiple logistic regression tests to identify the dominant variables.*
***Results:*** *Only 25.9% of children received two types of recommended booster vaccines (DPT/HB/HiB-4 and MR-2). Partially, behavioral factors that correlate with booster immunization adherence are knowledge, attitudes, and perceptions about multiple injections, while psychological factors that correlate are motivation and basic immunization status. Experience with previous basic immunization status is the most dominant factor influencing booster immunization adherence. The fear of disease infection and trust in healthcare providers are the keys to a successful immunization. Need to increase motivation through strengthening literacy and improving access to and health service system to reduce hesitation about, distrust, and refusal of immunization, while also providing a positive immunization experience.*

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## INTRODUCTION

Globally, immunization has succeeded in reducing the millions of children's deaths due to infectious diseases.[1,2] Even though immunization has been proven to be cost-effective in preventing dangerous disease transmission[3] and has a significant impact in reducing morbidity and mortality,[4,5] not all children receive the vaccines they need for various reasons.[6] Based on estimates, in 2019-2021, there were 67 million children who did not receive complete routine immunization or only received it partially, of which 8.3 million children were from the East Asia and Pacific region, including Indonesia.[7] The existence of a routine immunization program for children is the main strategy as well as a core part of successful vaccination.[8]

The high level of non-adherence is a major concern in the implementation of current immunization program policies.[9] Many factors influence non-adherence or incomplete immunization, including low confidence in vaccines which can cause hesitation about, resistance to, delays, or refusal of vaccines,[10] as well as many negative rumors and controversies related to vaccine safety.[11] Anxiety about the vaccines' side effects and the pain felt by children during vaccination often makes parents reluctant and hesitant to vaccinate their children,[12,13] resulting in incomplete immunization status. When children's routine immunizations are not completed, children become vulnerable individually and collectively, putting them at a higher risk of contracting diseases that actually can be prevented by vaccines.[14] Increasing

vaccine hesitancy not only harms individuals, but also society due to its potential to cause outbreaks of disease.[15] WHO also firmly states that vaccine hesitancy is one of the global health threats in the future.[3,16]

The effectiveness of immunization in providing optimal protection will be obtained when children receive certain antigens in stages according to disease types and age. Immunization status is declared complete when the child receives all antigens according to the provisions, including booster immunization. It must be acknowledged that each type of antigen's ability to generate antibodies and maintain them for a certain period is different, leading to different abilities and body immune systems. This is the reason why certain types of vaccines require strengthening through repeat vaccination (booster). The aim of booster immunization is to maintain and extend the child's immune system.[17] According to the Demographic Health Survey (DHS) data in 46 countries, many children still miss out on receiving vaccinations at the end of their second year, even though they have had contact with health services. This condition increases MOV (missed opportunity for vaccination), especially in the lower middle-income countries.[18]

In accordance with the Health Minister Regulation Number 12 of 2017 concerning the Implementation of Immunization, routine immunization status is declared complete when the child receives all types of vaccines which are given in stages until 9 months of age, including: HB-0 (1 dose); BCG (1 dose); Polio drops/OPV (4 doses); Inactivated polio/IPV (1 dose); DPT/HB/HiB (3 doses); and Measles Rubella/MR (1 dose). In 2022, the government added two new types of vaccine to the mandatory immunization program, namely Rotavirus (3 doses) and PCV (3 doses). When they are 18 months old, children receive booster immunization, namely: DPT/HB/HiB-4 and MR-2.[17,19,20] Even though immunization is a mandatory program for children, the number of children who receive no vaccination or only partial vaccination remains high.[20] Booster immunization coverage has also shown a tendency to remain low in recent years. Therefore, since 2022, the government has implemented the Month of National Child Immunization (MNCI) program, designed specifically for children aged 9-59 months to fulfill their basic immunization status (including boosters). Administering booster doses and completing missed vaccines contribute to disease control and elimination goals.[18]

Low utilization and adherence to immunization potentially increase the risk of disease transmission caused by dangerous viruses. Several studies have proven that children receiving no immunization or incomplete immunization is one of the leading causes of disease outbreaks that have occurred so far. Studies in the U.S. proved that routine immunization reduces the incidence of all targeted diseases, with a range from 17% for influenza to 100% for diphtheria, haemophilus influenzae type B, measles, mumps, polio, and rubella.[21] The low adherence and support from parents, families, and communities indicated that there are obstacles in their perceptions and attitudes towards immunization, both from behavioral and psychological dimensions. So far, barriers to immunization cover three main interrelated themes, namely barriers related to belief, issues of vaccine safety, trust, and misinformation they receive.[22]

Parental adherence to children's complete immunizations (including booster immunizations) is highly important. Parents have a crucial role in ensuring the fulfillment of children's rights. It is important to understand their attitudes and beliefs towards vaccines and immunizations to form positive acceptance and requests for intervention.[23,24] Generally, the fear of side effects, anxiety about injections, and hesitation about vaccine safety are caused by misinformation and misunderstanding of immunization.[22,25,26]. Apart from that, their satisfaction with immunization services received so far or their overall experience also influences the mother's decision whether to immunize her child or not.[27] Dissatisfaction with immunization is generally rooted in reluctance, delays, and inaccuracy of immunization according to schedule.[28,29] The result of the preliminary study showed low literacy and parents' understanding regarding the immunization program, in addition to low attitudes and wrong perceptions about booster immunization. Therefore, this study aims to analyze the correlation between behavioral and psychological factors on adherence to booster immunization in children aged <24 months.

## METHOD

This quantitative study was carried out in 31 districts out of 35 districts in the Central Java province using a cross-sectional approach. The population of the study consists of parents with children aged 18-23 months, totaling a sample of 522 children. The data in 2021 shows that the 968,981 children aged <24 months in the Central Java province, and using the Slovin formula, the minimum sample size required is 399.83 or rounded up to 400 children. The sample was determined using a purposive technique based on the Primary Health Center (PHC) with the lowest booster immunization coverage from each district. After that, from each PHC, one village was determined to have the lowest immunization coverage, where 20 children were accidentally selected from each village according to the specified inclusion criteria, resulting in a total of 620 samples. After filtering the data due to unclear and incomplete answers, 522 samples that

met the criteria to proceed to the analysis stage were obtained. The respondents are parents or caregivers of children who have previously expressed their agreement to be involved in the study through informed consent.

The independent variables include two factors, namely behavioral factors, including the variables of knowledge, attitudes, perceptions of booster immunization, perceptions of AEFI, perceptions of multiple injections, and perceptions of perceived barriers, as well as psychological factors, including the variables of motivation, satisfaction and immunization experience which are measured based on the complete basic immunization (CBI) status. The dependent variable adheres to booster immunization, including DPT/HB/HiB-4 and MR-2. Field data collection for the independent variables was carried out by interviews using a structured questionnaire, and by observation through the MCH-Book containing evaluation records of children immunization from birth to 5 years old for the dependent variables. Data collection was planned to be carried out in July-August 2022. The enumerators for this study were students participating in the Community Service Program (Thematic of Immunization) of Diponegoro University who had previously been given an explanation of questionnaires and observation sheets completion, as well as how to collect field data using accidental techniques.

The questionnaire for collecting primary data of independent variables consists of 8-12 question items for each variable. Each question is divided into 4 (four) options with a score range of 1-4 using a Likert scale. Based on the total score, the category was determined based on the median value as the cut-off point since the result of the normality test showed that the data distribution of all independent variables was not normal. Booster immunization adherence was measured by observation, where respondents were declared as adherent if they received all types of antigens for booster immunization (DPT/HB/HiB-4 and MR-2), and declared as non-adherent if they only received one or not at all. Furthermore, all collected data underwent univariate analysis using frequency distribution, bivariate analysis using the Chi-Square test due to the categorical nature of the data, and multivariate analysis using multiple logistic regression tests to identify the dominant influence of variables on adherence to booster immunization. Fulfilling the ethical standards and requirements, this study has received a certificate of Description of Ethical Approval from the Health Research Ethics Committee, Faculty of Public Health, Diponegoro University with Number 361/EA/KEPK-FKM/2022.

## RESULTS AND DISCUSSION

**Table 1.** Respondents' characteristics

| Characteristics | f | % |
|---|---|---|
| **Mother's age** | | |
| < 20 years old | 6 | 1.1 |
| 21-30 years old | 275 | 52.7 |
| 31-40 years old | 199 | 38.1 |
| > 40 years old | 42 | 8.0 |
| **Mother's education** | | |
| Did not complete ES | 5 | 1.0 |
| Elementary school | 63 | 12.1 |
| Junior high school/equivalent | 128 | 24.5 |
| High school/equivalent | 240 | 46.0 |
| Diploma/Undergraduate | 85 | 16.3 |
| Postgraduate | 1 | 0.2 |
| **Mother's occupation** | | |
| Housewife | 363 | 69.5 |
| Laborer | 29 | 5.6 |
| Informal sector | 43 | 8.2 |
| Private sector worker | 58 | 11.1 |
| Gov Employee/Soldier/Police | 17 | 3.3 |
| Another job | 12 | 2.3 |
| **Number of children** | | |
| 1-2 | 403 | 77.2 |
| 3-4 | 113 | 21.6 |
| >4 | 6 | 1.1 |
| **Income per month** | | |
| < PMW (Rp 1,813,011) | 183 | 35.1 |
| ≥ PMW (Rp 1,813,011) | 339 | 64.9 |
| **Health insurance coverage** | | |
| None | 107 | 20.5 |
| NHI/BPJS | 411 | 78.7 |
| Private insurance | 4 | 0.8 |
| **Children's age** | | |
| 18-20 months old | 370 | 70.9 |
| > 20 months old | 152 | 29.1 |
| **Birth weight** | | |
| Less than (< 2500 grams) | 42 | 8.0 |
| ≥ 2500 grams | 480 | 92.0 |
| **Child's gender** | | |
| Male | 247 | 47.3 |
| Female | 275 | 52.7 |
| **Delivery method** | | |
| Vaginal delivery | 383 | 73.4 |
| Caesarean section | 139 | 26.6 |

Based on the characteristics, it is known that from 522 respondents, the average mother's age is 30.91 years old (SD 5.85 years old) with the largest proportion in the range of 20-40 years old (90.8%). Most of them completed secondary education (junior high school to high school) 70.5%, work as housewives (69.5%), have 1-2 children (77.2%) with an average monthly income of IDR 2,344,827 and have health insurance or "BPJS" of 78.7%. Based on the children's characteristics, it can be inferred that the average age of children is 18.91 months old (SD 2.5 months old), with an average birth weight of 3,000 grams (92% with birth weight ≥ 2500 grams). Most of them are female, with a percentage of 52.7%, and were born through vaginal delivery (73.4%). The detailed description of respondents' characteristics is shown in Table 1.

Based on the booster immunization adherence, only 32.6% of children aged 18-23 months old have received DPT/HB/HiB-4 booster, and 49.8% have received MR-2 booster. Judging from the booster immunization completeness, only 25.9% of children received both types of booster vaccine (see Table 2).

**Table 2.** Distribution of booster immunization adherence

| Type of antigens | No | | Yes | |
|---|---|---|---|---|
| | n | % | n | % |
| DPT/HB/HiB-4 (B*ooster*) | 352 | 67.4 | 170 | 32.6 |
| MR-2 (B*ooster*) | 262 | 50.2 | 260 | 49.8 |
| Booster Completeness | 387 | 74.1 | 135 | 25.9 |

**Table 3.** Relationship analysis of independent variables and booster immunization adherence

| Variables | Booster Immunization Adherence | | | | Total | | Sig. |
|---|---|---|---|---|---|---|---|
| | Non-adherent | | Adherent | | | | |
| | n | % | n | % | n | % | |
| **Knowledge** | | | | | | | |
| Low | 126 | 80.8 | 30 | 19.2 | 156 | 100 | 0.024 |
| High | 261 | 71.3 | 105 | 28.7 | 366 | 100 | |
| **Attitude of booster immunization** | | | | | | | |
| Low | 163 | 80.3 | 40 | 19.7 | 203 | 100 | 0.010 |
| High | 224 | 70.2 | 95 | 29.8 | 319 | 100 | |
| **Perception of AEFI** | | | | | | | |
| Low (negative) | 190 | 74.2 | 66 | 25.8 | 256 | 100 | 0.967 |
| High (positive) | 197 | 74.1 | 69 | 25.9 | 266 | 100 | |
| **Perception of multiple injections** | | | | | | | |
| Low (negative) | 190 | 79.2 | 50 | 20.8 | 240 | 100 | 0.015 |
| High (positive) | 197 | 69.9 | 85 | 30.1 | 282 | 100 | |
| **Perception of barriers** | | | | | | | |
| High | 251 | 73.6 | 90 | 26.4 | 341 | 100 | 0.704 |
| Low | 136 | 75.1 | 45 | 24.9 | 181 | 100 | |
| **Motivation** | | | | | | | |
| Low | 198 | 80.8 | 47 | 19.2 | 245 | 100 | 0.001 |
| High | 189 | 68.2 | 88 | 31.8 | 277 | 100 | |
| **Satisfaction of imm services** | | | | | | | |
| Low | 155 | 74.9 | 52 | 25.1 | 207 | 100 | 0.754 |
| High | 232 | 73.7 | 83 | 26.3 | 315 | 100 | |
| **Basic immunization status (CBI)** | | | | | | | |
| Not complete | 175 | 90.2 | 19 | 9.8 | 194 | 100 | 0.000 |
| Complete | 212 | 64.6 | 116 | 35.4 | 328 | 100 | |

Table 3 shows that in the group of parents who did not adhere to booster immunization, the proportion of those with less knowledge was higher than those with high knowledge. The same condition is also seen in booster immunization variables comprising perception of AEFI, perception of multiple injections, motivation, level of satisfaction, and previous immunization status (CBI). It is partially known that knowledge, attitudes toward booster immunization, perception of multiple injections, motivation, and previous immunization status are positively correlated with booster immunization adherence in children 18-23 months old as the p-value is <0.05. By multivariate analysis, it has been proven that motivation variables and previous basic immunization status (CBI) jointly influence booster immunization adherence. The previous basic immunization status variable (CBI) is the one with the most significant influence since it has the largest Exp(B) value, namely 4.908, followed by the motivation variable with an Exp(B) value of 1.859. The chance of booster immunization adherence will increase 4.908 times higher when the immunization status (CBI) is complete. Likewise, the opportunity for adherence will increase 1.859 times higher when parental motivation increases (see Table 4). The influence of these two variables is 14.6% and the remainder is influenced by other various variables.

In accordance with the standards of the national immunization program, the DPT/HB/HiB-4 and MR-2 booster immunizations are given to every child at 18 months of age. The time interval between the last previous immunization was around 9 months (according to the MR-1 immunization schedule for children aged 9 months). The prolonged time lag between immunization follow-ups often leads to parents delaying immunization or non-adherence. Parents often forget the immunization schedule, especially when they do not have their child's immunization records or immunization cards. A study in Malaysia proved that apart from the hesitation regarding the halal nature of vaccines, forgetting and not having time are also classified as factors causing parents' reluctance and refusal of immunization,[30] as is the situation in Indonesia.[22] The lack of reminders, home visits, the spread of misinformation and misunderstanding, as well as dissatisfaction with immunization also serves as the determining factor leading to incomplete immunization.[31]

This study's results prove that behavioral dimensions significantly correlating with booster immunization adherence consist of knowledge, attitudes toward boosters, and perceptions of multiple injections. Meanwhile, the psychological dimensions comprise motivation and experience as seen through the complete basic immunization status (CBI). By multivariate analysis, it has been proven that only the psychological dimension has a direct effect on booster immunization adherence. This result also shows the significant contribution of psychological factors to a person's adherence. A person's adherence or non-adherence is mainly influenced by certain drives or motives that exist within him. Certain behavioral motives will also be strengthened by experience. These results are in line with several studies that show that encountering negative attitudes from healthcare workers, long waiting hours, and unpleasant immunization service procedures, as well as uncomfortable clinic environments are factors that prevent parents from coming for follow-up immunization schedules.[24,32] The rude or even hostile attitudes shown by healthcare workers toward parents become psychological barriers that influence parents' attitudes and perceptions toward immunization services.[33] In addition, determinants of acceptance or rejection of immunization are also related to their perceptions of disease risk, perceived vulnerability, concerns about vaccine safety, perceived need, past experiences with healthcare services, emotions, mindset, sources of information, and different levels of social norms.[16] The socio-economic factors have also been proven to correlate with complete immunization.[20]

**Table 4.** The result of multivariate analysis

| Variables | B | SE | Wald | df | Sig. | Exp(B) | 95% CI for Exp(B) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Lower | Upper |
| Motivation | 0.620 | 0.215 | 8.285 | 1 | 0.004 | 1.859 | 1.219 | 2.835 |
| Basic immunization status (CBI) | 1.591 | 0.269 | 34.932 | 1 | 0.000 | 4.908 | 2.896 | 8.318 |

Apart from the risk of disease outbreaks, incomplete childhood immunization also impacts children's health status. A study in Pakistan revealed that incomplete immunization is significantly related to children's malnutrition and underweight.[34] Complete childhood immunization is a protective factor for preventing stunting in children aged <5 years old, in addition to LBW, parenting style, and number of children <3 as per a study in Indonesia. Children with incomplete immunization have a 41.1% higher prevalence of stunting compared to children with complete immunization, and they face a sevenfold higher risk.[35] The study results in Timor Leste suggested that the risk of stunting is also related to immunization completeness and the child's history of infectious diseases.[36] A study in the U.S. indicated an increase in VPD cases in recent years is consistently related to parents' refusal of recommended immunizations. There is a correlation between the level of non-vaccination behavior and permissive vaccine exemption policies. Exceptions due to religion and belief, as well as vaccination being a prerequisite for entering school, are not constitutionally required, leading to waiver. This research concludes that legal reform and strict regulatory settings can encourage higher immunization rates.[37]

Navin et al further explained that the reasons for refusing vaccines can vary according to different motivations. Parents who refuse vaccines because they do not care about diseases that can be prevented by immunization, will be more likely to immunize their children once they realize that such diseases are serious and on top of that, dangerous diseases with a level of herd immunity remain highly fragile. Likewise, parents who refuse due to vaccine safety reasons must be provided with evidence that the vaccine complications risk is very low and the basic ingredients for making vaccines are very safe and natural.[38] Providing immunizations for children is motivated by concerns about the risk of children's vulnerability and a belief that vaccines can protect them. On the other hand, research in Temanggung District Indonesia, showed that fear of post-immunization side effects also causes parents to avoid giving immunization because they are worried and afraid that their children will have a fever.[39]

In a psychological context, the connection between parents or family and vaccines evokes various cognitive associations. A study conducted by Howell et al showed that a person's cognitive associations are correlated with trust, beliefs, and resistance to vaccines and immunizations. The cognitive associations surrounding vaccine identity, especially those related to the vaccine's protective efficacy versus perceived harm, can be a psychological foundation that shapes parents' immunization beliefs and behavior.[40] The better the cognitive associations about vaccines, antigens, and immunization are formed, the higher the opportunity to utilize immunization services. There is a relationship between a mother's knowledge and perception of the completeness of her child's immunization.[31,38,41] A study by Smith et al proved that there is a strong relationship between immunization utilization and the perception that vaccines do not cause adverse effects, positive attitudes and recommendations, and the levels of perceived difficulty, including the relationship with perceived susceptibility and disease severity.[42]

It must be acknowledged that reliable information sources about vaccines and immunization can be obtained from healthcare workers.[24] To increase motivation and provide positive experiences, effective communication arrangements with parents are very important to overcoming various barriers to immunization, including hesitancy, refusal, and eventually, to increase immunization coverage.[32] So far, hesitation and refusal of immunization have been mainly caused by misinformation, negative experiences, and the strong influence of anti-vaccine groups through mass media.[16,26,30] Since parents are the decision-makers for their children, their knowledge, attitudes, and behavior will determine decisions regarding immunization. Decision-making about immunization itself is a highly complex process[24] due to the multitude of influencing factors involved.

The level of satisfaction with the information and explanations received regarding vaccine safety and the risk of side effects remains relatively low.[26,29] Some parents also exhibit distrust in the information about vaccines provided by healthcare workers, perceiving it as subjective and potentially manipulated. The explanation only revolves around how to minimize and report the side effects of vaccination and does not promote and support "open" debate or further discussions about vaccine safety.[26] Although service providers (including healthcare workers) and medical literature are the main sources of information about vaccines, complaints regarding the lack of communication and explanations provided remain an obstacle.[43] Basically, parents seek vaccine information that is tailored to their own and their children's needs.[26] Therefore, all vaccination messages, information, and stimuli about immunization must be able to generate a range of positive values and attract other different values, including those embedded in society, to change their behavior regarding vaccines and immunizations.[44] This can also motivate parents who used to be hesitant or refused vaccines to finally accept them.[26]

Some efforts can be made to overcome the problem of forgetting the immunization schedule, for

instance, by using reminder tools. Parents will receive notifications regarding the follow-up immunization schedule, thereby reducing the potential risk of forgetting due to busyness or other reasons. A study in Denmark revealed that a prospective reminder system sent digitally or by post before the scheduled immunization time proved effective in increasing the coverage and timeliness of booster immunization.[9] Maintaining a high level of vaccination coverage can also be done by providing flexible times of immunization service and at the same time, ensuring that children receive vaccinations on time[8] and that every child has the opportunity to get vaccinated. Reducing MOV is not only done through increasing the vaccination timeliness, but also through increasing the effectiveness, efficiency, and access to health service delivery, as well as encouraging synergy between curative and preventive services at the health facility level.[18]

The main support and motivation for carrying out immunization primarily stems from parents' fear of disease infection and belief in the recommendations given by doctors or healthcare workers. If parents are unsure, vaccine hesitancy will naturally increase. The fear of disease infection serves as the main driver of pro-vaccination behavior, along with the trust in doctors, healthcare providers, and reliable and easily accessible health system support. Recommendations from medical professionals are positively correlated with immunization utilization. Another driving factor in this case involves the perception and interpretation of adverse events after immunization, whether experienced by oneself or others. Theoretically, it is also understood that many factors influence motivation, namely knowledge, attitudes, perceptions, beliefs, and culture, as well as ease of access to health facilities. Increasing knowledge and literacy can reduce the risk of receiving inaccurate information, in addition to institutional supporting factors for health services. Cross-sector involvement also serves as the key to successful booster immunization since immunization is a shared responsibility between the community, healthcare providers, and the government as the policymakers.

## CONCLUSION

Only 25.9% of children aged <24 months received two types of recommended booster vaccines, namely DPT/HB/HiB-4 and MR-2. Meanwhile, 32.6% of children only received the DPT/HB/HiB-4 booster and 49.8% received the MR-2 booster. The behavioral factors partially correlate with the adherence to booster immunization include knowledge, attitudes, and perceptions about multiple injections. On the other hand, the psychological factors involve motivation and basic immunization status (CBI). Experiences with previous basic immunization status are the most dominant factor influencing booster immunization adherence, followed by motivation. The fear of disease infection and trust in healthcare providers are the keys to successful immunization. The experience regarding immunization services can be enhanced by improving mechanisms, work systems, and access to immunization services in health facilities. Easy, friendly, and comfortable services provide a positive experience that increases satisfaction. Motivation can be increased by strengthening literacy, improving access and service systems, as well as increasing IEC (information, education, communication) since it is also a strategic step in reducing immunization hesitation, distrust, and refusal. Cross-sector involvement must also be carried out as immunization is a shared responsibility between the community, healthcare providers, and government institutions.

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## Conflicts of Interest

The authors state that this article is an original work written with the teams, and state that there is no conflict of interest related to this research, both during the writing and publication process.

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