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# *Exclusive Breastfeeding and Immunization as Determinants of Stunting Among Indonesian Children Under Five: Evidence from a Community-Based Case-Control Study*

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## ABSTRACT

***Background**: Stunting remains a major public health issue in Indonesia, reflecting chronic undernutrition and recurrent infections in early childhood. Exclusive breastfeeding and immunization are key interventions to promote healthy growth and child survival, aligning with SDG 2 (Zero Hunger) and SDG 3 (Good Health and Well-Being). However, evidence on their combined effects on stunting is inconsistent, especially in rural areas like Sumedang, where local data are limited. **Objective**: This study aimed to examine the association between exclusive breastfeeding, immunization status, and stunting among children aged 2-5 years in rural Indonesia. **Methods**: A community-based, case-control study involved 132 children (66 stunted and 66 non-stunted), aged 24-59 months. Data on stunting, breastfeeding, and immunization were collected via structured questionnaires and verified through child health records. Purposive sampling was used. Statistical analyses included descriptive statistics, Chi-square tests, and odds ratios (ORs) with 95% confidence intervals (CIs). **Results**: Children not exclusively breastfed had a significantly higher risk of stunting (p=0.001; OR=3.27, 95% CI: 1.48-7.22). Immunization completeness was not significantly associated with stunting (p=0.380; OR=1.36, 95% CI: 0.68-2.71). **Conclusion**: Exclusive breastfeeding offers strong protection against stunting and is vital for achieving SDG 2 and SDG 3. While immunization was not directly linked to stunting in this study, it remains essential for preventing infections that may indirectly impair growth. Strengthening breastfeeding promotion and community health programs are crucial for reducing stunting in rural Indonesia.*

***Keywords**: Children Under Five, Exclusive Breastfeeding, Immunization, Sdgs, Stunting*

## INTRODUCTION

Stunting, defined as impaired linear growth resulting from chronic undernutrition, remains one of the most critical public health challenges globally. The World Health Organization (WHO, 2025) reported that approximately 150.2 million children under five years old worldwide are stunted, representing 23.2% of the global child population. In Asia, stunting continues to be highly prevalent, especially in South and Southeast Asia, where socioeconomic disparities, food insecurity, and poor health infrastructure exacerbate the problem (Scott *et al.*, 2020; Sharma, 2020). According to UNICEF and WHO (2025), approximately 83.6 million stunted children live in Asia, with the largest proportion in South Asia (58.7%) (WHO, 2025). Although many countries in the region have made progress in reducing undernutrition, the rate of improvement remains insufficient to meet the Sustainable Development Goal (SDG) target of reducing stunting to below 20% by 2030 (Sharma, 2020).

Indonesia ranks among the top three Southeast Asian countries with the highest prevalence of stunting, after Timor-Leste and India (GoodStat, 2023). According to the 2021 Survey Status Gizi Indonesia (SSGI) conducted by the Kementerian Kesehatan Republik Indonesia, the national prevalence of stunting among children under five was 24.4% (Kementerian Kesehatan Republik Indonesia, 2021). West Java, one of the country's most populous provinces, has shown particularly concerning data—nearly one in four children under five (24.5%) in West Java experience stunting (Kementerian Kesehatan Republik Indonesia, 2021). Sumedang Regency recorded a stunting


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prevalence of 22%, ranking it in the middle tier among districts in West Java (Kementerian Kesehatan Republik Indonesia, 2021).

Stunting results from a combination of inadequate nutrition, recurrent infections, and insufficient maternal and child healthcare. Key determinants include suboptimal infant feeding practices, especially the lack of exclusive breastfeeding during the first six months, and incomplete immunization coverage (Aguayo and Menon, 2016). These factors are particularly critical during the "first 1,000 days"—a window from conception to two years of age when rapid growth and brain development occur (Islam *et al.*, 2020). Failure to meet nutritional and health needs during this period can lead to irreversible deficits in growth and cognitive development.

Childhood malnutrition, as a primary factor causing stunting, is also closely related to exclusive breastfeeding. Exclusive breastfeeding is defined as the provision of breast milk to infants from birth up to six months of age without adding or replacing it with other foods or drinks, except for vitamin supplements, medications, and minerals (Brockway *et al.*, 2024). Breast milk is an important source of nutrition for infant health (Permatasari, Simbolon and Yunita, 2024). It can meet three-quarters of the protein needs of infants aged 6–12 months and contains all the essential amino acids required by the baby. Exclusive breastfeeding plays a vital role in meeting infants' nutritional needs, which impacts their growth and development—including psychomotor, cognitive, and social aspects—as well as their immune system (Asmin and Abdullah, 2021).

The benefits of exclusive breastfeeding include enhancing the infant's immunity, preventing disease by protecting children from various health-threatening illnesses, and most importantly, supporting brain and physical development. During the first six months of life, infants depend solely on breast milk to meet their nutritional needs. Therefore, providing exclusive breast milk during this period has a significant and lasting impact on the infant's brain development and overall physical growth (Hadi *et al.*, 2021; Rusyda and Ronoatmodjo, 2021).

Children who do not receive exclusive breastfeeding are at increased risk of adverse health outcomes. Breastfeeding for less than six months is associated with higher rates of malnutrition, micronutrient deficiencies, and impaired growth, potentially leading to undernutrition and stunting. In Indonesia, only 52% of children under six months are exclusively breastfed, which falls short of the national target of 80% coverage (World Health Organization (WHO), 2021). This shortfall significantly contributes to the country's ongoing nutritional challenges.

Breastfeeding can prevent the deaths of more than 820,000 children under five years of age, with the majority (87%) occurring in children under six months (Beal *et al.*, 2018). Previous studies have shown that when infants do not receive exclusive breastfeeding, the risk of stunting increases. Studies conducted in several developing countries—including Ethiopia, Burundi, Malawi, South Africa, and Nepal—demonstrate that exclusive breastfeeding significantly reduces the incidence of stunting (Jezua, Silitonga and Rambung, 2021).

Several studies indicate that infections contribute to stunting. Preventing infectious diseases in children can be effectively achieved through immunization (Purwanti, Masitoh and Ronoatmodjo, 2025). Immunization artificially induces immunity, either via vaccination (active immunization) or antibody administration (passive immunization). Active immunization stimulates the immune system to produce specific antibodies and cellular immune responses, whereas passive immunization provides temporary protection through exogenously administered antibodies or transplacental transfer from mother to fetus. A child's immunization status also serves as an indicator of engagement with healthcare services (Purwanti, Masitoh and Ronoatmodjo, 2025).

Complete basic immunization in children plays a critical role in supporting growth and development. Administering these essential immunizations helps protect children from developmental disorders and diseases that frequently cause disability or mortality. The recommended basic immunizations administered between birth and nine months of age include hepatitis B, BCG,


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polio/IPV, DPT-HB-Hib, and measles vaccines (Diva *et al.*, 2023).

Data from Haurgombong Community Health Center indicate that exclusive breastfeeding coverage in the area reached 77.78% (male: 76.47%, female: 78.95%). However, childhood immunization coverage in this area has not yet met the target, reaching only 74%, primarily due to the impact of the COVID-19 pandemic. Although previous studies on the direct relationship between immunization status and stunting have shown mixed results, and local community-level evidence—particularly from rural areas such as Haurngombong—is limited. Therefore, this study aims to assess the associations among exclusive breastfeeding, immunization status, and stunting among children aged 24–59 months in the Haurngombong Health Center area, Sumedang Regency.

## METHODS

### Study design and setting

This study employed an analytical observational case–control design, comparing children aged 2–5 years with stunting (cases) and without stunting (controls). The study was conducted at Haurngombong Health Center, Sumedang Regency, West Java, Indonesia, covering six villages: Cilembu, Mekarbakti, Haurngombong, Ciptasari, Cimarias, and Cinanggerang. These villages represent a mix of agricultural and semi-urban communities. Data collection took place between July and September 2022.

### Population and sampling

The target population consisted of all children aged 2–5 years registered at the Haurngombong Health Center during the study period. The accessible population included 190 children under five, both stunted and non-stunted, whose anthropometric data were available in health records.

### Sample Size

The required sample size was calculated using Slovin's formula (Nursalam, 2016), with a margin of error of 10%, resulting in a minimum of 66 participants:

$$n = \frac{N}{1 + N(d)^2} = \frac{190}{1 + 190(0.1)^2} = \frac{190}{1 + 1.9} = \frac{190}{2.9} \approx 66$$

Where:
n = sample size
N = population size (190 children)
d = margin of error (0.1).

Because a case–control design requires equal groups, the sample was doubled to include 66 children with stunting and 66 children without stunting (total n = 132). It is acknowledged that Slovin's formula is not the standard approach for sample size calculation in analytical case–control studies, which ideally require calculations based on expected exposure proportions and effect sizes (odds ratios). However, the use of Slovin's formula in this study reflects a pragmatic decision, given the limited number of eligible children with complete and verifiable anthropometric records in the study area. Consequently, the sample size was determined by the availability of eligible participants during the study period rather than by an effect size calculation.

### Sampling technique

Purposive sampling was employed to select participants. This technique involves intentionally choosing subjects from the population based on specific characteristics relevant to the research objectives, ensuring that the sample represents the population of interest (Nursalam, 2016). Purposive sampling was necessary in this study because identifying stunted children required verification through Growth Monitoring Program (Pemantauan Status Gizi, or PSG) records and growth charts (KMS). Only children with confirmed anthropometric data were eligible.

### Inclusion Criteria

*Cases:* Mothers with children aged 24–60 months diagnosed as stunted based on the Growth Monitoring Program (PSG) and child health records (KMS), residing within the Haurngombong Health Center area, and willing to provide informed consent.
*Controls:* Mothers with children aged 24–60 months residing in the same area, with normal growth status, and willing to provide informed consent.


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**Exclusion Criteria**

Children with congenital disorders or chronic illnesses affecting growth were excluded.

The authors acknowledge that the use of purposive sampling in a case–control study may introduce selection bias, potentially limiting the generalizability of the findings. However, this approach was justified to ensure accurate classification of stunting status, which was critical for examining the associations between exclusive breastfeeding, complete immunization, and stunting.

**Instrument**

Data were collected using a structured questionnaire developed from the literature and validated for content validity by three public health experts. The instrument included four sections: (1) demographic information, (2) breastfeeding history, (3) immunization records, and (4) anthropometric measurements. Anthropometric data (height-for-age) were extracted from child health books (Kartu Menuju Sehat – KMS) maintained by local health cadres supervised by health staff. The questionnaire was developed based on previous literature and expert consultation. Content validity was assessed by three public health experts, who evaluated the relevance, clarity, and comprehensiveness of each item. The Content Validity Index (CVI) was calculated, and all items achieved a CVI ≥ 0.80, indicating good content validity. To ensure reliability, data extraction was performed independently by two trained enumerators, and inter-rater reliability was assessed using Cohen's kappa, which indicated substantial agreement ($\kappa = 0.82$).

**Data Collection**

Prior to data collection, the researcher obtained formal permission from the Sumedang District Health Office and the Haurngombong Health Center. Mothers or caregivers of eligible children were approached at their households or during scheduled health visits. After providing verbal and written informed consent, respondents were interviewed using the validated questionnaire. Data were anonymized and coded to protect participant confidentiality.

**Data analysis**

Data were entered and analyzed using IBM SPSS Statistics version 26. Descriptive statistics, including frequencies and percentages, were used to describe participant characteristics. Bivariate analysis was conducted using Chi-square tests to examine the association between independent variables (exclusive breastfeeding and immunization) and the dependent variable (stunting). Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated to measure the strength of the associations. Statistical significance was set at $p < 0.05$.

**Ethical Consideration**

This study received ethical approval from the Health Research Ethics Committee of Dharma Husada Health Institute, approval number 176/KEPK/SDHB/B/VIII/2022. Informed consent was obtained from all parents or legal guardians. Participation was voluntary, and participants could withdraw at any time. Confidentiality and privacy were strictly maintained, with all data used solely for academic purposes. The study adhered to ethical principles ensuring the rights and welfare of child participants.

## RESULTS AND DISCUSSION

### Results

**Characteristics of respondents**

A total of 132 children aged 24–59 months were included in this study. Most mothers had completed senior high school and were housewives, while most fathers had also completed senior high school and worked as laborers or small business owners. More than half of the households had incomes below the regional minimum wage. Slightly more boys than girls participated in the study. Only a small proportion of children had a history of prematurity, low birth weight, infection, or hospitalization. Complete descriptive data are presented in Table 1.

**Table 1. Characteristics of respondent (n=132)**

| Variable | Category | n (%) |
|---|---|---|
| **Mother's education** | Junior High School | 34 (25.8) |


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| Variable | Category | n (%) |
|---|---|---|
| | Senior High School | 95 (72.0) |
| | Diploma | 1 (0.8) |
| | Bachelor | 2 (1.5) |
| **Mother's occupation** | Housewife (IRT) | 83 (62.9) |
| | Laborer | 19 (14.4) |
| | Farmer | 1 (0.8) |
| | Private employee | 1 (0.8) |
| | Entrepreneur / Business owner | 28 (21.2) |
| **Father's education** | Junior High School | 5 (3.8) |
| | Senior High School | 112 (84.8) |
| | Diploma | 6 (4.5) |
| | Bachelor | 9 (6.8) |
| **Father's occupation** | Laborer | 49 (37.1) |
| | Farmer | 11 (8.3) |
| | Civil Servant (PNS) | 2 (1.5) |
| | Odd jobs | 1 (0.8) |
| | Private employee | 12 (9.1) |
| | Business owner | 36 (27.3) |
| | Entrepreneur (Wiraswasta) | 21 (15.9) |
| **Family income** | < UMR (3,200,000 IDR) | 80 (60.6) |
| | ≥ UMR (3,210,000 -4,000,000 IDR) | 52 (39.4) |
| **Child's sex** | Male | 72 (54.5) |
| | Female | 60 (45.5) |
| **History of prematurity** | Yes | 6 (4.5) |
| | No | 126 (95.5) |
| **History of Low Birth Weight (<2500 g)** | Yes | 6 (4.5) |
| | No | 126 (95.5) |
| **History of infection** | Yes | 11 (8.3) |
| | No | 121 (91.7) |
| **Hospitalization history** | Yes | 36 (27.3) |
| | No | 96 (72.7) |

**Exclusive breastfeeding practices**

Among the 132 children, 49.1% were exclusively breastfed for the first six months. Children who were not exclusively breastfed had a 3.27 times higher risk of stunting compared to those who were exclusively breastfed, indicating that exclusive breastfeeding is protective against stunting (Table 2).

**Table 2. Distribution of exclusive breastfeeding and stunting status (n=132)**

| Exclusive Breastfeeding Status | Stunted (n=66) | Not stunted (n=66) | Total | p | OR (95% CI) |
|---|---|---|---|---|---|
| | n (%) | n (%) | n (%) | | |
| **No** | 43 (23.6) | 24 (18.2) | 67 (50.8) | 0.001 | 3.27 (1.48-7.22) |
| **Yes** | 23 (17.4) | 42 (31.8) | 65 (49,1) | | |
| **Total** | 66 (50.0) | 66 (50.0) | 132 (100) | | |

**Immunization status**

Among the 132 children, 56.8% had completed basic immunizations. However, no statistically significant association was found between immunization status and stunting. Full details are shown in Table 3.

**Table 3. Distribution of immunization status and stunting (n=132)**

| Immunization Status | Stunted (n=66) | Not stunted (n=66) | Total | p | OR (95% CI) |
|---|---|---|---|---|---|
| | n (%) | n (%) | n (%) | | |
| **Incomplete** | 31 (23.5) | 26 (19.7) | 57 (43.2) | 0.380 | 1.36 (0.68-2.71) |
| **Complete** | 35 (26.5) | 40 (30.3) | 75 (56.8) | | |
| **Total** | 66 (50.0) | 66 (50.0) | 132 (100) | | |

**Exclusive breastfeeding status and stunting**

The strong association between exclusive breastfeeding and stunting aligns with global evidence highlighting the protective role of breastfeeding in child growth. Studies from Ethiopia, Nepal, and Indonesia consistently indicate that


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children who are not exclusively breastfed are more likely to be stunted (Azizah, Dewi and Murti, 2022; Gebreayohanes and Dessie, 2022; Permatasari, Simbolon and Yunita, 2024). Breast milk provides essential macro- and micronutrients that support optimal growth and development in infants. Inadequate breastfeeding leads to insufficient nutrient intake, which may result in malnutrition and increase the risk of stunting (Kusumawati, Rahardjo and Sari, 2015).

Exclusive breastfeeding for the first six months of life reduces the risk of stunting. Breast milk supplies all essential nutrients and bioactive compounds necessary for growth during this period, while also protecting infants against infections that can impair nutrient absorption (Boix-Amorós *et al.*, 2019; Brockway *et al.*, 2024). The immunological properties of breast milk—including antibodies, lactoferrin, and oligosaccharides—enhance gut health and immunity, thereby reducing the risk of disease-related malnutrition (Brockway *et al.*, 2024; Szyller *et al.*, 2024). Additionally, the high bioavailability of calcium in breast milk supports bone formation, further promoting optimal physical growth. These properties underscore the critical role of exclusive breastfeeding in preventing stunting and ensuring healthy child development.

In Indonesia, however, the prevalence of exclusive breastfeeding remains below the national target of 80%, with only about half of infants under six months receiving breast milk exclusively (World Health Organization [WHO], 2021; UNICEF, 2024). Sociocultural barriers, maternal employment challenges, and limited breastfeeding support contribute to this situation. The findings of this study reinforce the urgency of strengthening community-based breastfeeding promotion and counseling, particularly in rural settings where access to lactation education and postnatal follow-up is limited.

**Immunization status and stunting**

In this study, immunization status was not significantly associated with stunting among children aged 24–59 months. This finding should be interpreted with caution. The relatively high immunization coverage in the study population (approximately 72–74%) limited variability, reducing the ability to detect a measurable effect on stunting. Additionally, stunting is a multifactorial condition, primarily influenced by nutrition, maternal health, socioeconomic factors, and environmental conditions.

While immunization is critical for preventing infectious diseases, its direct impact on linear growth may be indirect, mediated by nutritional status, recurrent infections, and socioeconomic conditions. Previous studies in Indonesia report mixed results: some found a significant association between incomplete immunization and higher stunting (Purwanti, Masitoh and Ronoatmodjo, 2025), while others did not (Diva *et al.*, 2023). These findings are also consistent with those reported by Azriful et al. (2018) who studied 183 toddlers aged 24–59 months in Rangas Village, Bangke District, Majene Regency. The chi-square test yielded a p-value of 0.123 ($p > 0.05$), indicating no significant relationship between the completeness of basic immunizations and stunting incidence.

Several factors may explain the lack of significance in this study. First, the relatively high immunization coverage (72.6%) reduces variability, limiting the ability to detect an effect. Additionally, the distribution of immunization status within the case group (stunted children) did not show a meaningful difference, with incomplete immunization at 23.5% and complete immunization at 26.5%, resulting in non-significant findings. Overall, immunization coverage in Haurgombong Village remains below 80% in both the case and control groups, which contributes to the absence of a significant difference between immunization status and stunting.

Low immunization coverage may be caused by mothers' lack of awareness of its importance. Immunization, or vaccination, is a way to boost immunity against disease, making it crucial for toddlers to prevent various infectious diseases that can lead to malnutrition. Factors such as lack of knowledge, awareness, and perceptions of immunization side effects influence family participation. Ultimately, children—whether or not they are immunized—can experience stunting if not supplemented with adequate nutrition, sanitation, and a clean, safe environment, because stunting is multifactorial and influenced by factors such as diet, maternal education,


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household income, and environmental conditions (Fanny Dewi, Wirawan and Muslihah, 2025).

Other considerations include the researchers' failure to control for sociodemographic variables, particularly maternal education and household income, which could confound the relationship between immunization and stunting.

Stunting prevention in Haurgombong should prioritize strengthening exclusive breastfeeding through integrated, community-based interventions supported by health cadres and maternal–child health services. Although immunization primarily prevents infectious diseases, its role in reducing stunting is enhanced when combined with nutrition-sensitive interventions, such as growth monitoring and parental education. Coordinated collaboration among nurses, midwives, and community health workers is essential to deliver comprehensive services that support SDG 2 (Zero Hunger) and SDG 3 (Good Health and Well-Being) in rural settings.

**Implication**

The findings have important implications for Indonesia's national stunting reduction program (Stranas Stunting). Exclusive breastfeeding promotion should remain a core component. Training healthcare professionals to provide breastfeeding counseling, establishing workplace lactation support facilities, and strengthening community peer support could substantially improve breastfeeding adherence. While immunization remains essential for child survival, its indirect contribution to stunting reduction suggests that programs must adopt an integrated framework that combines vaccination campaigns with nutrition-sensitive interventions. Targeted interventions in rural areas like Haurgombong are particularly crucial, given the higher vulnerability of these populations to health disparities.

**Strengths and limitations**

A significant strength of this study is its focus on a rural, community-based population, providing locally relevant evidence for policy and practice. The case–control design allowed for comparisons between stunted and non-stunted children, yielding meaningful insights into risk factors. However, several limitations should be acknowledged. First, potential recall bias may affect breastfeeding and immunization histories. Additionally, the study did not include other relevant factors such as dietary diversity and maternal nutritional status, which may also contribute to stunting. Furthermore, the sample size was determined pragmatically based on the availability of eligible children with complete anthropometric and health records, rather than through an effect-size–based calculation.

## CONCLUSION

This study demonstrates that exclusive breastfeeding significantly reduces the risk of stunting among children aged 2–5 years, underscoring its critical role in preventing chronic undernutrition. Strengthening breastfeeding promotion and community-based support directly contribute to SDG 2 (Zero Hunger), while integrating immunization with nutrition-sensitive interventions supports SDG 3 (Good Health and Well-Being). An integrated approach through primary healthcare and community programs is essential to reduce stunting and improve child health outcomes in rural settings such as Sumedang, West Java.

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