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# RISK FACTORS OF STUNTING, ANEMIA AND VITAMIN A DEFICIENCY (VAD) COEXISTENCE AMONG CHILDREN UNDER FIVE IN INDONESIA

*Faktor Risiko Koeksistensi Stunting, Anemia, dan Kekurangan Vitamin A (KVA) pada Balita di Indonesia*

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**ABSTRACT**

**Stunting, anemia, and vitamin A deficiency (VAD) are nutritional problems among children under five that can occur simultaneously (coexistence). This study aimed to determine the prevalence and risk factors of the coexistence of stunting, anemia, and VAD among children under five years of age in Indonesia. This study utilized secondary data from the 2023 Indonesia Health Survey (SKI) and included 628 children aged 0–59 months old. Data were analyzed using the Rao-Scott Chi-Square test and complex logistic regression. The prevalence of stunting, anemia, and VAD was 26.2 percent, 16.1 percent and 9.1 percent, respectively. The coexistence of stunting and anemia 4.4 percent, coexistence of stunting and VAD 2.7 percent, coexistence of anemia and VAD 2.9 percent and coexistence of stunting, anemia and VAD 0.3 percent. Mothers who attended fewer than six antenatal care (ANC) visits during pregnancy had a 13.558 times higher risk (OR=13.558; 95% CI=1.465–125.460; p=0.022) and children of mothers with low education had a 11.467 times higher risk (OR=11.467; 95% CI=1.131–119.329; p=0.039) of having the coexistence of stunting, anemia, and VAD. Attending ANC services at least six times and nutrition education can reduce the risk of coexisting stunting, anemia, and VAD.**

**Keywords: anemia, coexistence, stunting, vitamin A deficiency**

**ABSTRAK**

**Stunting, anemia, dan kekurangan vitamin A (KVA) merupakan masalah gizi pada balita yang dapat terjadi secara bersamaan (koeksistensi). Penelitian ini bertujuan untuk mengetahui prevalensi dan faktor risiko koeksistensi stunting, anemia dan KVA pada balita di Indonesia. Penelitian ini menggunakan data sekunder dari Survei Kesehatan Indonesia (SKI) tahun 2023 dengan melibatkan 628 anak usia 0–59 bulan. Data dianalisis menggunakan uji Chi-Square Rao-Scott dan regresi logistik kompleks. Prevalensi stunting, anemia dan KVA masing-masing sebesar 26,2 persen, anemia 16,1 persen, KVA 9,1 persen. Koeksistensi stunting dan anemia 4,4 persen, koeksistensi stunting dan KVA 2,7 persen, koeksistensi anemia dan KVA 2,9 persen, serta koeksistensi stunting, anemia, dan KVA sebesar 0,3 persen. Ibu yang melakukan kunjungan antenatal care (ANC) kurang dari enam kali selama kehamilan memiliki risiko 13,558 kali lebih tinggi (OR=13,558; 95% CI=1,465–125,460; p=0,022) untuk memiliki anak dengan koeksistensi stunting, anemia, dan VAD. Selain itu, anak dari ibu dengan pendidikan rendah memiliki risiko 11,467 kali lebih tinggi (OR=11,467; 95% CI=1,131–119,329; p=0,039) mengalami koeksistensi stunting, anemia, dan KVA. Kunjungan ANC minimal enam kali dan edukasi gizi dapat membantu menurunkan risiko koeksistensi stunting, anemia, dan KVA pada anak balita.**

**Kata kunci: anemia, koeksistensi, stunting, defisiensi vitamin A**

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## INTRODUCTION

Children under five are in a phase of very rapid growth and development, requiring adequate nutritional intake to support their metabolic needs.[1] Inadequate nutrition in this age group increases the risk of malnutrition.[1] Malnutrition refers to deficiencies, excesses, or imbalances in the intake of nutrients.[1] Indonesia is currently facing a triple burden of malnutrition, which is also defined as the coexistence of undernutrition and overnutrition involving both macro- and micronutrient deficiencies and excesses that may occur within the same population, community, household, or even individual.[2] Micronutrient deficiencies frequently occur among stunted children, particularly during the critical first two years of life.[3] Stunting, anemia, and vitamin A deficiency (VAD) are three forms of malnutrition that may occur simultaneously, especially among children in developing countries.[3]

Stunting is a condition in which a child has a length or height of less than -2 standard deviations (SD) from the median height-for-age (H/A).[1] The prevalence of stunting in Indonesia has declined, although not significantly, over recent years: 30,8 percent[4], 24,4 percent[5], 21,6 percent[6], 21,5 percent[7], and 19,8 percent.[8] The short- and long-term consequences of stunting include increased morbidity and mortality, poor child development, reduced learning capacity, higher risk of infections and non-communicable diseases, reduced energy expenditure, insulin resistance, and an elevated risk of diabetes, obesity, hypertension, dyslipidemia, and decreased work capacity, among others. [9] [10]

Children who suffer from stunting often experience micronutrient deficiencies due to infection and inadequate dietary intake.[1] Complementary feeding begins at approximately six months of age because breastfeeding alone is no longer sufficient to meet the nutritional needs of infants.[11] Therefore, children must receive safe and nutritionally adequate foods in terms of protein, energy, vitamins, and minerals, alongside continued breastfeeding for up to 23 months or beyond.[11]

Stunting commonly co-occurs with anemia.[12] Data from the Indonesian Family Life Survey (IFLS-5) in 2014–2015 showed that the prevalence of stunting among children aged 6–9 years was 24,8 percent, while anemia was 30,5 percent, and the coexistence of stunting and anemia was 8.8 percent.[12] Studies have reported the prevalence of concurrent stunting and anemia among children under five to be 24,4 persen in Ethiopia[13], 21,5 percent in India, and 30,4 percent in Peru.[14] Anemia leads to impaired growth and cognitive development and increased morbidity and mortality in children, making it more difficult for children to participate in physical activities that promote their growth.[3,15]

The coexistence can exacerbate the negative effects on child growth and development, increasing morbidity and mortality risks.[16] Therefore, children with both anemia and VAD may experience more severe stunting than those with only one deficiency.[3] A study of 21.172 children aged 6–59 months in Ethiopia found that the likelihood of coexisting stunting and anemia was higher among children born to anemic mothers, mothers of very short stature, households practicing open defecation, children of mothers with no education, and those living in rural areas.[17] Research in Uganda among children aged 6–59 months showed that children with VAD were 1,43 times more likely to be stunted than those without VAD.[18] A meta-analysis reported that stunted toddlers had a 1,54 times higher risk of VAD and that children who did not receive vitamin A supplementation had a 1,37 times higher risk of iron deficiency anemia (IDA).[19] Preschool children in Chongqing, China with VAD had a 2,56 times greater risk of anemia.[20] This association is linked to pathogenesis and metabolic mechanisms, including increased growth and differentiation of erythroid progenitor cells, immune responses to infection, and mobilization of iron stores from tissues.[21]

Additionally, anemia associated with vitamin A deficiency is influenced by the regulation of hepcidin, a hormone that controls iron homeostasis.[22] A study in Brazil found that higher serum retinol levels were correlated with lower hepcidin levels, which may enhance iron absorption and reduce the risk of anemia.[22] Vitamin A also plays a role in regulating iron availability in the body, both through the mobilization of iron stores and increased intestinal absorption.[23] Studies have shown that vitamin A supplementation combined with iron therapy is more effective in increasing hemoglobin levels than iron therapy alone.[24]

Therefore, further investigation is needed to identify the risk factors for coexisting stunting, anemia, and VAD among young children especially in Indonesia. The interaction of these three nutritional problems is important to study, considering that several studies have indicated the interrelation of these nutritional issues. A more specific understanding of these risk factors is expected to provide valuable insights for formulating policies and effective interventions aimed at reducing the coexistence of stunting, anemia, and VAD in Indonesia. This study aimed to analyze the risk factors associated with the coexistence of stunting, anemia, and VAD among children under five years of age in Indonesia.

## METHODS

This study employed a cross-sectional design using secondary data from the 2023 Indonesia Health Survey (SKI) conducted by the Ministry of Health of Indonesia. Data collection took place between August and the first week of October 2023, and data analysis was conducted in Bogor between June and September 2025. A total of 628 children aged 0–59 months. The study sample was derived from the nationally representative 2023 Indonesia Health Survey dataset based on the availability of complete biochemical (serum retinol, hemoglobin) and anthropometric measurements (height/length and weight). The inclusion criteria were children aged 0–59 months with valid height-for-age z-scores ($-6$ SD $\leq z \leq +5$ SD) and complete retinol and hemoglobin data. The exclusion criteria were incomplete data or unmatched records with parental or household characteristics.

All processes of collecting specific health data were carried out by trained data collectors with a minimum educational background of D3 in health. Data collection was conducted through interviews, measurements, and examinations. The measuring and examination equipment used were validated. Anthropometric measurements were performed using a digital weight scale (accuracy level 0.1 kg) and a height/length measuring tool (accuracy of 1 mm). Hb examination was conducted using a rapid detection tool called the Point of Care Test (POCT), namely, the Hemocue Hb201+ Analyzer. Retinol levels are examined using HPLC or UPLC. Retinol in serum was added with an internal standard and separated from interfering substances with the aid of ethanol, then extracted using n-hexane. The extraction result was dried using nitrogen gas and then dissolved in methanol. The dissolved sample was then injected into HPLC or UPLC at a wavelength of 325 nm using a methanol: water mobile phase. The resulting peak was quantified using a retinol standard curve.

Household characteristics included place of residence (urban/rural), maternal age, occupation, education level, number of children under five in the household, total household members, socioeconomic status, maternal height, and social assistance received in the past year. Child characteristics included age, sex, birth weight, and birth length. Health-related variables included infectious disease history (diarrhea or acute respiratory infection in the past month, malaria in the past year), immunization status, vitamin A supplementation (for both children and mothers), and iron–folic acid (IFA) supplementation during pregnancy. Nutritional status was assessed using anthropometric indicators (weight and height) calculated as z-scores, and biochemical status was determined through serum retinol and hemoglobin levels.

Maternal healthcare variables included antenatal care (ANC) coverage and components. ANC coverage was assessed based on at least six visits: one in the first trimester, two in the second, and three in the third. The "10T" components of ANC services included: (1) measurement of maternal height and weight, (2) blood pressure assessment, (3) fundal height measurement, (4) tetanus toxoid (TT) immunization, (5) iron–folic acid (IFA) supplementation, (6) mid–upper arm circumference (MUAC) measurement, (7) laboratory testing, (8) counseling, and (9) case management. ANC was categorized as complete if all six visits and the 10T components were met, and incomplete otherwise; the environmental health variables included household access to drinking water, sanitation facilities, and maternal handwashing practices. Access to drinking water was categorized as follows: (1) no access (ladder 1–2): households using unprotected surface water sources such as rivers, lakes, ponds, or unprotected springs; (2) basic access (ladder 3–4): households using improved drinking water sources; and (3) safely managed access (ladder 5): households with improved water sources located on-premises, available when needed, and meeting quality standards. Proper sanitation was defined as the use of a water-sealed toilet with a flushing system.

Socioeconomic status was determined using a household wealth index computed via principal component analysis (PCA) in IBM SPSS version 22. The variables included the type and power of household lighting, ownership of appliances (washing machine, refrigerator, air conditioner, computer/laptop, and TV ≥30 inches), jewelry (≥10 g), private vehicles, type of cooking fuel, ceiling material, flooring, and wall material. The resulting wealth index was divided into five quintiles and further grouped into three socioeconomic categories: low (quintiles 1–2), middle (quintile 3), and high (quintiles 4–5) socioeconomic status.

Data were analyzed using WHO Anthro, Microsoft Excel 2021, and IBM SPSS 22,0 with a complex sample design approach. Coexistence was defined as the simultaneous presence of stunting, anemia, and vitamin A deficiency in the same child. Descriptive analysis was presented as frequency and proportion distribution. Bivariate associations were tested using the Rao-Scott Chi-Square test. Variables with p ≤ 0,25 were included in the binary logistic regression (complex sample) model to identify the risk factors for stunting–anemia coexistence. Logistic regression remains appropriate despite the relatively small number of participants with coexisting stunting, anemia, and vitamin A deficiency because it is widely used for dichotomous outcomes, including rare events. The assumptions of logistic regression were met, notably the absence of multicollinearity and the appropriate model specification. In this study, the use of a complex sample logistic regression approach also strengthened the validity of the analysis, as it considered the complex survey design, including weighting, stratification, and clustering. This approach is recommended in national health survey data analysis to produce more accurate parameter estimates and standard errors than conventional logistic regression. Results are presented as odds ratios (OR), 95 pecent confidence intervals (CI), and p-values, with statistical significance set at p<0,05.

## RESULTS

The sample of this study consisted of 628 children aged 0–59 months from 34 provinces in Indonesia based on the 2023 SKI data. The characteristics of the study subjects showed that the majority were aged 25–59 months (76,4%) and female (50,6%). Low birth weight (LBW) was found in 6,8 percent of children, and 13,1 percent had short birth length. These findings indicate that a small proportion of children were already at risk for impaired growth from birth.

Table 1
Characteristics of Subjects by Region

| Variable | Urban n (%) | Rural n (%) | Urban + Rural n (%) |
|---|---|---|---|
| Age (month) | | | |
| 0-12 mo | 33 (8.1) | 14 (6.4) | 47 (7.5) |
| 13-24 mo | 68 (16.7) | 33 (15.0) | 101 (16.1) |
| 25-59 mo | 307 (75.2) | 173 (78.6) | 480 (76.4) |
| Total | 408 (100) | 220 (100) | 628 (100) |
| Sex | | | |
| Male | 185 (45.3) | 125 (56.8) | 310 (49.4) |
| Female | 223 (54.7) | 95 (43.2) | 318 (50.6) |
| Total | 408 (100) | 220 (100) | 628 (100) |
| Birth weight | | | |
| Normal | 381 (93.4) | 204 (92.7) | 585 (93.2) |
| LBW | 27 (6.6) | 16 (7.3) | 43 (6.8) |
| Total | 408 (100) | 220 (100) | 628 (100) |
| Birth length | | | |
| Normal | 351 (86.0) | 195 (88.6) | 546 (86.9) |
| Short | 57 (14.0) | 25 (11.4) | 82 (13.1) |
| Total | 408 (100) | 220 (100) | 628 (100) |

Table 2
Prevalence of Stunting, Anemia, VAD, and Their Coexistence

| Variable | Urban n (%) | Rural n (%) | Urban + Rural n (%) |
|---|---|---|---|
| Height for age (H/A) | | | |
| Normal | 328 (80.4) | 145 (65.9) | 473 (75.3) |
| Stunting | 80 (19.6) | 75 (34.1) | 155 (24.7) |
| Total | 408 (100) | 220 (100) | 628 (100) |
| Hemoglobin level | | | |
| Normal | 333 (81.6) | 175 (79.5) | 508 (80.9) |
| Anemia | 75 (18.4) | 45 (20.5) | 120 (19.1) |
| Total | 408 (100) | 220 (100) | 628 (100) |
| Serum retinol level | | | |
| Normal | 371 (90.9) | 197 (89.5) | 568 (90.4) |
| VAD | 37 (9.1) | 23 (10.5) | 60 (9.6) |
| Total | 408 (100) | 220 (100) | 628 (100) |
| The coexistence of stunting and anemia | | | |
| No | 391 (95.8) | 207 (94.1) | 598 (95.2) |
| Yes | 17 (4.2) | 13 (5.9) | 30 (4.8) |
| Total | 408 (100) | 220 (100) | 628 (100) |
| The coexistence of stunting and VAD | | | |
| No | 400 (98) | 216 (98.2) | 616 (98.1) |
| Yes | 8 (2) | 4 (1.8) | 12 (1.9) |
| Total | 408 (100) | 220 (100) | 628 (100) |
| The coexistence of anemia and VAD | | | |
| No | 395 (96.8) | 210 (95.5) | 605 (96.3) |
| Yes | 13 (3.2) | 10 (4.5) | 23 (3.7) |
| Total | 408 (100) | 220 (100) | 628 (100) |
| The coexistence of stunting, anemia and VAD | | | |
| No | 406 (99.5) | 218 (99.1) | 624 (99.4) |
| Yes | 2 (0.5) | 2 (0.9) | 4 (0.6) |
| Total | 408 (100) | 220 (100) | 628 (100) |

Table 3
Relationship Between Subject Characteristics, Family Characteristics, Environmental Sanitation, Health Status, and the Coexistence of Stunting, Anemia, and VAD

| Variabel | Normal n (%) | Stunting + anaemia + VAD n (%) | Total n (%) |
|---|---|---|---|
| Vitamin A consumption in postpartum (*p value* = 0.044) | | | |
| Complete | 198 (31.7) | 1 (25.0) | 199 (31.7) |
| incomplete | 426 (68.3) | 3 (75.0) | 429 (68.3) |
| Maternal education (*p value* = 0.003) | | | |
| Low (< junior high school) | 282 (45.2) | 3 (75.0) | 285 (45.4) |
| High (senior high school or above) | 342 (54.8) | 1 (25.0) | 343 (54.6) |
| ANC visit required (*p value* =0.001) | | | |
| Complete | 323 (51.8) | 1 (25.0) | 324 (51.6) |
| incomplete | 301 (48.2) | 3 (75.0) | 304 (48.4) |
| Total | 624 (100) | 4 (100) | 628 (100) |

Table 4
Risk Factors for The Coexistence of Stunting, Anemia, and VAD

| Variabel | Kategori | Odd Ratio | 95% CI | *p-value* |
|---|---|---|---|---|
| Minimum of 6 ANC visit | Complete | 1.000 | - | 0.022 |
| | Incomplete | 15.738 | 1.398 – 177.139 | |
| Maternal education | Low | 11.647 | 1.137 – 119.329 | 0.039 |
| | High | 1.000 | - | |

The prevalence of stunting was 24,7 percent, with higher rates observed in rural (34,1%) than in urban areas (19,6%) (Table 2). A total of 19,1 percent of the children experienced anemia. Anemia prevalence was higher in rural areas (20,5%) than in urban ones (18,4%). The prevalence of VAD among children was 9,6 percent. The findings of this study show that the coexistence of stunting, anemia, and VAD among children in Indonesia still occurs, although the proportion is relatively small. Of the estimated 284.784 children, 4,8 percent experienced concurrent stunting and anemia, 1,9 percent experienced stunting and VAD, 3,7 percent had anemia and VAD, and 0,6 percent had all three conditions simultaneously (Table 2). These results indicate that although the prevalence of each condition individually is already a major national concern, their coexistence remains an important issue because of its potential impact on child growth and long-term health outcomes. This phenomenon reflects the complexity of nutritional problems in Indonesia, which are influenced not only by macronutrient deficiencies but also by interrelated micronutrient deficiencies.

A bivariate analysis was conducted to evaluate the relationship between independent variables and the coexistence of stunting, anemia, and VAD. The Rao–Scott Chi-square test revealed a significant association between height and stunting ($p<0,05$). The bivariate analysis also showed that several factors were significantly associated with the coexistence of stunting and anemia, including maternal vitamin A supplementation during the postpartum period ($p=0,044$), maternal education ($p=0,003$) and completeness of antenatal care (ANC) visits ($p=0,001$). Maternal vitamin A consumption during the postpartum period was also significantly associated with the coexistence of the three conditions ($p=0,044$), with 66,4 percent of mothers not consuming vitamin A supplementation. ANC visits were significantly associated with the coexistence of stunting, anemia, and VAD ($p = 0,001$).

The recommended minimum number of ANC visits is six during pregnancy (once in the first trimester, twice in the second trimester, and thrice in the third trimester). The analysis revealed that mothers who did not complete at least six ANC visits during pregnancy had a 13,558 times higher risk of having a child with coexisting stunting, anemia, and VAD than mothers who completed all recommended ANC visits (OR=13,558; 95% CI=1,465–125,460; $p=0,022$) (Table 3). This high odds ratio indicates that incomplete ANC visits are a significant risk factor for the occurrence of multiple nutritional problems in children.

The analysis revealed that low maternal educational attainment was a significant risk factor for the coexistence of stunting, anemia, and VAD among children under five years of age (OR=11,647; 95% CI=1,137–119,329; $p=0,039$). Children whose mothers had low educational attainment were approximately 11.6 times more likely to experience the coexistence of these three nutritional problems than those whose mothers had higher educational attainment. Furthermore, approximately 93.2 percent of children with the coexistence of stunting, anemia, and VAD were from families in which the mothers had low educational attainment.

## DISCUSSION

This study shows that the prevalence of stunting, anemia, and VAD remains a significant nutritional problem in children under five years of age. The coexistence of stunting, anemia, and VAD indicates that nutritional problems are interrelated and influenced by shared risk factors such as socioeconomic status, history of exclusive breastfeeding, and history of infectious diseases.[25]

Stunting, an indicator of chronic undernutrition, is often accompanied by inadequate intake of micronutrients, including iron, and chronic infections that increase the risk of anemia.[26,9] The coexistence of anemia and stunting may result from overlapping factors, including insufficient dietary intake, infectious diseases, poor sanitation, hygiene, and suboptimal caregiving practices.[27] Stunting in young children due to prolonged nutritional deficiencies that fail to support optimal growth can also impair immune function and increase the risk of anemia, particularly in younger children.[27]

A study conducted in Indonesia in 2023 reported a significant association between vitamin A status and stunting.[28] The study found that stunted and wasted school-aged children had lower serum vitamin A levels than children with normal nutritional status.[28] Vitamin A plays a crucial role in regulating average growth and development through its direct effects on growth hormones and their carrier proteins.[28] The coexistence of stunting and vitamin A deficiency can also be explained by mechanisms involving impaired nutrient absorption and immune dysfunction.[29] Vitamin A deficiency compromises intestinal epithelial barrier function and mucosal immunity, thereby increasing the risk of recurrent gastrointestinal infections such as diarrhea.[29] These infections lead to malabsorption of macro- and micronutrients required for growth, including proteins, zinc, and iron.[29]

Conversely, severe malnutrition may impair liver function, which is responsible for synthesizing retinol-binding protein (RBP).[30] Reduced RBP levels subsequently affect plasma retinol availability.[30] Therefore, these conditions frequently coexist, particularly among children whose diets are low in animal-source protein.[3] A meta-analysis of 10 clinical trials with a total of 680 participants demonstrated that combined iron and vitamin A supplementation was more effective in improving iron status, particularly serum retinol, hemoglobin, and serum iron levels, than iron supplementation alone.[31]

Postpartum vitamin A supplementation among mothers was also significantly associated with the coexistence of stunting, anemia, and vitamin A deficiency in children. A randomized clinical trial involving 66 mothers (33 receiving a single dose of 200.000 IU vitamin A and 33 receiving soybean oil as a placebo) showed that mothers who received high-dose vitamin A experienced a significant increase in serum retinol levels after supplementation compared with pre-supplementation levels (1,05 vs. 1,17 µmol/L; $p = 0.026$).[32] This increase was also significant compared to post-supplementation levels in the control group (1,02 µmol/L; $p = 0,032$). In addition, a significant decline in breast milk retinol levels was observed in the control group when comparing pre- and post-supplementation levels (1,93 vs. 1,34 µmol/L; $p < 0,001$). These findings indicate that maternal vitamin A supplementation positively affects maternal vitamin A status and the retinol concentration in breast milk.[32]

Vitamin A plays an essential role in erythropoiesis, the process of red blood cell production, via its active metabolite retinoic acid (RA).[33] RA signaling is critical for the expression of genes involved in hematopoiesis, particularly in the fetal liver, where it stimulates erythropoietin production and promotes red blood cell (RBC) formation.[33] In individuals with vitamin A deficiency, iron mobilization within the body is impaired, reducing the availability of iron for erythropoiesis and increasing the risk of anemia.[34] Vitamin A deficiency may also increase hepatic hepcidin levels, triggering the release of inflammatory cytokines that contribute to systemic inflammation and infection, thereby exacerbating the coexistence of anemia and VAD.[35] Furthermore, vitamin A deficiency affects the expression of iron regulatory protein 2 (IRP2), influencing the expression of genes involved in intracellular iron metabolism.[35] Therefore, adequate vitamin A intake is crucial for supporting immune function, epithelial integrity and iron metabolism.[36]

A study conducted in Rwanda using data from the Rwanda Demographic and Health Survey found that newborns born to mothers who attended fewer than four antenatal care (ANC) visits had nearly three times higher odds of low birth weight (LBW) (aOR = 2,8; 95% CI: 1,5–5,4; $p = 0,002$) than those whose mothers attended four or more visits. [37] Maternal anemia increased the risk of LBW by 3,5 times (aOR = 3,5; 95% CI: 1,5–5,4; $P < 0,001$), lack of nutritional counseling increased the risk by 2,5 times (aOR = 2,5; 95% CI: 2,0–8,5; $P < 0,001$), and lack of information regarding pregnancy complications increased the risk by 3,3 times (aOR = 3,3; 95% CI: 1,5–6,6; $P = 0,003$). In contrast, iron and folic acid supplementation during pregnancy was identified as a protective factor against LBW (aOR = 0,5; 95% CI: 0,3–0,9; P = 0,015).[37]

Children born to anemic mothers were more likely to experience the coexistence of stunting and anemia (CAS) (AOR = 1.25).[13] Infants with LBW are more vulnerable to infections, including diarrhea and lower respiratory tract infections, and have a higher risk of complications, such as sleep apnea, jaundice, anemia, chronic lung disease, fatigue, and poor appetite, compared with infants with normal birth weight.[38] Low birth weight is strongly associated with maternal anemia during pregnancy, primarily due to iron deficiency, which leads to inadequate oxygen and nutrient supply to the fetus.[39] Iron is a critical micronutrient for tissue growth as it contributes to DNA synthesis; therefore, iron deficiency can inhibit tissue growth.[40] Iron deficiency also disrupts the development and function of dendritic cells, reduces immune cell number and function, and impairs T cell proliferation, leading to a reduced capacity to clear infections and increased susceptibility to acute lower respiratory tract infections.[41] Prolonged infection may subsequently result in impaired growth and contribute to stunting.[40]

Low parental educational attainment, particularly that of mothers, may influence child feeding practices. Mothers with lower educational attainment tend to have limited knowledge of complementary feeding practices, nutritious foods selection, and responsive caregiving, thereby increasing the risk of stunting. Maternal education level also affects the ability to access and comprehend nutrition-related information, including information related to stunting prevention. Mothers with higher educational attainment are generally more capable of accessing health and nutrition information than mothers with lower educational attainment.[42] A study conducted among children aged 6–59 months in Ethiopia reported that children born to mothers with low educational attainment had a 3.6-fold higher risk of experiencing the coexistence of stunting and anemia (AOR = 3.66; 95% CI = 1.85–7.22).[13] In addition, lower maternal educational attainment was identified as a significant predictor of VAD among children age under five years in Brazil. Mothers with lower educational attainment may have inadequate knowledge of appropriate nutrition and dietary diversity, which may contribute to insufficient vitamin A intake and consequently increase the risk of VAD in their children.[43]

The number of participants with coexisting stunting, anemia, and vitamin A deficiency was relatively limited, which may have affected the statistical power and stability of the association estimates. Despite the relatively small number of participants with coexisting events, logistic regression remains appropriate because this method is widely used for dichotomous outcomes, including rare events. Odds ratio estimates in logistic regression generally remain stable as long as the model is not too complex and the analysis is conducted carefully, especially in the context of survey data with a complex sampling approach. Furthermore, this study did not use food consumption variables because of the unavailability of data. The cross-sectional study design does not allow for the determination of causality between risk factors and coexisting malnutrition, as the exposure and outcome variables were measured simultaneously. Therefore, the findings of this study can only be interpreted as an association, and longitudinal research is required to confirm a stronger causal relationship between these variables.

## CONCLUSION

The coexistence of stunting, anemia, and VAD among children under five in Indonesia is predominantly driven by suboptimal maternal healthcare utilization and inadequate perinatal nutritional support. Specifically, insufficient ANC visits and the lack of maternal postpartum vitamin A intake emerge as the most significant risk factors for this overlapping nutritional burden. Rather than presenting as isolated physiological deficits, the concurrent manifestation of these conditions highlights a complex, compounding vulnerability that is deeply rooted in the early stages of maternal-child health pathways and systemic nutritional interactions.

## RECOMMENDATIONS

Efforts to address coexisting stunting, anemia, and VAD should focus on strengthening ANC services, ensuring a minimum of six ANC visits during pregnancy, and adherence to the 10T standard components, including anthropometric measurements, blood pressure monitoring, fundal height assessment, TT immunization, iron–folic acid supplementation, MUAC measurement, laboratory testing, counseling, and case management. Healthcare workers must enhance support for prospective couples and pregnant women as a preventive measure against stunting, anemia, VAD, and their coexistence.

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## REFERENCE

1. World Health Organization [WHO]. Malnutrition [Internet]. 2024 [cited 2025 Jan 20]. Available from: https://www.who.int/news-room/fact-sheets/detail/malnutrition
2. Shrimpton R, Rokx C, Elder L, Marzoeki P. Dorkin D, Pinto R, Pambudi E, Fund UNC, DeRuiter D KM. Indonesia Health Sector Review Indonesia : menghadapi beban malnutrisi ganda [Internet]. 2012. Available from: https://documents1.worldbank.org/curated/en/278471468258284433/pdf/NonAsciiFileName0.pdf
3. Penny ME. Micronutrients in the Treatment of Stunting and Moderate Malnutrition. 2012;70:11–21.
4. Kementerian Kesehatan RI. Laporan nasional RISKESDAS. Jakarta; 2018.
5. Badan Penelitian dan Pengembangan Kesehatan. Buku Saku Hasil Survei Status Gizi Indonesia (SSGI) 2021. Jakarta: Kementerian Kesehatan RI; 2021.
6. Badan Penelitian dan Pengembangan Kesehatan [BKPK, ]. Hasil Survei Status Gizi Indonesia (SSGI) 2022. Jakarta: Kementerian Kesehatan RI; 2022.
7. Badan Penelitian dan Pengembangan Kesehatan [BKPK]. Survei Kesehatan Indonesia (SKI) Tahun 2023 Dalam Angka [Internet]. Jakarta: Kementerian Kesehatan RI; 2023. Available from: https://www.badankebijakan.kemkes.go.id/ski-2023-dalam-angka/
8. Badan Penelitian dan Pengembangan Kesehatan [BKPK]. Buku Saku Hasil Survei Status Gizi Indonesia (SSGI) 2024. Kementerian Kesehatan RI, editor. Jakarta; 2024.
9. Onis de M, Branca F. Review Article Childhood stunting : a global perspective. Matern Child Nurt [Internet]. 2016;12:12–26. doi: 10.1111/mcn.12231
10. Soliman A, Sanctis V De, Alaaraj N, Ahmed S, Alyafei F, Hamed N, et al. Early and Long-term Consequences of Nutritional Stunting : From Childhood to Adulthood. Acta Biomed. 2021;92(4):1–12. doi: 10.23750/abm.v92i1.11346
11. Karlsson O, Kim R, Hasman A SS. Consumption of Vitamin-A-Rich Foods and Vitamin A Supplementation for Children under Two Years Old in 51. Nutrients [Internet]. 2022;14(188). Available from: https://doi.org/10.3390/nu14010188
12. Utami, Mia Mustika Hutria LKCMD. Risk Factors of Stunting, Iron Deficiency Anemia, and Their Coexistence among Children Aged 6-9 Years in Indonesia: Results from the Indonesian Family Life Survey-5 ( IFLS-5 ) in 2014-2015 Faktor Risiko Stunting, Anemia Defisiensi Besi, dan Koeksiste. Amerta Nutr [Internet]. 2023;7(1):120–30. doi: 10.20473/amnt.v7i1.2023.120-130
13. Sahiledengle B, Mwanri L, Petrucka P, Agho KE. Coexistence of Anaemia and Stunting among Children Aged 6 – 59 Months in Ethiopia : Findings from the Nationally Representative Cross-Sectional Study. Int J Environ Res Public Heal. 2023;1–19. https://doi.org/10.3390/ijerph20136251
14. Gosdin L, Matorell R, Bartolini RM, Mehta R, Srikantiah S YM. The co-occurrence of anaemia and stunting in young children india dan peru.pdf. 2018; Available from: doi: 10.1111/mcn.12597%0AORIGINAL
15. Kemenkes RI. Pedoman Pencegahan dan Penanggulangan Anemia pada Remaja Putri dan Wanita Usia Subur (WUS). Jakarta: Kementerian Kesehatan RI; 2018.
16. Anderson VP, Mbchb SJ, Mb DM, Hem N, Hok P, Bailey KB, et al. Co-existing micronutrient deficiencies among stunted Cambodian infants and toddlers. 2008;17(March 2007):72–9.
17. Abbafati C, Abbas KM, Abbasi-Kangevari M, Abd-Allah F, Abdelalim A, Abdollahi M, et al. Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet [Internet]. 2020;396(10258):1223–49. Available from: https://api.elsevier.com/content/article/eid/1-s2.0-S0140673620307522
18. Ssentongo P, M D, Ssentongo AE, Id CF, Id AW, Yang Y, et al. Association of vitamin A deficiency with early childhood stunting in Uganda : A population- based cross-sectional study. PLoS One. 2020;1–16. doi: 10.1371/journal.pone.0233615
19. Dessie G. Prevalence and Determinants of Stunting-Anemia and Wasting-Anemia Comorbidities and Micronutrient Deficiencies in Children Under 5 in the Least-Developed Countries : A Systematic Review and Meta-analysis. Nutr Rev [Internet]. 2024;83(2). Available from: https://doi.org/10.1093/nutrit/nuae063
20. Chen K, Zhang X, Li T yu, Chen L, Qu P, Liu Y xue. Co-assessment of iron, vitamin A and growth status to investigate anemia in preschool children in

suburb Chongqing, China. World J Pediatr. 2009;5(4). doi: 10.1007/s12519-009-0052-z
21. Bloem MW. Semba RD , Bloem MW . Anemia defisiensi vitamin A : epidemiologi dan patogenesis . Eur J Clin Nutr 56 , 271-281. Eur J Clin Nutr. 2002; doi: 10.1038/sj/ejcn/1601320):271–81.
22. Silva AdP, Pereira AdS, Simões BFT, Omena J, Cople-Rodrigues CdS, de Castro IRR, et al. Association of vitamin A with anemia and serum hepcidin levels in children aged 6 to 59 mo. 2021;92. doi: 10.1016/j.nut.2021.111463
23. Gamble M V, Palafox NA, Dancheck B, Ricks MO, Briand K, Semba RD. Relationship of vitamin A deficiency , iron deficiency, and inflammation to anemia among preschool children in the Republic of the Marshall Islands. Eur J Clin Nutr. 2004;10:1396–401. doi:10.1038/sj.ejcn.1601982
24. Patel SK, Chaturvedi A, Bhardwaj A, Chandra S, Naik G, Hb S. Effect of Vitamin A Supplements with Iron Therapy among Adolescent Girls. 2019;
25. Agustina SA RM. Analisis Determinan Masalah Gizi Balita. J Kesehat. 2020;01:8–14.
26. Black RE, Allen LH, Bhutta ZA, Caulfi LE, Onis M De, Ezzati M, et al. Maternal and Child Undernutrition 1 Maternal and child undernutrition : global and regional. Lancet [Internet]. 2008;243–60. Available from: doi:10.1016/S0140-6736(07)61690-0
27. Stunting H, Nugraheni A. Perkembangan Anak Usia Batita di Puskesmas Kebondalem Hubungan Stunting dengan Anemia, Morbiditas dan Perkembangan Anak Usia Batita di Puskesmas Kebondalem Pemalang. J Epidemiol Kesehat Indones. 2023;7(1). doi: 10.7454/epidkes.v7i1.6667
28. Ernawati F, Nurjanah N, Aji GK, Tjandrarini DH, Widodo Y, Retiaty F, et al. Micronutrients and Nutrition Status of School-Aged Children in Indonesia. J Nutr Metab. 2023; doi: 10.1155/2023/4610038
29. Xia L, Tu L JC. Progress of Vitamin A deficiency affecting on intestinal epithelial barrier function. Chinese life Sci [Internet]. 2012; doi: 10.1376/j.cbls/2012/01.002
30. Goetghebuer T, Brasseur D, Dramaix M, Mol PD, Donnen, Bahwere P, Duchateau J HP. Significance of Very Low Retinol Levels During Severe Protein-energy Malnutrition. J Trop Pediatr. 1996; doi: 10.1093/tropej/42.3.158
31. Ping F, Ling WF, Zhen D XW. A Meta-analysis:effect of improving iron nutritional status with the supplementation of iron alone and in combination with vitamin A. Chinese Prev Med [Internet]. 2010; Available from: doi:10.16506/j.1009-6639.2010.12.006
32. Martins TM, Ferraz IS, Daneluzzi JC, Martinelli CE, Ciampo LA, Ricco RG, Jordao AA, Patta MC VH. Impact of maternal vitamin A supplementation on the mother-infant pair in Brazil. Eur J Clin Nutr. 2010; doi: 10.1038/ejcn2010.165
33. Cañete A, Cano E, Carmona R. Role of Vitamin A / Retinoic Acid in Regulation of Embryonic and Adult Hematopoiesis. Nutrients. 2017;1:1–18. doi: 10.3390/nu9020159
34. Cunha MB, Hankins NAC AS. Effect of vitamin A supplementation on iron status in humans: a systematic review and meta-analysis. Food Sci Nutr. 2018;8398. doi: 10.1080/10408398.2018.1427552
35. Mejia LA E. Impact of vitamin A deficiency on iron metabolism and anemia: a historical perspective and research advances. Nutr Rev [Internet]. 2024;83(3):577–84. doi: 10.1093/nutrit/nuae183
36. Rahman S, Sha A, Alam N, Ahmed AMS, Ireen S, Chowdhury IA, et al. Vitamin A deficiency and determinants of vitamin A status in Bangladeshi children and women : fi ndings of a national survey. Public Heal Nutr. 2016;20(6):1114–25. doi: 10.1017/S1368980016003049
37. Biracyaza E, Evans H, Habimana S, Rusengamihigo D. Regular antenatal care visits were associated with low risk of low birth weight among newborns in Rwanda : Evidence from the 2014/2015 Rwanda Demographic Health Survey (RDHS) Data. F1000 Res. 2022;1–27. doi: 10.12688/f1000research.51969.2
38. Rahman MS, Howlader T, Masud MS. Association of Low-Birth Weight with Malnutrition in Children under Five Years in Bangladesh : Do Mother's Education, Socio- Economic Status, and Birth Interval Matter? BMC Nutr [Internet]. 2016;23:1–16. doi: 10.1371/journal.pone.0157814
39. Luthfiana A, Putri D. The relationship between anemia in pregnant women and Low Birth Weight (LBW): A literature review. World J Adv Res Rev. 2024;23(03):962–5. doi: 10.30574/wjarr.2024.23.3.0147
40. Flora R, Zulkarnain M, Fajar NA, Jasmine AB, Yulianan I, Tanjung R, Sulaiman S, Putra SA, Martini S AA. Factors associated with iron deficiency in elementary school children. Maced J Med Sci. 2022;97–100. doi: 10.3889/oamjms.2022.7800
41. Ren Q, Xu X, Dong Z, Qiu J, Shan Q, Chen R, et al. Iron Deficiency Impairs Dendritic Cell Development and Function, Compromising Host Anti-Infection Capacity. Adv Sci. 2025;2408348:1–14. doi: 10.1002/advs.202408348
42. Ni'mah C, Muniroh L. Hubungan tingkat pendidikan, tingkat pengetahuan dan pola asuh ibu dengan wasting dan stunting pada balita keluarga miskin. Media Gizi Indonesia. 2015;10(1);doi.org/10.20473/mgi.v10i1.84-90
43. Pedrasa DF. Vitamin A deficiency in Brazilian children younger than 5 years old: a systematic review. Rev Bras Saude Mater Infant Recife. 2020. doi.org/10.1590/1806-93042020000300002