



## Relationship Between Free Nutritious Food Intake (MBG) And Nutritional Status And Hemoglobin Levels In Elementary School Children In Indonesia: A Cross-Sectional Study Based On SSGI Data 2024

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### Abstract

**Background:** Indonesia recorded a stunting prevalence of 19.8% (SSGI 2024), down from 21.5% in 2023, but still far from the 2029 RPJMN target of 14.2%. At the same time, the prevalence of anemia in school-age children (5–14 years old) was recorded at 20.6% (Riskesdas, 2018), and in adolescents aged 15–24 years, at 15.5% (SKI, 2023). The Free Nutritious Meal (MBG) Program, launched by the government in January 2025, targets 82.9 million beneficiaries, including elementary and high school students, but its impact on nutritional status and hemoglobin levels has not been systematically measured empirically.

**Objective:** To analyze the relationship between exposure to school feeding programs to nutritional status (z-score TB/U, BB/U, BB/TB) and hemoglobin levels of elementary school children aged 6–12 years in Indonesia, as well as identify determinants of nutrition that can be strengthened through the design of the MBG program.

**Methods:** Quantitative research with a cross-sectional design used SSGI 2024 secondary data (n = 298,903 toddlers) combined with school-age children's supplement data from the 2023 Indonesian Health Survey (SKI). The analysis used multivariate logistic regression to identify determinants of stunting and anemia, with stratification by urban-rural area, household expenditure group, and access to government nutrition programs.

**Results:** Children from households with access to institutional nutrition programs had a significantly lower stunting OR of 0.72 (95%CI: 0.68–0.76) and an anemic OR of 0.68 (95%CI: 0.63–0.74) compared to the group without access. Food diversity (dietary diversity score  $\geq 5$ ) was associated with protection against stunting (AOR 0.61; 95% CI: 0.56–0.67). The six provinces with the largest stunting burden accounted for 50% of the total national cases: West Java (638,000 children under five), Central Java (485,893), East Java (430,780), North Sumatra (316,456), NTT (214,143), and Banten (209,600).

**Conclusion:** School-based feeding programs have significant potential to reduce the burden of stunting and anemia in school-age children, especially if they include adequate food diversity. The MBG design, which ensures that one serving meets at least 1/3 of the daily Nutritional Adequacy Rate (AKG) with iron content  $\geq 5$  mg and animal protein, can be a catalyst for accelerating stunting reduction towards the RPJMN target of 14.2% by 2029.

**Keywords:** *stunting; anemia; Free nutritious meals; school feeding; the nutritional status of school children; SSGI 2024; Indonesia*



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## INTRODUCTION

Malnutrition in school-age children is a persistent public health challenge in Indonesia. Based on the results of the 2024 Indonesian Nutrition Status Survey (SSGI), released by the Health Development Policy Agency (BKPK) of the Ministry of Health of the Republic of Indonesia in May 2025, the national prevalence of stunting was 19.8%, down from 21.5% in 2023.<sup>1</sup> Although this achievement exceeded the Bappenas projection of 20.1%, the decrease of 1.7 percentage points still requires significant acceleration to achieve the 2029 RPJMN target of 14.2%.<sup>2</sup>

Along with stunting, iron deficiency anemia among school-age children is also a double burden that complicates efforts to improve the quality of human resources. Riskesdas 2018 data recorded a prevalence of anemia in children aged 5–14 years at 20.6%, while the adolescent group aged 15–24 years showed a prevalence of 15.5% based on the 2023 Indonesian Health Survey (SKI).<sup>3</sup> Anemia in school-age children has a direct impact on cognitive ability, learning concentration, and long-term productivity.<sup>4</sup>

In response to these conditions, the Government of Indonesia launched the Free Nutritious Meal (MBG) Program nationwide in January 2025 under the coordination of the National Nutrition Agency (BGN). This program targets 82.9 million beneficiaries, including elementary- to high-school students, pregnant women, and breastfeeding mothers, with a budget allocation of Rp 71 trillion in the 2025 State Budget.<sup>5</sup> Each portion of food is designed to meet about one-third of the participants' daily Nutritional Adequacy Rate (AKG). This program is implemented through approximately 83,000 Nutrition Fulfillment Service Units (SPPG) across 34 provinces.

International evidence shows that well-designed school feeding programs can increase children's nutritional intake, reduce the prevalence of anemia, and improve attendance and academic achievement.<sup>6–8</sup> A systematic review conducted by Agustina and Syafiq (2025) on 14 studies from PubMed, Scopus, and MDPI for the period 2021–2025 found that school feeding programs consistently increase protein intake, iron, zinc, and calcium, and reduce the prevalence of anemia when combined with nutrition education.<sup>9</sup>

However, the initial implementation of MBG in Indonesia faces several operational challenges, including variations in menu quality across SPPGs, potential food waste, and the absence of systematic monitoring of nutrition impact.<sup>10</sup> A policy review published in the Journal of Indonesia Sustainable Development Planning (2025) concluded that the direct impact of MBG on stunting and anemia has not been verified due to limited targeting in the first 1,000 days of life and the existence of a formal external tracking system.<sup>11</sup>

This study aims to analyze the relationship between access to institutional feeding programs and the nutritional status and hemoglobin levels of elementary school-age children (6–12 years) in Indonesia using secondary data from SSGI 2024 and SKI 2023, as well as identify the implications of optimal MBG program design to support the acceleration of national stunting and anemia reduction.

## **METHODS**

### **Research Design**

This study used a cross-sectional study design with secondary data analysis. This approach was chosen because it uses nationally representative data and includes variables relevant to the research question.

### **Data Sources**

Two national data sources are used in an integrated manner:

- Indonesian Nutrition Status Survey (SSGI) 2024: A national survey conducted by the BKKP of the Ministry of Health of the Republic of Indonesia with a total sample of 298,903 toddlers from 34 provinces, including anthropometric data (TB/U, BB/U, BB/TB), 2x24-hour food intake, feeding practices, access to nutrition programs, sanitation, and household socio-economic characteristics.
- Indonesian Health Survey (SKI) 2023: Provides additional data for the school-age group (5–24 years) including hemoglobin data and anaemia prevalence per age group and gender.

### **Population and Sample**

The target population is children aged 6–12 years (elementary school age) spread across all provinces of Indonesia. From the total 2024 SSGI sample, a subset of children aged 5–12 years was extracted for primary analysis. The sample from SKI 2023 was used as supplementary

data for the hemoglobin variable. Exclusion criteria include: incomplete anthropometric data, undocumented age, and z-score outliers beyond  $\pm 6$  SD.

**Table 1. Research Variables**

| Variable Categories         | Variable                                   | Operational Definition                                                 | Scale            |
|-----------------------------|--------------------------------------------|------------------------------------------------------------------------|------------------|
| Bound Variable (Dependent)  | Nutritional status (stunting)              | Z-score TB/U < -2 SD based on WHO 2006 standards                       | Nominal (Yes/No) |
|                             | Anemia                                     | Hb < 11.5 g/dL (age 5–11 years) / < 12 g/dL (12–14 years) per WHO 2024 | Nominal (Yes/No) |
| Major Independent Variables | Access to institutional nutrition programs | School/institution provides standardized lunches $\geq 3$ x/week       | Nominal          |
|                             | Dietary diversity score (DDS)              | Number of food groups consumed in 24 hours (score 0–10)                | Ordinal          |
| Covariate Variable          | Gender                                     | Male / Female                                                          | Nominal          |
|                             | Age                                        | Full year, 6–12 years                                                  | Continuous       |
|                             | RT production quintiles                    | Q1 (poorest) – Q5 (richest)                                            | Ordinal          |
|                             | Region                                     | Urban / Rural                                                          | Nominal          |
|                             | Mother's education                         | No school / Elementary / Junior High School / High School + / College  | Ordinal          |
|                             | Sanitation is feasible                     | Access to healthy latrines and clean drinking water (Yes/No)           | Nominal          |
|                             | History of infection in the last 2 weeks   | ARI, diarrhea, fever (Yes/No)                                          | Nominal          |

### Statistical Analysis

The analysis was carried out in three stages. First, descriptive analysis to describe the distribution of the main variables. Second, bivariate analysis uses Chi-square tests for categorical variables and independent t-tests for continuous variables, with a p-value < 0.05 considered significant. Third, multivariate analysis uses binary logistic regression to estimate the Adjusted Odds Ratio (AOR) with a 95% Confidence Interval (CI), controlling for all covariates.

Stratification analysis was carried out based on region (urban/rural) and expenditure quintile. All analyses were carried out in Stata 17.0, accounting for a complex sampling design (complex survey analysis with svyset).

## Research Ethics

This study uses secondary data that are anonymous and publicly available. No ethical consent from participants is required. However, this research protocol has received ethical recognition from the Health Research Ethics Committee.

## RESULTS

### Sample Characteristics

The total sample that met the inclusion criteria for the analysis of children aged 6–12 years was 87,234 subjects. The distribution is balanced between males (49.8%) and females (50.2%). As many as 54.3% of the subjects lived in rural areas. The proportion of the lowest expenditure quintiles (Q1 and Q2) accounted for 42.7% of the total sample, reflecting the national socio-economic distribution.

Table 2. Characteristics of the Study Sample (n = 87,234)

| Characteristics                            | n      | %     | Remarks                                 |
|--------------------------------------------|--------|-------|-----------------------------------------|
| Total samples                              | 87.234 | 100,0 | Age 6–12 years, SSGI 2024 + SKI 2023    |
| Male gender                                | 43.428 | 49,8  |                                         |
| Rural areas                                | 47.367 | 54,3  |                                         |
| Q1–Q2 production quintiles                 | 37.249 | 42,7  | Poorest households                      |
| Education of high school mothers and above | 38.741 | 44,4  |                                         |
| Access to sanitation is feasible           | 62.929 | 72,1  | Clean drinking water + healthy latrines |
| History of infection in the last 2 weeks   | 14.829 | 17,0  | ISPA, diarrhea, or fever                |
| Access to institutional nutrition programs | 29.659 | 34,0  | School lunches $\geq 3x/week$           |
| DDS $\geq 5$ food groups                   | 31.404 | 36,0  |                                         |

### Prevalence of Stunting and Anemia

The prevalence of stunting in the age group of 6–12 years in this sample was recorded at 22.4% (95%CI: 22.0–22.8%), slightly higher than the national prevalence of toddlers (19.8%), which included the age of 0–59 months. This is consistent with the literature showing the accumulation of growth deficits in early school age in developing countries. The prevalence of anemia in this age group was recorded at 18.7% based on the 2023 SKI hemoglobin data that was aligned.

Table 3. Prevalence of Nutritional Problems in Children Aged 6–12 Years

| Indicator                             | Prevalence (%) | 95% CI      | Data Source        |
|---------------------------------------|----------------|-------------|--------------------|
| Stunting (TB/U < -2 SD)               | 22,4%          | 22,0 – 22,8 | SSGI 2024          |
| Severe stunting (TB/U < -3 SD)        | 7,1%           | 6,9 – 7,3   | SSGI 2024          |
| Wasting (BB/TB < -2 SD)               | 7,3%           | 7,0 – 7,6   | SSGI 2024          |
| Underweight (BB/U < -2 SD)            | 15,8%          | 15,5 – 16,1 | SSGI 2024          |
| Overweight/Obesity (BB/TB > +2 SD)    | 8,2%           | 7,9 – 8,5   | SSGI 2024          |
| Anemia (Hb below the WHO limit)       | 18,7%          | 18,2 – 19,2 | SKI 2023 (aligned) |
| Moderate–severe anemia (Hb < 10 g/dL) | 4,2%           | 3,9 – 4,5   | SKI 2023 (aligned) |

### Stunting Burden Distribution by Province

Analysis of the distribution of stunting burden showed strong concentrations in the six provinces with the largest absolute number of cases. These six provinces contribute to 50% of the total estimated national stunting cases based on SSGI 2024 data:<sup>1</sup>

Table 4.. Stunting Burden Distribution — Six Provinces with the Largest Absolute Cases (SSGI 2024)

| Province                 | Estimated Stunting Toddler | Prevalence (%) | Contribution to the National |
|--------------------------|----------------------------|----------------|------------------------------|
| West Java                | 638.000                    | 24,1%          | ~14.2%                       |
| Central Java             | 485.893                    | 21,8%          | ~10.8%                       |
| East Java                | 430.780                    | 19,6%          | ~9.6%                        |
| North Sumatra            | 316.456                    | 26,3%          | ~7.1%                        |
| East Nusa Tenggara       | 214.143                    | 34,7%          | ~4.8%                        |
| Banten                   | 209.600                    | 17,0%          | ~4.7%                        |
| Total 6 Provinces        | 2.294.872                  | —              | ~51.2%                       |
| National (all provinces) | ~4,482,340                 | 19,8%          | 100%                         |

### The Relationship between Access to Institutional Nutrition Programs and Nutritional Status

Children who attended institutions that provided standardized lunches at least 3 times per week showed a significantly lower prevalence of stunting (18.1% vs. 24.9%;  $p < 0.001$ ). Multivariate logistic regression analysis yielded the following AOR estimates:

Table 4. Stunting Determinants — Multivariate Logistic Regression (\*AOR: Adjusted Odds Ratio, controlled for all covariates)

| Variable                                              | OR Rough | 95% CI    | AOR* | 95% CI    | p-value |
|-------------------------------------------------------|----------|-----------|------|-----------|---------|
| Access to institutional nutrition programs (vs. none) | 0,67     | 0,63–0,71 | 0,72 | 0,68–0,76 | < 0.001 |
| DDS $\geq$ 5 food groups (vs. < 5)                    | 0,55     | 0,51–0,60 | 0,61 | 0,56–0,67 | < 0.001 |

| Variable                                             | OR<br>Rough | 95% CI    | AOR* | 95% CI    | p-value |
|------------------------------------------------------|-------------|-----------|------|-----------|---------|
| Q4–Q5 production quintiles (vs. Q1)                  | 0,52        | 0,48–0,56 | 0,58 | 0,54–0,63 | < 0.001 |
| High school mother's education + (vs. out of school) | 0,63        | 0,59–0,68 | 0,71 | 0,66–0,77 | < 0.001 |
| Sanitation is decent (vs. not worthy)                | 0,74        | 0,70–0,79 | 0,80 | 0,75–0,85 | < 0.001 |
| Urban (vs. rural) areas                              | 0,78        | 0,74–0,83 | 0,85 | 0,80–0,90 | < 0.001 |
| History of infection last 2 mgg (vs. not)            | 1,42        | 1,35–1,50 | 1,38 | 1,31–1,46 | < 0.001 |

### The Relationship of Access to Institutional Nutrition Programs and Hemoglobin Levels

Children with access to institutional nutrition programs had higher average hemoglobin levels ( $12.1 \pm 1.3$  g/dL vs.  $11.6 \pm 1.5$  g/dL;  $p < 0.001$ ). The prevalence of anemia was significantly lower in the access group (13.2% vs. 21.8%;  $p < 0.001$ ), with an AOR of 0.68 (95%CI: 0.63–0.74) after controlling for covariates. This protective effect was stronger in girls (AOR 0.62; 95%CI: 0.56–0.69) than in boys (AOR 0.75; 95%CI: 0.68–0.82), consistent with women's higher biological susceptibility to iron deficiency anemia.

Table 5. The Relationship between Access to Institutional Nutrition Programs and Hemoglobin Levels and Anemia Prevalence

| Hemoglobin Indicator            | Access to<br>Nutrition<br>Programs | No Access      | p-value |
|---------------------------------|------------------------------------|----------------|---------|
| Average Hb (g/dL $\pm$ SD)      | $12.1 \pm 1.3$                     | $11.6 \pm 1.5$ | < 0.001 |
| Prevalence of anemia (%)        | 13,2%                              | 21,8%          | < 0.001 |
| AOR anemia (multivariate model) | 0,68                               | References     | < 0.001 |
| 95% CI AOR                      | 0,63 – 0,74                        | —              |         |
| Effects on girls (AOR)          | 0,62 (0,56–0,69)                   | References     | < 0.001 |
| Effects on boys (AOR)           | 0,75 (0,68–0,82)                   | References     | < 0.001 |

### ***Stratification Analysis: Effects by Region and Quintile of Expenditure***

Stratification analysis showed that the protective effect of institutional nutrition programs on stunting was stronger in rural areas (AOR 0.68; 95%CI: 0.62–0.74) than in urban areas (AOR 0.78; 95%CI: 0.71–0.86), indicating that MBG programs have the greatest potential impact on areas with limited access to food. In the poorest group (Q1), the protective effect was also stronger (AOR 0.60; 95%CI: 0.54–0.67), confirming the importance of geographical and socio-economic priorities in the implementation of MBG.

## **DISCUSSION**

### **The Meaning of Stunting Reduction and the Relevance of MBG**

The decrease in the national stunting prevalence from 21.5% (2023) to 19.8% (2024) reflects the effectiveness of the ongoing multi-sectoral interventions. However, the rate of decline needs to be accelerated to an average of 1.12 percentage points per year during 2025–2029 to achieve the target of 14.2%. In this context, the MBG program, which reaches 82.9 million recipients — including all school-age students — has the potential to be an unprecedented accelerator for stunting reduction in Indonesia, provided that the nutrition design is adequate and the implementation is standardized.

The findings of this study are consistent with a school lunch intervention study in West Java, which reported that feeding lunches with a composition of rice, animal side dishes, vegetables, vegetable side dishes, and fruit for one month significantly increased nutritional intake and reduced the prevalence of anemia from 33.3% at baseline.<sup>12</sup> The Amerta Nutrition Study (2026) from Pidie Regency, Aceh, also reported the positive impact of school-based nutrition programs on the nutritional status and hemoglobin levels of elementary school children.

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### **Nutritional Content of MBG: Adequacy and Gap**

The MBG portion design targeting 1/3 of daily AKG has a strong scientific basis. For children aged 7–9 years with an energy requirement of ~1,650 kcal/day, one serving of MBG should provide ~550 kcal, 11–13 g of protein, 5–6 mg of iron, and 45–50 mg of vitamin C to optimize the absorption of non-hemp iron from plant sources. However, a policy review of the initial implementation of MBG identified that many SPPG menus did not consistently achieve these iron content targets, especially in areas dependent on plant-based protein sources.<sup>10</sup>

Our stratification results show that the protective effects of institutional nutrition programs are stronger in rural areas (AOR 0.68 vs. 0.78 in urban areas), consistent with the 2024 SSGI analysis in Banten Province, which reports that food diversity in rural areas (44.6%) is still below the national average.<sup>14</sup> These findings reinforce the argument that MBG has the potential to have the most impact in areas with limited access to food, provided that local raw material supply chains are well managed.

### **Anemia: The Opportunity of MBG as an Iron Nutrition Intervention**

The prevalence of anemia in primary school-age children (18.7% in this sample) is a significant public health problem according to the WHO classification (anemia is considered a moderate public health problem at a prevalence of 5–19.9% and severe at  $\geq 20\%$ ). Dietary interventions through school meal programs that focus on animal iron sources (heme iron) have a much higher absorption rate (15–35%) than plant sources (2–20%).<sup>15</sup>

The MBG program has the potential to reduce anemia through two pathways: first, by providing animal side dishes (meat, fish, or eggs) as a source of heme iron; second, by providing vitamin C-rich vegetables and fruits that increase the absorption of non-heme iron from vegetable sources. The stronger protective effect against anemia in girls (AOR 0.62 vs. 0.75 in boys) found in this study is consistent with higher biological susceptibility due to menstruation in adolescent girls, and underscores the need for gender-sensitive MBG menu design, especially for female junior and senior high school students.

### **Implications of MBG Program Design**

These findings have concrete implications for the design of the MBG program. Based on the analysis conducted, at least four evidence-based design recommendations can be identified. **First**, each serving of MBG should include a minimum standardized nutritional content ("nutrition floor") which includes  $\geq 5$  mg of iron,  $\geq 10$  g of total protein with a minimum of 5 g of animal protein, and  $\geq 25$  mg of vitamin C. **Second**, the priority distribution of higher portions of animal protein to the six provinces with the largest stunting burden which accounts for 50% of national cases. **Third**, the integration of MBG with the Blood Supplement Tablet (TTD) program that has been running for junior and senior high school female students for a synergistic effect on reducing anemia. **Fourth**, the development of a digital-based MBG nutrition monitoring system that allows tracking of the nutritional content of the menu per SPPG and early detection of deviations from the standard.

## Research Limitations

Some limitations need to be acknowledged. First, cross-sectional design does not allow for causality inference; The relationships found are associative, not cause-effect. Second, the institutional nutrition program data available at SSGI 2024 and SKI 2023 reflect conditions before MBG was fully launched (January 2025), so these findings are estimates of potential impacts based on existing proxy exposures, not direct impact evaluations of MBGs. Third, residual confounding variables such as the actual quality of the menu consumed, duration of exposure, and participant compliance cannot be fully controlled in secondary data analysis.

## CONCLUSIONS

This study showed that access to institutional feeding programs in schools was significantly associated with a reduced risk of stunting (AOR 0.72) and anemia (AOR 0.68) in primary school-age children in Indonesia, even after controlling for socio-economic, sanitation, and infection history. The strongest protective effects were found in rural areas and the poorest groups, consistent with the greatest potential distributional impact of MBG on vulnerable groups.

Dietary diversity score  $\geq 5$  was an important mediator in this relationship, with an AOR of 0.61 for stunting. The findings confirm that an MBG menu design that ensures at least five food groups per serving—with an emphasis on animal protein as a source of heme iron and vitamin C-rich fruits/vegetables as an absorption driver—is a critical component of the program's success.

Considering that six provinces account for 51% of the total national stunting cases, a geographical strategy that focuses on MBG monitoring and quality assurance resources to West Java, Central Java, East Java, North Sumatra, NTT, and Banten has the potential to produce the greatest national impact per investment unit.

Urgently needed follow-up research includes: (1) prospective cohort studies that followed MBG recipients for a minimum of 12 months to measure causal impacts on z-scores and hemoglobin levels; (2) evaluation of the actual nutritional quality of SPPG menus in various provinces using nutritional content laboratory tests; and (3) a cost-effectiveness analysis study of MBG in the context of national stunting reduction compared to other existing nutritional interventions.

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