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**Artikel Asli / Original Article**

# Association Between Maternal Nutritional Status and Stunting Among Exclusively Breastfed Children Attending Posyandu in Indonesia: An Exploratory Cross-Sectional Study

## Hubungan Antara Status Pemakanan Ibu dan Tumbesaran Terbantut di Kalangan Kanak-Kanak yang Disusukan Secara Eksklusif di Posyandu, Indonesia: Kajian Keratan Rentas Eksploratif

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## ABSTRACT

Stunting remains a significant public health challenge in Indonesia, with a national prevalence of 21.6%. Whether maternal nutritional status is associated with stunting outcomes among exclusively breastfed children remains inadequately characterised. This exploratory cross-sectional study enrolled 30 mother-child pairs attending Posyandu in Semarang, Central Java, Indonesia. Chronic energy deficiency (CED) was assessed by mid-upper arm circumference (MUAC) <23.5 cm, measured onsite by trained health workers; anaemia was ascertained through clinical records during antenatal care visits. Exclusive breastfeeding status during the first six months and child stunting (height-for-age Z-score <−2 SD, WHO Child Growth Standards) were documented. Participants were stratified into four groups by breastfeeding and maternal nutritional status. Of 39 children anthropometrically assessed, five children aged over 60 months were excluded, leaving 34 for HAZ analysis (overall stunting: 11.8%, 4/34). Among the 30 matched questionnaire pairs used for group analysis, exclusive breastfeeding prevalence was 83.3% and CED affected 20.0% of mothers. A difference in stunting prevalence was observed between nutritional status subgroups among exclusively breastfed children: 5.6% (1/18) in those born to well-nourished mothers versus 42.9% (3/7) in those born to malnourished mothers (OR = 12.75, 95% CI: 1.03–157; p = 0.053, Fisher's exact). These preliminary findings, from a small exploratory study, should be treated as hypothesis-generating. The non-exclusively-breastfed groups were too small to estimate an interaction between breastfeeding and maternal nutrition (n = 4 and n = 1). Concurrent attention to maternal nutrition and breastfeeding support warrants investigation in adequately powered prospective studies

Keywords: chronic energy deficiency, exclusive breastfeeding, Indonesia, maternal nutrition, stunting

## ABSTRAK

Tumbesaran terbantut merupakan cabaran kesihatan awam yang signifikan di Indonesia, dengan prevalen kebangsaan sebanyak 21.6%. Kajian keratan rentas eksploratif ini melibatkan 30 pasangan ibu-anak yang menghadiri Posyandu di Semarang, Jawa Tengah, Indonesia. Kekurangan tenaga kronik (KEK) ibu dinilai menggunakan ukur lilit lengan atas (MUAC) kurang daripada 23.5 cm, diukur oleh pekerja kesihatan terlatih mengikut garis panduan standard; anemia ditentukan melalui rekod klinikal semasa lawatan penjagaan antenatal. Status penyusuan susu ibu eksklusif selama enam bulan pertama dan tumbesaran terbantut kanak-kanak (skor z tinggi-mengikut-umur di bawah −2 SD mengikut piawai WHO) dicatatkan. Daripada 39 kanak-kanak yang diukur secara antropometrik, lima orang kanak - kanak yang berumur lebih daripada 60 bulan dikecualikan, menjadikan baki 34 untuk analisis HAZ (prevalen tumbesaran terbantut keseluruhan: 11.8% (4/34)). Dalam kalangan 30 pasangan ibu-anak yang sepadan, prevalen penyusuan susu ibu eksklusif ialah 83.3% dan kekurangan tenaga


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kronik mempengaruhi 20.0% ibu. Perbezaan dalam prevalen tumbesaran terbantut diperhatikan antara subkumpulan status pemakanan dalam kalangan kanak-kanak yang disusukan secara eksklusif iaitu 5.6% (1/18) bagi kanak-kanak yang dilahirkan oleh ibu dengan status pemakanan yang baik berbanding 42.9% (3/7) bagi kanak-kanak yang dilahirkan oleh ibu yang mengalami kekurangan zat pemakanan (OR = 12.75, 95% CI: 1.03–157; p = 0.053). Kumpulan yang tidak diberi susu ibu sepenuhnya adalah terlalu kecil untuk menganggarkan interaksi antara penyusuan susu ibu dan pemakanan ibu (n = 4 dan n = 1). Penemuan awal ini daripada kajian eksploratif yang kecil, perlu dianggap sebagai hipotesis yang memerlukan pengesahan dalam kajian prospektif yang lebih besar dengan kuasa statistik yang mencukupi.

Kata kunci: Indonesia, kekurangan tenaga kronik, pemakanan ibu, penyusuan susu ibu eksklusif, tumbesaran terbantut

## INTRODUCTION

Stunting, defined as height-for-age below −2 standard deviations from the WHO Child Growth Standards median, affects approximately 148.1 million children under five globally (UNICEF, WHO & World Bank Group 2022). In Indonesia, the 2022 national nutrition survey recorded a stunting prevalence of 21.6%, representing approximately 4.5 million children whose growth trajectories were compromised during the critical first 1,000 days of life (Kementerian Kesehatan RI 2023). Stunting carries lasting consequences for cognitive development, educational attainment, and adult productivity, creating intergenerational disadvantage that is difficult to interrupt once established (McGovern et al. 2017; Prendergast & Humphrey 2014).

Exclusive breastfeeding for the first six months is among the most evidence-based early interventions for reducing stunting risk, with data from multiple countries estimating reduced stunting rates among exclusively breastfed versus mixed-fed infants (Victora et al. 2016). Maternal nutritional status may be associated with this relationship. While breast milk macronutrient composition is relatively robust to maternal nutritional variation, milk volume and concentrations of water-soluble vitamins and minerals are sensitive to maternal nutritional state (Young et al. 2019; Allen 2012). Chronic energy deficiency (CED), indexed by mid-upper arm circumference (MUAC) below 23.5 cm, affects a substantial proportion of pregnant women in low- and middle-income countries and may constrain lactation capacity (Young et al. 2018). Maternal anaemia has been associated with earlier breastfeeding cessation in some studies, though the evidence is mixed (Georgieff 2020; Chaparro & Suchdev 2019). Despite this biological plausibility, the combined influence of maternal nutrition and breastfeeding practice on child growth has been rarely examined in Indonesian community settings. This study describes associations between maternal nutritional status and stunting among exclusively breastfed children attending Posyandu in Semarang, Central Java, as a preliminary exploratory analysis.

## MATERIALS AND METHODS

This exploratory cross-sectional study was conducted at a Posyandu in the Semarang municipal area, Central Java, Indonesia, during July to August 2025. All mothers with children under five years (balita, ≤60 months) attending scheduled monthly Posyandu sessions were consecutively invited to participate. Inclusion required willingness to provide written informed consent and the capacity to complete the questionnaire. Mothers with documented cognitive impairments were excluded. Two duplicate entries (same mother, same child, confirmed by identical contact details) were removed during data cleaning, yielding 30 unique mother-child pairs for the primary analysis. Of the 39 children for whom anthropometric measurements were obtained at Posyandu, five children aged over 60 months were excluded from height-for-age (HAZ) analysis as WHO Anthro reference charts do not extend beyond this age, leaving 34 children for nutritional status assessment. The discrepancy between 34 measured children and 30 questionnaire respondents reflects multipara mothers who attended with more than one child but completed a single questionnaire entry.

Overall stunting prevalence (11.8%, 4/34) is reported from the anthropometric sample; the stratified group analysis is based on the 30 matched pairs. Chronic energy deficiency (CED) was defined as MUAC below 23.5 cm, measured onsite at the Posyandu session by trained health workers following Ministry of Health guidelines using a non-elastic measuring tape at the midpoint of the non-dominant upper arm (Young et al. 2018; Kementerian Kesehatan RI 2023). It should be noted that this represents current postnatal MUAC; antenatal MUAC data from records were used where available but were not available for all participants. Anaemia during pregnancy was ascertained by clinical diagnosis, with haemoglobin values recorded from antenatal care records where available. Mothers were classified as having poor nutritional status if they experienced CED, anaemia, or both; good nutritional status was defined as the absence of both. While CED and anaemia operate through different biological pathways, small cell sizes precluded separate analyses; both components

are reported descriptively in Table 1. Exclusive breastfeeding (EBF) was defined per WHO guidelines as breast milk only during the first six months, without other liquids or solids except oral rehydration solution, vitamins, or medicines (World Health Organization 2008). Data were collected through interviewer-administered structured questionnaire. Weight was recorded with calibrated digital scales (Seca 876, 0.1 kg precision); recumbent length (children <24 months) with length boards (Seca 417) and standing height (≥24 months) with stadiometers (Seca 213), both to the nearest 0.1 cm. Two measurements were taken per child; where discrepancy exceeded 0.5 cm for length/height or 0.1 kg for weight, a third measurement was obtained and the median used. All enumerators were trained before data collection. HAZ, weight-for-height (WHZ), and weight-for-age (WAZ) Z-scores were derived using WHO Anthro software (version 3.2.2, 2011); no biologically implausible Z-scores (HAZ <−6 or >+6) were identified. Stunting was defined as HAZ <−2 SD. Participants were stratified into four groups: Group 1 (EBF + good nutritional status), Group 2 (EBF + poor nutritional status), Group 3 (no EBF + good nutritional status), and Group 4 (no EBF + poor nutritional status). Stunting prevalence was calculated per group. Associations were examined using Fisher's exact test; exact odds ratios (OR) with 95% confidence intervals (CI) are reported using the Woolf method, with the caveat that this method is unstable with cells of n = 1 (Group 4) and the resulting CI should be interpreted with caution. All p-values are two-tailed; $p < 0.05$ was the threshold for statistical significance, though given the small sample and single comparison, all findings are considered exploratory. Data were analysed in SPSS version 25.0 (IBM Corp., Armonk, NY). The study was not formally powered for interaction analysis; the sample size was determined by convenience and available resources. Ethical approval: No. 374B/LPPM/UMPKU/VII/2025.

## RESULTS AND DISCUSSION

Thirty mother-child pairs were included in the primary analysis (Table 1). Mean maternal age was 32.3 ± 5.9 years (range: 22–49 years); 53.3% of children were male. Chronic energy deficiency affected 20.0% (6/30) and anaemia 13.3% (4/30) of mothers; 26.7% (8/30) had poor nutritional status overall. Exclusive breastfeeding prevalence was 83.3%. Of 39 children with anthropometric measurements, five children aged over 60 months were excluded from HAZ analysis, leaving 34 children for nutritional status assessment. Overall stunting prevalence in the 34 HAZ-assessed children was 11.8% (4/34): moderate stunting 8.8% (3/34) and severe stunting 2.9% (1/34). Among the 30 questionnaire-linked pairs used for stratified analysis, four children were stunted (13.3%). The difference between these two figures reflects six additional children from multipara mothers who had anthropometric data but whose mothers contributed a single questionnaire entry. Mean HAZ was −0.8 ± 1.2 SD. Child age ranged from 1 to 60 months (median 18, IQR: 12–22 months).

Stratified analysis (Table 2) showed that among the 25 exclusively breastfed children, stunting prevalence was 5.6% (1/18) in Group 1 (good maternal nutrition) and 42.9% (3/7) in Group 2 (poor maternal nutrition), yielding an OR of 12.75 (95% CI: 1.03–157, $p = 0.053$, Fisher's exact) and a prevalence ratio of 7.71 (95% CI: 0.96–62.2). Both confidence intervals are wide, reflecting the limited sample, and the p-value does not reach conventional significance. Critically, the non-EBF groups contained only four (Group 3) and one (Group 4) participants respectively, with zero stunting events in both. Consequently, the association between exclusive breastfeeding and stunting cannot be estimated within either nutritional status stratum, and this analysis does not constitute a formal test of effect modification. The finding is descriptive only: among exclusively breastfed children, those born to malnourished mothers had higher stunting prevalence than those born to well-nourished mothers. Group 4 (n = 1) is presented for completeness and supports no inference.

The primary descriptive finding is a difference in stunting prevalence between nutritional status subgroups among exclusively breastfed children. This pattern is consistent with biological mechanisms described in the literature: malnourished mothers may produce lower milk volumes and breast milk with reduced concentrations of water-soluble vitamins and bioactive compounds, which could compromise infant growth even when breastfeeding is practised exclusively (Allen 2012; Young et al. 2019; Bravi et al. 2016). However, breast milk volume and composition were not measured in this study; these mechanisms are presented as plausible hypotheses rather than demonstrated pathways. Maternal anaemia has been associated with earlier breastfeeding cessation in prospective designs (Georgieff 2020; Chaparro & Suchdev 2019), but this relationship could not be examined with the present data. Importantly, unmeasured confounders including birth weight, gestational age, household food security, sanitation, infection history, and socioeconomic status may fully or partially explain the observed difference; multivariable adjustment was not possible given the sample size. The 5.6% stunting prevalence in Group 1 approaches the WHO threshold of below 5% for low public health significance (World Health Organization 2010), a suggestive pattern that warrants investigation in

adequately powered prospective studies with comprehensive confounder measurement.

The 83.3% exclusive breastfeeding rate far exceeds the Indonesian national average of 52% and the WHO Global Nutrition Target of 50% (Kementerian Kesehatan RI 2023). This may reflect health-engaged behaviour among regular Posyandu attendees; however, convenience sampling of this population is likely to select mothers with above-average health engagement, and social desirability bias in self-reported breastfeeding is a plausible alternative explanation for the high rate (Victora et al. 2016). The high coverage should therefore not be directly attributed to programme effectiveness from this design. The persistence of stunting despite high exclusive breastfeeding rates is consistent with evidence that breastfeeding coverage alone does not fully determine child growth outcomes when maternal nutrition, complementary feeding quality, and household-level determinants remain suboptimal (Nilsen et al. 2020; Prendergast & Humphrey 2014).

TABLE 1. Sociodemographic and maternal characteristics of study participants (N=30)

| **Characteristic** | **n (%) or Mean ± SD** |
|---|---|
| Maternal age (years), mean ± SD | 32.3 ± 5.9 |
| **Maternal education** | |
| Primary / junior high school | 4 (13.3) |
| Senior high school | 12 (40.0) |
| Vocational high school | 4 (13.3) |
| Diploma / bachelor's degree | 7 (23.3) |
| Other | 3 (10.0) |
| Child age (months), median (IQR) | 18 (12–22) |
| Male sex | 16 (53.3) |
| Chronic energy deficiency (MUAC < 23.5 cm) | 6 (20.0) |
| Anaemia during pregnancy | 4 (13.3) |
| Any malnutrition (CED and/or anaemia) | 8 (26.7) |
| Good nutritional status | 22 (73.3) |
| Exclusive breastfeeding (0–6 months) | 25 (83.3) |

*MUAC = mid-upper arm circumference; IQR = interquartile range; CED = chronic energy deficiency.*

TABLE 2. Stunting prevalence stratified by exclusive breastfeeding status and maternal nutritional status

| **Exposure Group** | **Total n** | **Stunted n (%)** | **OR (95% CI)*** | **p-value** |
|---|---|---|---|---|
| Group 1: EBF + good maternal nutrition | 18 | 1 (5.6) | Reference[†] | |
| Group 2: EBF + poor maternal nutrition | 7 | 3 (42.9) | 12.75 (1.03–157) | 0.053[a] |
| Group 3: No EBF + good maternal nutrition | 4 | 0 (0.0) | N/A[b] | 1.000 |
| Group 4: No EBF + poor maternal nutrition | 1 | 0 (0.0) | N/A[c] | N/A |

*EBF = Exclusive Breastfeeding (0–6 months); OR = Odds Ratio (Woolf method, unstable with n = 1 cell); CI = 95% Confidence Interval. Prevalence Ratio for Group 2 vs Group 1 = 7.71 (95% CI: 0.96–62.2).*
*Groups sum to N = 30 (matched questionnaire pairs); overall stunting prevalence in 34 HAZ-assessed children = 11.8%.*
*[a]p = 0.053 (Fisher's exact, two-tailed). The CI from the Woolf method excludes 1.0 while the Fisher p does not reach conventional significance; these methods have different properties and should be interpreted together cautiously, particularly given the small cell sizes.*
*[b]Zero events in stunted cell; OR not calculable.*
*[c]n = 1; presented for completeness only, no statistical inference possible.*

## STUDY LIMITATIONS

This study carries several limitations that govern how findings should be interpreted. The cross-sectional design precludes causal inference: both maternal malnutrition and child stunting may reflect shared socioeconomic determinants rather than a direct physiological relationship. The sample of 30 mother–child pairs produced group cells as small as one (Group 4), yielding wide confidence intervals (OR: 1.03–157; PR: 0.96–62.2) and p = 0.053. This sample was not powered for effect-modification analysis, and all subgroup findings should be treated as exploratory and hypothesis-generating rather than

confirmatory. It is also important to note that a p-value previously reported as 0.03 was corrected to 0.053 on independent recalculation using Fisher's exact test applied to the stated cell counts.

Maternal nutritional status was classified as a binary good/poor variable combining chronic energy deficiency and anaemia, preventing examination of their distinct mechanisms and contributions. Self-reported breastfeeding practices may be subject to social desirability bias, which could partly account for the 83.3% exclusive breastfeeding rate exceeding the national average. Convenience sampling from Posyandu attendees limits generalisability to non-attending populations. Crucially, breast milk volume and composition were not directly measured, leaving the proposed biological mechanism untested. Unmeasured confounders including household income, food security, sanitation, birth weight, and gestational age may account for part of the observed pattern.

## FUTURE RECOMMENDATIONS

Three research priorities follow from these findings and limitations. Prospective cohort studies measuring maternal nutritional markers across pregnancy and the first six months postpartum, alongside serial breast milk volume and composition analysis and infant anthropometry, would characterise temporal relationships and test the proposed biological mechanism with a rigour that cross-sectional data cannot provide. The sample size for such studies should be formally calculated based on a prespecified interaction effect size, expected outcome prevalence, and an appropriate power level. Randomised trials comparing combined maternal nutrition and breastfeeding support programmes against single-component arms would quantify any synergistic benefit with experimental rigour. Future studies should measure anaemia using biochemical markers rather than secondary data from antenatal care reports, while also assessing CED separately and controlling for household-level confounders such as food security, sanitation, and birth weight.

## CONCLUSION

This exploratory cross-sectional study found a difference in stunting prevalence between nutritional status subgroups among exclusively breastfed children attending Posyandu in Semarang: 5.6% (1/18) among those born to well-nourished mothers versus 42.9% (3/7) among those born to malnourished mothers (OR = 12.75, 95% CI: 1.03–157; p = 0.053). These findings are preliminary and should be treated as hypothesis-generating. The non-exclusively-breastfed groups contained too few participants (n = 4 and n = 1) with no stunting events to estimate the association between breastfeeding and stunting within each nutritional status stratum; consequently, effect modification of breastfeeding by maternal nutritional status cannot be formally demonstrated from this dataset, and the term should not be applied to these results. Unmeasured confounders including birth weight, gestational age, household food security, infection history, and sanitation prevent causal interpretation. These results are consistent with biologically plausible mechanisms linking maternal nutritional status to breast milk quality, but these mechanisms were not directly tested. The findings justify larger prospective cohort studies with formal power calculations, objective nutritional biomarkers, breast milk analysis, and comprehensive confounder adjustment. Concurrent attention to maternal nutrition alongside breastfeeding support is a hypothesis warranting further programmatic and clinical investigation.

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Author contributions: DPDK, RDN, TPS: conceptualisation and study design. DPDK, RDN, TPS: data collection. RDN, MM: data analysis and interpretation. MM, AMH: manuscript drafting and critical revision. All authors approved the final manuscript.

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