

Recent Household Food Insecurity and Child Weight-for-Age in Two West Nusa Tenggara Settings

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ARTICLE INFO

Article History:

Received September 16, 2026

Accepted October 16, 2026

Published online October 18, 2026

Keywords:

Adolescent Nutrition;

Anemia Status;

Dietary Intake;

Nutritional Status;

Iron Intake

ABSTRACT

Household food insecurity may be associated with child undernutrition, but evidence based on continuous weight-for-age measures in Indonesia remains limited. This study examined the association between recent household food-insecurity experiences and weight-for-age z-scores (WAZ) among children under five in West Sumbawa and Bima and assessed whether the association differed between settings. We analysed cross-sectional data from 170 child–household pairs (85 per setting) collected in 2025. Eight household-referenced items adapted from the Food Insecurity Experience Scale were administered using a one-month reference period, with at least one affirmative response defining exposure. WAZ was calculated using WHO Anthro software and the 2006 WHO Child Growth Standards. Linear regression with HC3 robust standard errors was adjusted for setting, child age, sex, and household size. Overall, 66 households (38.8%) reported recent food-insecurity experiences, with a higher proportion in Bima than in West Sumbawa (51.8% vs 25.9%). Mean WAZ was -2.31 ± 0.70 among exposed children and -0.84 ± 0.80 among unexposed children. After adjustment, exposure was associated with a 1.44-unit lower WAZ ($\beta = -1.44$; 95% CI: -1.69 to -1.18 ; $p < 0.001$; $R^2 = 0.497$). There was no statistical evidence that the association differed by setting (interaction $p = 0.481$). This substantial cross-sectional association warrants cautious interpretation because the exposure measure was broad and uncalibrated, and the study used selected sampling frames. Recent food-access questions may complement anthropometric assessment, although longitudinal studies are needed to establish temporality.

INTRODUCTION

Undernutrition among Indonesian children under five remains an important public health problem, with substantial regional variation in its burden.¹ Previous studies in Indonesia have shown that weight and linear growth deficits are associated with a combination of child, parental, household, and geographic factors.² Limited household access to food may affect child nutrition through insufficient food quantity, reduced dietary diversity, and coping strategies that restrict access to nutritionally adequate meals. A systematic review and meta-analysis of Indonesian studies reported associations between household food insecurity and several forms of child malnutrition, including underweight.³ Similarly, an international meta-analysis identified associations between household food insecurity and undernutrition outcomes, although differences in study populations, measurement instruments, and research designs warrant caution when comparing pooled estimates.⁴

Studies conducted in Indonesian urban communities, national datasets, and local household surveys have reported associations between food-access constraints and child nutritional outcomes.^{5–9} A nationally representative analysis also identified socioeconomic disparities in childhood stunting across household wealth groups in Indonesia.¹⁰ Although household wealth reflects economic position, it does not directly capture recent experiences of difficulty accessing food. Moreover, much of the Indonesian literature has examined nutritional status using categorical measures. Analyzing weight-for-age z-scores (WAZ) as a continuous outcome preserves variation across the weight-for-age distribution rather than classifying children solely according to predefined cut-offs.

The Indonesian literature remains geographically concentrated, with relatively limited evidence from West Nusa Tenggara in the studies synthesized to date.³ A specific research gap concerns the association between recent household food-access experiences and continuous WAZ, particularly whether this association varies across subnational settings. West Sumbawa and Bima were selected as contrasting contexts based on district-level stunting prevalence reported in the 2023 Indonesian Health Survey. However, the present catchment-based sample was not designed to estimate district-wide prevalence or provide district-level representativeness.

This paper presents a focused quantitative analysis of a predefined component of a broader cross-sectional mixed-methods study conducted in 2025. WAZ was specified as the primary continuous outcome, while underweight categories were summarized descriptively. Because the adapted eight-item food-insecurity module was not calibrated against the global Food Insecurity Experience Scale (FIES) reference scale, the primary exposure was pragmatically defined as any versus no reported recent food-insecurity experience, rather than as a calibrated severity category. The study aimed to estimate the association between this measure and WAZ in two selected study settings and explore whether the association differed between them.

MATERIALS AND METHODS

Study Design and Setting

This was a focused quantitative analysis of data from a larger cross-sectional mixed-methods study conducted from March to August 2025. The study was undertaken in the catchment areas of Jereweh Community Health Center in West Sumbawa Regency and Palibelo Community Health Center in Bima Regency, West Nusa Tenggara, Indonesia. The two settings were selected to represent contrasting child-nutrition contexts in the parent study. Site feasibility and field safety were also considered in operational planning. These purposively selected settings should not be interpreted as district-representative samples.

Participants and Sampling

The source population comprised households with at least one child under five years of age. Within each selected health-center catchment area, six Posyandu (integrated community health posts) were included. Sampling frames were prepared for the selected settings, and eligible households were selected systematically from these frames using the same procedure in both settings. Families of selected children were approached after selection, and written informed consent was obtained before participation. All families approached for participation agreed to take part. Eighty-five child-household pairs were included from each setting, yielding 170 pairs in total. The present analysis included all 170 records with complete data for WAZ, the eight food-insecurity items, setting, child age, child sex, and household size.

Household Food-Insecurity Exposure

Recent household food-insecurity experience was assessed using eight experience-based items derived from the Food Insecurity Experience Scale (FIES), with household-referenced wording and a one-month reference period. The items addressed worry about insufficient food, inability to eat healthy and nutritious food, limited food variety, meal skipping, eating less than needed, household food depletion, hunger without eating, and going without food for a whole day. Internationally comparable FIES severity estimates generally rely on Rasch-model calibration.¹¹ Methodological work supports use of a 30-day FIES frame for recent food insecurity, while emphasizing appropriate calibration and interpretation.¹² Indonesian psychometric evaluation has likewise supported the validity of FIES items while highlighting the importance of local calibration.¹³

Because no global-reference Rasch calibration was available for this dataset, responses were not classified into standardized FAO moderate or severe food-insecurity categories. For the primary analysis, households were classified as reporting any recent food-insecurity experience if at least one of the eight items was answered affirmatively; households with no affirmative responses formed the reference group. This broad threshold combines experiences of differing severity and was used as a pragmatic indicator of any reported recent food-access difficulty, not as a validated severity classification. The number of affirmative responses (0–8) was retained for sensitivity analysis. Item-level reliability and global-reference Rasch calibration were not established for this analysis.

Nutritional Outcome

Body weight and recumbent length or standing height were measured using the anthropometric procedures specified for the original field study. Field staff received training, and data collection was supervised; however, the available documentation did not provide technical error of measurement, inter-observer reliability, digit-preference assessments, or detailed equipment-calibration records. Weight-for-age z-scores (WAZ) were derived using WHO Anthro software based on the 2006 WHO Child Growth Standards.¹⁴ WAZ was analyzed primarily as a continuous variable.

For descriptive purposes, children with WAZ < -2 SD were classified as underweight, including children with WAZ < -3 SD as severely underweight.

Covariates

The primary adjusted model included district (West Sumbawa or Bima), child age in months, child sex, and household size. Household size was defined as the number of household members who usually lived in the household and whose meals were managed from one kitchen, recorded directly from the household roster as the total number of household members. Monthly per-capita household expenditure was evaluated in a socioeconomic sensitivity model, and the Household Dietary Diversity Score (HDDS) was evaluated separately because dietary diversity may lie partly on the pathway between food insecurity and nutritional status rather than act solely as a confounder. Covariates for the primary model were selected a priori based on conceptual relevance and sample-size considerations to maintain a parsimonious model and reduce overfitting.

Statistical Analysis

Continuous variables were summarized as mean $\pm$ standard deviation when approximately symmetric and as median (interquartile range) for skewed expenditure data. Categorical variables were summarized as n (%). Participant characteristics were presented descriptively according to recent household food insecurity experience.

The primary association was estimated using ordinary least-squares regression with WAZ as the dependent variable and any recent food insecurity experience as the exposure. HC3 heteroskedasticity-consistent standard errors were used to estimate 95% confidence intervals and p-values. The primary adjusted model included study setting, child age, child sex, and household size. An exposure-by-setting interaction term assessed whether the association differed between settings; this analysis was exploratory, and the study was not specifically powered to detect modest interaction effects. Sensitivity analyses additionally adjusted for log-transformed per-capita household expenditure and HDDS. The number of affirmative responses was analyzed as a continuous sensitivity exposure, but was not treated as a calibrated severity scale. Because only one underweight child was observed in the no-experience group, logistic regression of underweight was not used as the main inferential analysis because of sparse-data and separation concerns. HC3 standard errors address heteroskedasticity but do not account for within-Posyandu clustering; this is acknowledged as a limitation. Two-sided $p < 0.05$ was considered statistically significant. Analyses were performed using Python 3.13.5, NumPy 2.3.5, SciPy 1.17.0, and statsmodels 0.14.6.

Ethical Considerations

Before field implementation, the study protocol underwent scientific review by an expert panel from IPB University. Ethical approval was obtained from the Health Research Ethics Commission of Poltekkes Kemenkes Mataram on 21 March 2025 (No. DP.04.03/F.XL.26/196/2025). Written informed

consent was obtained from a parent or caregiver before participation. Participation was voluntary; participants were informed of their right to withdraw at any time, and confidentiality of personal information was assured. Study findings were permitted to be reported and published without disclosure of participants' identities.

RESULTS

Participant Characteristics and Recent Food-Insecurity Experiences

All 170 child-household pairs were included in the primary analysis, with 85 participants from West Sumbawa and 85 from Bima. The mean child age was 33.0 ± 15.3 months; 91 children (53.5%) were girls; and the mean household size was 4.16 ± 1.12 persons. Overall, 66 households (38.8%) reported at least one recent food-insecurity experience. The proportion was higher in Bima (44/85; 51.8%) than in West Sumbawa (22/85; 25.9%) (Table 1).

Table 1. Participant characteristics according to recent household food insecurity experience

Characteristic	Overall (n=170)	No affirmative experience (n=104)	Any experience (n=66)
District, n (%)			
West Sumbawa	85 (50.0)	63 (60.6)	22 (33.3)
Bima	85 (50.0)	41 (39.4)	44 (66.7)
Child sex, n (%)			
Male	79 (46.5)	45 (43.3)	34 (51.5)
Female	91 (53.5)	59 (56.7)	32 (48.5)
Age, months	33.0 ± 15.3	31.8 ± 16.2	34.8 ± 13.9
Household size, persons	4.16 ± 1.12	4.15 ± 1.12	4.17 ± 1.13
Per-capita household expenditure, Rp/month	628,979 (417,225–940,000)	688,417 (489,350–1,066,833)	536,533 (347,775–768,813)
Household Dietary Diversity Score	10.01 ± 2.74	10.18 ± 2.89	9.73 ± 2.47

Data are mean $\pm$ SD, median (IQR), or n (%), as appropriate.

Weight-for-Age According to Food Insecurity Experience

Mean WAZ in the full sample was -1.41 ± 1.04 . Children living in households reporting any recent food-insecurity experience had markedly lower mean WAZ than children in households reporting none (-2.31 ± 0.70 vs -0.84 ± 0.80). Overall, 46 children (27.1%) were underweight; 45 of 66 children (68.2%) in households reporting any recent food-insecurity experience were underweight compared with 1 of 104 children (1.0%) in households reporting none. All nine children with severe underweight were in households reporting at least one recent food-insecurity experience (Table 2).

Table 2. Weight-for-age outcomes according to recent household food-insecurity experience

Outcome	Overall (n=170)	No affirmative experience (n=104)	Any experience (n=66)
Weight-for-age Z-score	-1.41 ± 1.04	-0.84 ± 0.80	-2.31 ± 0.70
Underweight, n (%)	46 (27.1)	1 (1.0)	45 (68.2)
Severe underweight, n (%)	9 (5.3)	0 (0.0)	9 (13.6)

Regression Analysis

In the unadjusted model, any recent food-insecurity experience was associated with a 1.46-unit lower WAZ ($\beta = -1.464$; 95% CI: -1.693 to -1.235 ; $p < 0.001$; $R^2 = 0.471$). After adjustment for district, child age, sex, and household size, the association remained essentially unchanged (adjusted $\beta = -1.436$; 95% CI: -1.690 to -1.183 ; $p < 0.001$). The primary adjusted model explained 49.7% of the observed variance in WAZ ($R^2 = 0.497$; Table 3).

Additional adjustment for log-transformed per-capita household expenditure in 166 participants with positive expenditure values yielded a similar estimate ($\beta = -1.39$; 95% CI: -1.64 to -1.14 ; $p < 0.001$). Adding HDDS to the primary adjusted model also produced a comparable estimate ($\beta = -1.42$; 95% CI: -1.68 to -1.17 ; $p < 0.001$). There was no statistical evidence that the association differed between West Sumbawa and Bima (food-insecurity-by-setting interaction $\beta = 0.19$; 95% CI: -0.33 to 0.70 ; $p = 0.481$). When the number of affirmative FIES responses was analyzed continuously, each additional affirmative response was associated with a 0.25-unit lower WAZ after adjustment ($\beta = -0.251$; 95% CI: -0.304 to -0.198 ; $p < 0.001$). However, among households reporting at least one experience, the number of additional affirmative responses was not associated with WAZ ($\beta = 0.005$; $p = 0.921$), indicating no simple monotonic dose-response pattern among exposed households.

Table 3. Association between recent household food-insecurity experience and weight-for-age z-score

Model	n	Mean difference in WAZ (β)	Robust SE	95% CI	p value	R ²
Unadjusted	170	-1.464	0.117	-1.693 to -1.235	<0.001	0.471
Adjusted primary model ¹	170	-1.436	0.129	-1.690 to -1.183	<0.001	0.497
Adjusted expenditure ² +	166	-1.389	0.129	-1.642 to -1.135	<0.001	0.507
Adjusted HDDS ³ +	170	-1.421	0.130	-1.676 to -1.166	<0.001	0.503
Food insecurity $\times$ setting ⁴	170	0.186	0.264	-0.332 to 0.704	0.481	0.499

β represents the mean difference in WAZ for any affirmative recent food-insecurity experience versus none. ¹Adjusted for district, child age, child sex, and household size. ²Additionally adjusted for log per-capita household expenditure; four records with non-positive expenditure were excluded. ³Additionally adjusted for Household Dietary Diversity Score (HDDS). 95% confidence intervals and p-values were estimated using HC3 robust standard errors. ⁴Interaction term added to the primary adjusted model.

DISCUSSION

In this catchment-based sample, households reporting any recent food-insecurity experience had lower mean WAZ than households reporting none. The adjusted mean difference was -1.44 WAZ units, and the estimate changed little after additional adjustment for household expenditure or dietary diversity. This is a notably large observed contrast. It should be interpreted as an association in the sampled households, not as the causal effect of food insecurity or as an estimate that can automatically be generalized to either district. The interaction test did not provide statistical evidence that the association differed between the two selected settings.

This pattern accords with evidence that links household food insecurity to child undernutrition. An Indonesian systematic review and meta-analysis found associations with several malnutrition outcomes, including underweight,³ and an international synthesis likewise reported elevated risks of stunting and underweight in food-insecure groups.⁴ Studies from several Indonesian urban, rural, and coastal populations have also connected constrained household food access with poorer child growth or nutritional status.^{5, 15–16} Complementary evidence from JoNE, based on the 2024 Indonesian Nutritional Status Survey, demonstrated marked wealth-related inequalities in childhood stunting.¹⁰ The two exposures are related but not interchangeable: wealth reflects household economic position, whereas our measure describes recently reported experiences of difficulty accessing food. Using continuous WAZ further extends predominantly categorical evidence by retaining variation throughout the weight-for-age distribution.

The association can be understood through several plausible pathways. The UNICEF nutrition framework places household-level resources and food access upstream of the diets and care that directly influence maternal and child nutrition.¹⁷ When food access is constrained, families may have less food available, fewer dietary choices, greater dependence on inexpensive foods, or smaller and less frequent meals. A second pathway may involve illness: Indonesian national evidence indicates that infectious-disease risk rises with increasing household food insecurity.⁹ These observations support plausible dietary and morbidity pathways, but mediation was not examined in the present dataset.

The proportion of households reporting any recent food-insecurity experience was higher in the Bima sample than in the West Sumbawa sample (51.8% vs 25.9%). However, these are sample proportions from selected catchment areas and should not be interpreted as district-level prevalence estimates. The interaction estimate did not show statistical evidence of effect modification by setting. Because the study was not specifically powered to detect modest interaction effects, this result does not establish that the setting-specific associations are identical.

The one-month FIES-derived module requires cautious interpretation. Internationally comparable estimates of moderate or severe food insecurity ordinarily rely on psychometric calibration to a reference scale.¹¹ Methodological work supports assessment of recent food insecurity

with a 30-day reference period when the scale is appropriately interpreted,¹² while Indonesian evaluation underscores the importance of local calibration and item performance.¹³ The any-versus-none threshold combines a broad range of experiences, from worry about food to going a whole day without food. It may therefore classify households with substantially different experiences in the same exposed group. The binary indicator should be interpreted as a pragmatic marker of any reported recent food-access difficulty, not as a calibrated measure of severity.

The number of affirmative responses was inversely associated with WAZ in the full sample, but additional affirmative responses were not associated with progressively lower WAZ among households already reporting at least one experience ($\beta=0.005$; $p=0.921$). This non-monotonic pattern does not support a simple dose-response interpretation. The large difference observed between the any-versus-none groups may reflect a threshold or proxy for broader household vulnerability, differences in sample composition, or residual confounding rather than a graded causal effect.

Several design and analytic features strengthen the study. Both sites used the same eight-item food-insecurity module and a common anthropometric field protocol. Treating WAZ continuously preserved information that would be lost by dichotomising nutritional status. The adjusted model was intentionally parsimonious; inference used heteroskedasticity-robust standard errors, district effect modification was tested explicitly, and additional adjustment for socioeconomic and dietary-diversity measures did not materially change the exposure estimate.

Several limitations warrant emphasis. First, the cross-sectional design prevents determination of temporal order and causal inference. The food-insecurity items referred to the preceding month, whereas WAZ reflects influences accumulating over a longer period. Reverse causation is possible: caregivers concerned about a child who is underweight or frequently ill may report food-related worry differently, while child illness may also increase household food-related strain. Second, the any-versus-none exposure is based on an adapted, non-calibrated FIES-derived module, and item-level reliability was not established in this analysis. The eight items combine experiences of differing severity. Third, the two health-center catchment areas were purposively selected, and systematic household selection was conducted within the available sampling frames. Because the frames did not cover all eligible households across either district, the sample cannot support district-representative estimates. Fourth, HC3 standard errors do not account for possible within-Posyandu correlation. Fifth, one caregiver generally reported household food-access experiences and household characteristics, creating potential common-method and reporting bias. Unmeasured factors—including recent illness, birth weight, maternal nutritional status, sanitation, caregiving, and access to health services—may have contributed to residual confounding. Anthropometric measurement error cannot be excluded because detailed calibration and inter-observer reliability statistics were not available. Finally, the

unusually large WAZ contrast and near-separation in underweight proportions warrant replication in independent samples and should not be interpreted as the effect of a single recent exposure.

In these selected settings, questions about recent household food-access difficulties may provide contextual information alongside routine growth assessment and prompt further evaluation of diet, feeding practices, illness, and available social support. However, the present findings do not validate food-insecurity questions as a stand-alone screening test or establish their predictive performance. Such questions should complement, not replace, anthropometric and clinical assessment. Prospective studies with probability-based sampling, calibrated food-insecurity measurement, and attention to clustering are needed to assess temporality and the reproducibility of the observed association.

CONCLUSION

Among 170 child–household pairs from two selected health-center catchment areas, any reported recent household food-insecurity experience was associated with lower WAZ (adjusted mean difference -1.44 ; 95% CI -1.69 to -1.18). The magnitude of this cross-sectional association requires cautious interpretation because the exposure was a broad, non-calibrated any-versus-none indicator, the settings were purposively selected, and possible residual confounding and within-Posyandu correlation were not fully addressed. Households were selected systematically within the available sampling frames, but the findings should not be generalized to all households in either district. No statistical evidence of effect modification by setting was observed, although modest interaction effects cannot be excluded. Recent food-access questions may offer contextual information alongside anthropometric assessment; they should not be treated as a causal or validated predictive indicator. Replication in larger, more representative longitudinal studies is needed.

ACKNOWLEDGMENT

The authors gratefully acknowledge the participating children and caregivers, field enumerators, community health workers, and the health authorities and staff of Jereweh Community Health Center in West Sumbawa and Palibelo Community Health Center in Bima for facilitating the study. The original research was supported by the Neys-van Hoogstraten Foundation (NHF), the Netherlands. The authors also thank the expert panel from IPB University for the scientific review of the study protocol.

CONFLICT OF INTEREST

Authors declare no conflict of interest to disclose.

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