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Household Food Expenditure Typology and Its Association with Child Stunting and Anemia in Indonesia

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Abstract

Stunting and anemia remain the coexisting nutritional problems among Indonesian children. However, evidence of household-level food expenditure and its association with child stunting and anemia is limited. This study aimed to observe the association between household food expenditure typology and child stunting and anemia in Indonesia. Data was obtained from the 2007 and 2014 Indonesia Family Life Survey (IFLS). The household food expenditure, child nutritional status, and anemia were observed in 2007 and 2014. Latent class analysis was taken to identify the food expenditure pattern. Binary logistic regression was applied to analyze the association between household food expenditure patterns and stunting and anemia status. A total of 2,296 children from 2,158 households were included in the study. Household food expenditure was identified into (1) higher processed food, refined grain, and purchased meals; (2) higher fish, seafood, plant protein, vegetables, and beans; and (3) balanced food purchases. Households with Pattern 2 had lower odds of anemia in 12–59-month-olds than Pattern 3 (AOR 0.78, p-value = 0.03, 95% CI). Households with Pattern 2 were likely to have stunted 8–12-year-olds compared to households with Pattern 3 (AOR 1.37, p-value = 0.09, 95% CI). Household food expenditure types may affect children's nutritional status.

Keywords: diet, food, nutrition, public health, purchasing

Introduction

Children are a vulnerable group to health and nutrition problems. Indonesia faces the triple burden of malnutrition, consisting of undernutrition, overweight-obesity, and micronutrient deficiencies.[1] Among a wide spectrum of nutritional problems, stunting and anemia co-occurrence have been widely reported.[2] The prevalence of stunted children under the age of 5 (the under-five) reached 30.8%, according to the 2018 Indonesian Basic Health Research.[3] The under-five with anemia in Indonesia increased to 38.5% in 2018 from 35.4% in 2014 compared to Malaysia, Thailand, and Brunei Darussalam at 29.85%, 26.6%, and 14.79%, respectively.[3,4] This comparison shows that anemia among children still needs to be a focus of public health issues, specifically in lower-middle-income countries (LMICs), including Indonesia. Stunting and anemia among children may prompt health risks in the short- and long-term. Stunting increases risks of infection and future noncommunicable diseases, poor development, and poor learning capacity.[5,6] Anemia may lead to decreased fitness levels, increased risk of infectious disease, cognitive decline, delayed motor development, morbidity, and mortality.[6,7]

Infancy and mid-childhood are periods of rapid growth. Despite the diverse manifestations, providing a nutritious diet in childhood is a major prevention of malnutrition.[8] Household food security and a healthy food environment are among the underlying determinants of child nutrition.[9] Based on the latest study on the food demand of the Indonesian population, households rely on home meal preparation and allocate their food spending budget primarily to home-cooked meals; however, in some higher socioeconomic groups, the trend also shifts to purchased meals.[10] Children's food consumption is often influenced by food choices at home, which could be represented by household food purchases. In several LMICs, household food expenditure patterns were associated with childhood anthropometry.[11,12]

Although the associations between food expenditure and stunting and anemia have not widely reported yet, some studies have suggested the association between food security in general and anemia and stunting. Food expenditure, as a proxy for economic access to nutritious food, is an element of food security, and according to the previous report, is known

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to affect nutrition and are considered prone to malnutrition.[9,13] A meta-analysis also shows that food insecurity was associated with anemia incidence among infants and toddlers.[14]

This study used a person-centered approach to determine the food expenditure pattern by classifying the household food expenditure traits or typologies. Household food expenditure typology can provide information on the general household food group purchase in the population. As food availability in the household determines children's consumption, it is important to understand further the association between the pattern of household food purchase and the prevalent nutrition problems in Indonesian children, which were stunting and anemia.[11] To date, analyses of the direct association between household food expenditure and stunting and anemia are still limited, particularly in Indonesia. This study aimed to analyze the types of household food expenditure patterns in the population and their association with stunting and anemia in different phases of childhood; under-five and school-age. By comprehending the association between food expenditure patterns and nutrition issues, this study could provide insights and evidence to design policies and interventions directed to food access and household purchasing patterns.

Method

Data were obtained from the Indonesian Family Life Survey (IFLS) from 2007 to 2014, a longitudinal study initiated in 1993. The target population of this study was children aged 12-59 months. The households' data were collected in 2007 when the children were at the age of 12-59 months, and the same households were revisited for data collection in 2014 when the children were at the age of 8-12 years old.[15] The IFLS data samples were taken from 13 provinces, representing 83% of the Indonesian population. A total of 321 areas for enumeration were randomly selected within the 13 provinces based on the National Socioeconomic Survey data sample frame. The households were then selected through random sampling based on the regional government statistics listings.

Based on prevalences among the under-five at the time of data collection at 27.7% anemia and 36.8% stunting, respectively, a minimum sample of 358 children was required after calculating the highest number of minimum samples for each case.[16] The inclusion criteria included children aged 12-59 months in 2007, followed up in 2014. There were 2,386 children followed up both in 2007 and 2014; however, 90 children were recorded without hemoglobin (Hb) and anthropometric data in 2007, thus leaving a total of 2,296 eligible children to be included in this study.

Dependent variables were stunting and anemia. Body height was based on standardized anthropometric measures by trained nurses, as explained in the IFLS protocol report.[17] Stunting was defined by height-for-age Z-score (HAZ) <2 SD, while others were considered not stunting. Anemia status was classified based on the Hb result measured by a trained operator using a point-of-care Hemocue™ Hb test device.[17] The cut-off value for anemia in children was Hb of less than 11 g/dL, based on the World Health Organization criteria for children's anemia. The anemia categories used in the study were divided into "anemia (Hb <11 g/dL)" or "no anemia (Hb >11 g/dL)".

The household's food expenditure was defined as the food expense made for all the members of the household during the past one week. The food group's expenditure was presented as the percentage of the food group expense per total food expenditure. The food categories were classified into staple foods (hulled, uncooked rice, sweet potato, potato, yam); meat (beef, lamb, water buffalo meat, and the like); poultry (chicken, duck, eggs, and the like); fish and seafood (fresh fish, oysters, shrimp, squid, and the like); plant-based protein (tofu, tempeh, mung beans, peanuts, soya beans, and the like); vegetables and beans (water spinach, cucumber, spinach, mustard greens, tomatoes, cabbage, sweet leaf, green beans, string beans, and the like); fruits (papaya, mango, banana, and the like); processed food and refined grains (instant foods, cakes, and the like); dairy (fresh milk, powdered milk, and the like); and purchased meal.

The household food expenditure percentage was compared to the child's food frequency questionnaire (FFQ) to evaluate the correlation between household food expenses and the child's consumption. The IFLS data FFQ contained limited food types, which are tuber, meat, fish, eggs, vegetables, and fruits. These food types were used as proxies for staple, meat, fish and seafood, poultry, vegetables and beans, and fruit consumption. This study limited its observation to the types of food in the context of meals and did not take condiments such as salt, sugar, and oil into observation. The pattern decided for the household food expenditure was based on the latent class analysis (LCA) conducted in the current study and further explained in the data analysis subsection.

Child basic characteristics, including sex (male and female) and age groups, were included as potential confounding variables. Records of birth weight (<2,500 grams and >2,500 grams) and compliance to public health recommendation programs were included as potential confounding variables; breastfed records (ever and never); vitamin A supplementation (ever and never); and basic immunization (incomplete and complete). Drinking water source variables also included a possible intake-related risk (pipe water, well water with a pump, well water with no pump, spring water, bottled water, and others). The presence of other forms of malnutrition, including stunting, wasting, obesity, and anemia, was also included as a potential confounding variable to the dependent variable. Wasting and obesity were based on Body Mass Index-for-age Z-score (BAZ), with <-2 SD classified as wasting and >2 SD classified as overweight and obese. All data were obtained through interviews using the IFLS questionnaire, which is described elsewhere.[15,17]

The IFLS interviewers were trained a month prior to the data collection, consisting of classroom training and field training. The data collection method was also pretested. The data cleaning was started in the field to ensure that the questionnaires were as complete and accurate as possible, to then entered into a data-entry software (CSPro 7.7.3, free version) to detect illogical values of code input and cleaned the data from remaining errors. The data in this study were extracted from the IFLS database and cleaned for duplicates.

Statistical analyses were performed with STATA software version 17 (licensed under StataCorp). The household food expenditure proportion per week was compared with the child's consumption frequency per week to observe if there was any correlation between the household food expenditure and the child's consumption. Pearson's correlation was applied to observe correlation and the degree of correlation, with a higher coefficient correlation representing a higher degree of correlation. After confirming the correlation between children's consumption and their household food expenditure (Supplementary 1), the LCA was used to identify clusters of household food expenditure typologies. LCA allows the observation of the heterogeneity in the subgroups within the population and is considered a "person-oriented analysis."[18]

To decide on the number of cluster models, the Bayesian Information Criterion (BIC) was used as the parameter to find the optimum number of clusters, with a lower number representing better optimization. After testing the goodness of fit of the two, three, and four-class models, the three-class model was used as the class solution for the LCA model (Table 1). After obtaining the food expenditure patterns, a binary regression was performed to compare the odds ratio (OR) of the different patterns to the incidence of stunting and anemia among the under-five (2007) and the followed-up data as school-aged children (2014).

Table 1. Household Food Expenditure Pattern Latent Class Analysis Goodness of Fit

Number of classes	2007 Household Food Expenditure Pattern	2014 Household Food Expenditure Pattern
	BIC	BIC
2 class	20413.24	21154.31
3 class	**20321.34**	**21027.29**
4 class	convergence not achieved	21045.72

Note: BIC: Bayesian Information Criterion

Not all participants' data were available in all potential confounding variables; therefore, the presented data might not match the total subjects. The potential confounding variables to child nutritional and anemia status were presented in numbers and percentages. The association between potential confounding variables and dependent variables was assessed with Chi-square. The food group's expenditures were presented in percent of total food expenditure. A p-value of <0.1 showed a likelihood, while a p-value of <0.05 with a 95% confidence interval (CI) was considered statistically significant.

Results

A total of 2,296 children from 2,158 households' data were included in this study. The prevalence of anemia in children aged 12–59 months (baseline) was 29.9% and significantly decreased to 11.0% when they were aged 8–12 years (end-line) (p-value = 0.00, 95% CI). The average Hb level of 2,296 children in the baseline data (2007) was 11.44±1.12 g/dL (min-max: 7.0–15.40 g/dL), and in the end-line data (2014) was 12.35±1.16 g/dL (min-max: 7.50-15.50 g/dL). Stunting at the baseline was 36.8% and significantly decreased in the end-line to 24.5% (p-value = 0.00, 95% CI).

The household food expenditure was correlated to the children's consumption in most food groups, except for staple food expenditure in 2007 and 2014 and meat expenditure in 2014 (Supplementary 1). The typology of household food expenditure patterns in 2007 and 2014 is presented in Figure 1. Based on the three-class LCA solution, the household food expenditure in 2007 was divided into three distinct patterns. Pattern 1 was leaning toward processed food and refined grain and purchased meals; Pattern 2 was distinct in higher fish and seafood, plant protein, and vegetables and beans household food purchase; and Pattern 3 was more varied in food groups except for meat and considered a balanced food expense model.

Meat expenditure percentage was low in all patterns. The typology of household food expenditure in 2014 showed a similar pattern to the typology in 2007, with slightly different percentages of household food expenditure adherence. The population distribution of the three-class household food expenditure pattern is described in Table 2. Pattern 1 was adhered to by 3.9% of the household in 2007 and increased to 8.4% in 2014. Pattern 2 was adhered to by 25.2% of the household in 2007 but decreased to 23.7% in 2014. Pattern 3 was the most adhered to household food expenditure pattern in 2007 (70.9%) and 2014 (67.9%). In 2007, Pattern 1 was higher in the urban population, while Pattern 2 was higher in the rural population. However, in 2014, Pattern 1 was higher in rural compared to urban, accompanied by decreased adherence to Pattern 2 and Pattern 3 in the rural population.

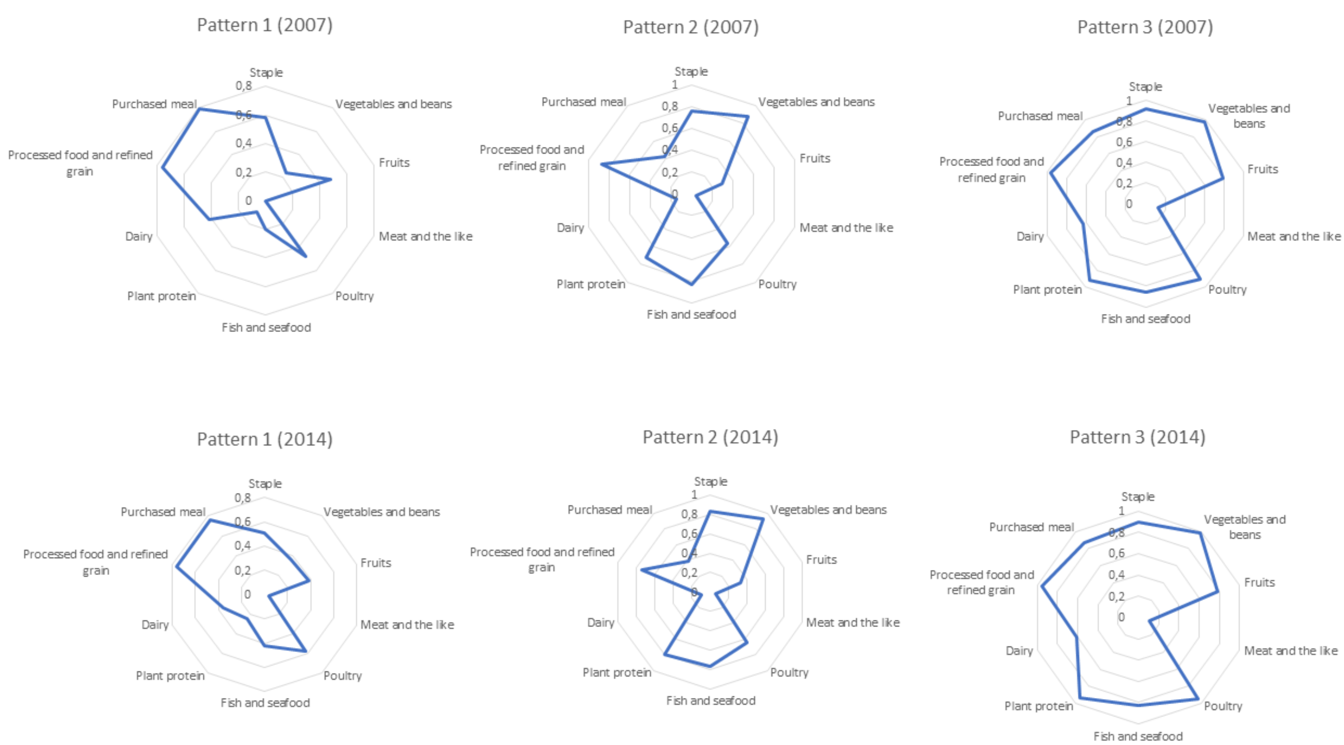

Figure 1. The Household Food Expenditure Pattern Classes Based on Latent Class Analysis

Table 2. Interpretation and Distribution of Household Food Expenditure Patterns (n = 2,296)

Pattern	Class Interpretation	2007			2014		
		n (%)	Urban n (%)	Rural n (%)	n (%)	Urban n (%)	Rural n (%)
1	Higher purchased meals and processed food	90 (3.90)	57 (5.20)	33 (2.70)	192 (8.40)	100 (7.80)	92 (9.00)
2	Higher fish and seafood, plant protein, and greens and beans	579 (25.20)	167 (15.40)	412 (34.00)	544 (23.70)	198 (15.50)	346 (33.90)
3	Balanced proportion	1,627 (70.90)	862 (79.40)	765 (63.20)	1,560 (67.90)	976 (76.60)	584 (57.10)

Some potential confounding variables to stunting and anemia in children are presented in Table 3. In the 12-59-month age group, HAZ and BAZ status are associated with anemia. Age group and BAZ status are still associated with child anemia in the 8-12 years old; however, HAZ status is no longer associated. Stunting is associated with drinking water sources, birth weight record, BAZ status, and anemia status in the 12-59 months; however, anemia is no longer associated with stunting in the 8-12 years old.

Household food expenditure pattern analyses with stunting and anemia among the 12-59 months old are shown in Table 4. Households with Pattern 2 food expenditure had significantly lower odds of having a child with anemia within the household compared to the households with adherence to Pattern 3 food expenditure (OR 0.78, p-value = 0.02, 95% CI). The significant association is retained after adjustment with the confounding variables, which are age group, HAZ status, and BAZ status (AOR 0.78, p-value = 0.03, 95% CI). Stunting in 12–59 months is also observed to be lower in households with Pattern 2 (OR 1.43, p-value = 0.00, 95% CI) compared to Pattern 3 food expenditure; however, the association is no longer significant after adjusting with drinking water sources, birth weight record, BAZ status, and anemia status (AOR 1.26, p-value = 0.16, 95% CI).

Table 3. Potential Confounding Variables of Child Stunting and Anemia

Variable	2007				2014			
	Stunting	p-value	Anemia	p-value	Stunting	p-value	Anemia	p-value
Sex (n = 2,296)								
Male	38.30%	0.11	30.79%	0.33	25.20%	0.43	30.79%	0.33
Female	35.10%		28.94%		23.80%		28.94%	
Age (n = 2,296)								
12-36 months	37.50%	0.39	43.00%	0.00*	24.00%	0.34	12.12%	0.01*
36-60 months	40.10%		31.40%		25.90%		8.11%	
Drinking water source (n = 2,296)								
Pipe water	34.80%	0.00*	25.54%	0.07	21.90%	0.00*	11.73%	0.19
Well water with pump	32.30%		31.33%		23.50%		12.29%	
Well water with no pump	45%		32.28%		37.40%		7.14%	
Spring water	40.90%		24.19%		35.80%		8.42%	
Bottled water	24.30%		31.10%		17.90%		11.73%	
Other	33.10%		33.30%		46.30%		7.50%	
Breastfeed record (n = 1,147)								
Ever	34%	0.13	30.39%	0.15	23.40%	0.39	23.40%	0.39
Never	20%		44.00%		16.00%		16.00%	
Complete immunization (n = 2,296)								
Yes	36.80%	0.82	29.78%	0.76	35.30%	0.01*	11.76%	0.78
No	36%		30.81%		20.70%		10.68%	
Vitamin A supplementation (n = 1,798)								
Yes	36.80%	0.64	30.97%	0.52				
No	38.90%		28.18%					
Low birth weight (n = 1,032)								
Yes	55.90%	0.00*	39.71%	0.09	35.30%	0.01*	11.80%	0.78
No	31.10%		29.88%		20.70%		10.70%	
HAZ status (n = 2,296)								
Stunting			33.06%	0.01*			12.26%	0.28
No stunting			28.03%				10.62%	
BAZ status (n = 2,296)								
Wasting	25.50%	0.00*	37.23%	0.03*	43.80%	0.00*	16.13%	0.04*
Normal	35.70%		30.28%		25.20%		10.66%	
Overweight and obese	45%		25.62%		8%		9.57%	
Anemia status (n = 2,296)								
Anemia	40.70%	0.01*			27.30%	0.28		
No anemia	35.10%				24.20%			

Notes: HAZ = height-for-age Z-score, BAZ = Body Mass Index-for-age Z-score, +p-value <0.10; *p-value <0.05

Table 5 shows the household food expenditure pattern analyses with stunting and anemia in 2014 when the children turned 8-12. Stunting was observed to be significantly higher in households adhering to Pattern 1 and Pattern 2 compared to Pattern 3 (OR = 1.44, p-value = 0.04, 95% CI and OR = 1.74, p-value = 0.00, 95% CI, respectively). However, the association after adjusting for the drinking water source, complete immunization status, birth weight record, and

BAZ status was no longer significant for Pattern 1 (AOR 1.33, p-value = 0.32, 95% CI) and only showed a tendency for Pattern 2 (AOR 1.37, p-value = 0.09, 95% CI) compared to Pattern 3. Anemia in the 8-12 years old was not associated with household food expenditure patterns.

Table 4. Association between Food Expenditure Pattern and Child Anemia and Stunting in 2007 (N = 2,296)

	n	Anemia n (%)	OR	95% CI	p-value	AOR[a]	95% CI	p-value
Pattern 1	90	26 (28.89)	0.89	0.56-1.42	0.63	0.88	0.55-1.42	0.61
Pattern 2	579	151 (26.08)	0.78	0.63-0.96	0.02*	0.78	0.63-0.97	0.03*
Pattern 3	1627	509 (31.28)	1			1		
	n	Stunting n (%)	OR	95% CI	p-value	AOR[b]	95% CI	p-value
Pattern 1	90	25 (27.78)	0.72	0.45-1.15	0.17	0.62	0.31-1.25	0.18
Pattern 2	579	251 (43.35)	1.43	1.18-1.73	0.00*	1.26	0.91-1.75	0.16
Pattern 3	1627	568 (34.91)	1			1		

Notes: OR = odds ratio, AOR = adjusted odds ratio, CI = confidence interval
a: Adjusted with age, height for age, and weight for age categories
b: Adjusted with drinking water source, low birth weight, body mass index for age status, and anemia categories

Table 5. Association between Food Expenditure Pattern and Anemia and Stunting in 2014 (n = 2,296)

	n	Anemia n (%)	OR	95% CI	p-value			
Pattern 1	192	16 (8.33)	0.69	0.40-1.18	0.17			
Pattern 2	544	55 (10.11)	0.85	0.62-1.17	0.32			
Pattern 3	1,560	182 (11.67)	1					
	n	**Stunting n (%)**	**OR**	**95% CI**	**p-value**	**AOR[a]**	**95% CI**	**p-value**
Pattern 1	192	54 (28.13)	1.44	1.03-2.01	0.04*	1.33	0.76-2.32	0.32
Pattern 2	544	175 (32.17)	1.74	1.40-2.16	0.00*	1.37	0.94-1.98	0.09+
Pattern 3	1,560	334 (21.41)	1			1		

Notes: OR = odds ratio, CI = confidence interval, AOR = adjusted odds ratio
a: Adjusted with drinking water, complete immunization, birth weight, body mass index for age status, and anemia status

Discussion

There were significant decreases in anemia and stunting between 2007 and 2014. The child's food consumption was correlated with the household food expenditure in most food groups but lower in the school-age compared to the under-five. The household food typology patterns were identified as three patterns: (1) higher in purchased meal, processed food, and refined grain; (2) higher in fish and seafood, plant protein, and vegetables and beans; and (3) higher in dairy, poultry, and fruits expenditures, with the latter was mostly adhered by the current population. After adjusting for the potential confounding variables, household food expenditure with higher fish and seafood, plant protein, and vegetables and beans was associated with lower odds of under-five anemia compared to balanced food expenditure. No association was found between food expenditure patterns and stunting in both age groups.

Nutrition deficiencies, especially iron, are a common risk factor for anemia. A lack of nutritious food intake and a diversified diet can lead to low iron intake.[19] There are several iron, folate, and vitamin B12-rich food sources, such as red meat, poultry, fish, eggs, green vegetables, and beans; also, foods with high vitamin C fruits and vegetables can promote iron absorption in the body.[20] However, heme-iron food sources such as red meat and eggs with high iron content are relatively more expensive than non-heme-iron food sources such as grain, beans, vegetables, and fruits.[12] In this study population, meat purchase was considerably low in all patterns, even for the balanced food expenditure pattern. Families with low income might have low purchasing power for these food groups, as also observed in another report on

Indonesian rural communities.[21] In addition, people in rural areas tend to have difficulty obtaining food other than self-produced food, one of which is animal protein, such as meat, especially when they have limited access to livestock products.[21] Therefore, lack of access to food might lead to low accessibility to meat products in the rural population.

Based on this study, the availability of non-heme iron, folate, and vitamin B12-rich food choices in households gave possible advantages to promote the nutritious intake required for Hb synthesis and red blood cell production. This idea is also supported by previous studies reporting the equal effect of fish and meat consumption on lower anemia.[22,23] Fish is one of the food sources with high protein, supporting erythropoiesis by allowing increased protein synthesis.[22] Another study also supports the role of non-heme iron from plant protein as a promising alternative iron source aside from meat.[24]

This study observed a different association across two periods: 12-59 months and 8-12 years. The household food expenditure pattern was associated with the children's anemia status when they were younger but not when the children turned older. This study also observed a higher prevalence of anemia in the baseline when the children were still under five years of age. Infant and young childhood feeding practices were associated with Hb concentration.[25] The low intake of iron-rich foods after weaning is also a risk factor for anemia among the 12-60 months old.[26]

Children aged five years to adolescence have the same iron intake requirements as adult men, and consuming iron-rich food is essential for children to balance their iron requirements.[27] Moreover, younger children rely on their parents or caregivers to provide food; therefore, household food may impact younger children more when they become older.[11] The prospective observation in this study also observed a lower correlation between household food and school-age children's consumption compared to when they were under five. In addition to feeding factors, illnesses such as fever incidence were also reported to be associated with anemia prevalence in under two years old, thus adding more risks of anemia in those under two years of age compared to older children.[28]

Previous reports in Indonesia have suggested the effects of food insecurities and lower-than-average food expenditure on nutritional status.[13,29] This population also shows a likelihood of an association between household food expenditure proportion patterns and stunting in school-aged children. Households with balanced food expenditure likely have a lower incidence of stunting compared to households with higher fish, seafood, plant protein, vegetables, and beans. The results were in contrast with the pattern association with anemia in the 12–59 months; however, it is supported by other studies suggesting that a more balanced diet in school-age gives benefits for better growth.[30] Further study on factors related to household food's effect on dietary patterns in school-aged children is necessary to draw conclusions related to the association between household food expenditure and stunting in 8–12-year-old children.

This study showed that higher household food expenditure on non-heme nutrient-rich foods was associated with a lower incidence of anemia in children of the household. Food expenditure in Indonesia is influenced by multiple factors, such as the Human Development Index (HDI), Gross Regional Development Product (GRDP), the number of family members, education, and household income.[31] Improving economic access to nutritious food sources will support the food-based and nutritional approach that has been conducted by the Indonesian government. An interdisciplinary approach through education, supplementation, and increased food purchasing power for nutritious foods is necessary to optimize efforts in reducing malnutrition.

Other variables were observed to be associated with stunting and anemia. Age, HAZ, and BAZ categories were associated with anemia while drinking water source, low birth weight, BAZ, immunization, and anemia categories were associated with stunting. Although this study did not explore these variables as dependent variables, these variables have been acknowledged as part of maternal and child nutrition framework determinants.[9] These variables possibly have their independent role in association with stunting and anemia in this population.

This study included children from all over Indonesia, spreading across various provinces and urban and rural areas, thus representing the Indonesian population. The multiple observations give a better understanding of the impact of household food in the different phases of childhood. This study proposed a novel analysis of food expenditure typology using the LCA. The typology allows for a better classification of the household's food purchasing pattern in the population compared to the general food-group variables.

However, this study observed each case of stunting and anemia independently. It did not observe groups that stayed stunted or anemic between 2007 and 2014, as well as groups having both stunting and anemia together at the same time. This study was taken from secondary data, causing a limitation in the availability of some supporting information, such as iron supplementation status and infectious diseases. This study also did not observe the children's food choices outside the household, such as when they bought food at school or had dinner at a friend's place. Other external factors, such as political and economic changes, were not included in the analyses. A further longitudinal study using a primary data collection method observing wider socioeconomic variables is necessary to gain insight related to the decision-making process for household food purchases.

Conclusion

Household food expenditure is a factor associated with anemia. The evidence for food expenditure associated with stunting is still limited. The lower-than-median household spending on meat is associated with anemia compared to the higher spending in the category. In addition, children without anemia have significantly increased household food expenditure on almost all types of food. The evidence for food expenditure association with stunting remains limited; however, food security aspects at the household level cannot be disregarded in both anemia and stunting prevention. Economic access to iron-rich food should be part of the policy to support the current programs in response to undernutrition.

Abbreviations

LMICS: lower-middle-income countries; IFLS: Indonesian Family Life Survey; HAZ: height-for-age Z-score; FFQ: food frequency questionnaire; LCA: latent class analysis; BAZ: Body Mass Index-for-age Z-score; BIC: Bayesian Information Criterion; OR: odds ratio; CI: confidence interval; AOR: adjusted odds ratio.

Ethics Approval and Consent to Participate

Inform liscence obtained from institution and research subject. This study has acquired approval from RAND Corporation, the institute that conducted the survey and owned the IFLS data. The IFLS survey was reviewed and approved by Institutional Review Boards at the University of Gadjah Mada with ethical clearance number s0064-06-01-CR01.

Competing Interest

There are no significant competing personal, professional, or financial interests that may have influenced the performance or presentation of the work described in this manuscript.

Availability of Data and Materials

The datasets are available on the RAND Corporation's website as the institute that conducted the survey and owned the IFLS data: https://www.rand.org/well-being/social-and-behavioral-policy/data/FLS/IFLS.html.

Authors' Contribution

RADS, Y, SAP, and FW designed the study; RADS, RAW, and WMN conducted the data selection and cleaning; RADS and FW analyzed the data; RADS, Y, and FW wrote the manuscript. All the authors have read and approved the manuscript.

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