Healthy eating index, growth status, and household-maternal factors among young children: Evidence from a stunting region in Indonesia

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ABSTRACT

Background and Objectives: Diet quality is a key determinant of child growth, yet little is known about its role in stunting-prevalent regions of Indonesia. This study assessed diet quality of young children using a modified Healthy Eating Index (HEI) and examined its associations with growth status and household–maternal factors. **Methods and Study Design:** A cross-sectional study was conducted among 215 children aged 12–59 months in Kulon Progo District, Yogyakarta. Dietary intake was assessed using a semi-quantitative food frequency questionnaire and 24-h recall. The HEI was modified to align with Indonesian dietary guidelines and nutrient adequacy standards. Anthropometry, maternal knowledge, education, and household food security were also measured. Children were classified into tertiles of HEI scores (T1: ≤116, T2: 117–127, T3: ≥128). Associations were analyzed using chi-square, ANOVA/Kruskal–Wallis, and multinomial logistic regression. **Results:** The mean HEI score was 122 ± 13.3, with 35.8% of children in the lowest tertile. Low intakes of fruits, vegetables, and dairy were the main contributors to poor scores, while grains and fats/oils scored higher. Younger age was independently associated with higher HEI (aOR 0.93; 95%CI 0.88–0.99; p = 0.03). Maternal education, household food security, and maternal knowledge showed no significant associations. **Conclusions:** Diet quality among children in stunting-prevalent areas remains suboptimal, especially for fruits, vegetables, and dairy. Younger children had better diet quality, underscoring the need for interventions beyond early complementary feeding. Strategies should improve access to diverse, nutrient-rich foods and reduce reliance on processed products.

Key Words: healthy eating index, diet quality, child nutrition, stunting, household food security

INTRODUCTION

The early years of life represent a critical window for child growth and development. Nutritional deficiencies or other growth barriers during this period can rapidly lead to impaired growth, with long-term consequences including an increased risk of chronic diseases in adulthood and elevated child mortality.[1,2]

In Indonesia, child undernutrition remains a major public health concern. Kulon Progo District, located in the Special Region of Yogyakarta, Indonesia has been identified as an area with persistently high stunting prevalence. According to the Indonesia Health Survey (SKI) 2023, the prevalence of stunting in Kulon Progo reached 21.2%, which was higher than the provincial average of 18.0%.[3] Local health office reports also indicated a rising trend in 2024, with stunting increasing from 9.43% to 10.38%, underweight from 10.1% to 12.1%, and wasting from 4.1% to 5.1%.[4,5] These figures underscore the ongoing challenges in improving child nutritional status in the district.

Determinants of child nutrition can be classified into direct factors, such as adequacy of energy and nutrient intake, and indirect factors, including household food security, maternal education, nutrition knowledge, and parenting practices. In Kulon Progo, household food insecurity affected 13.4% of the population,[6] while the prevalence of protein-energy malnutrition was 11.4%.[4] Data from the 2014 Total Diet Study showed that more than half of Indonesian children (55.7%) consumed energy below the recommended dietary allowance.[7] Educational attainment also plays an important role: only 5.86% of the Kulon Progo population had completed higher education, whereas the majority had only primary or secondary schooling.[8] Maternal education is closely related to nutrition knowledge and feeding practices, with lower education often associated with suboptimal feeding behaviors and an increased risk of child malnutrition.[9]

Diet quality is another crucial determinant of child growth, as it reflects not only the quantity of energy consumed but also the diversity and alignment of diets with dietary guidelines. A global analysis of 49 low- and middle-income countries reported that the diet quality of Indonesian children was among the poorest.[10,11] The Healthy Eating Index (HEI), originally developed by the USDA, is one of the most widely used instruments to assess diet quality.[12,13] Studies applying HEI in Indonesia remain limited, particularly among children, and most have relied on the original USDA framework or local adaptations consisting of about 10–12 components.[14–16] In this study, we expanded the HEI to 14 components and adapted it to the Indonesian Dietary Reference Intakes (AKG) and the Balanced Nutrition Guidelines, thereby capturing nutrient gaps and food groups that are especially relevant for child growth in the Indonesian context

Previous studies have highlighted the role of diet quality, maternal characteristics, and household factors in shaping child growth. A longitudinal study in India demonstrated that higher dietary quality and quantity were associated with improvements in weight-for-age and BMI-for-age indicators.[17] Research in Ethiopia showed that maternal nutrition knowledge was significantly linked with improved child feeding and willingness to invest in nutrition services.[18] Parenting style also plays an important role; a study from the United States found that authoritative parenting was associated with higher HEI scores among children.[19] Furthermore, evidence from Chad revealed that children from households with severe food insecurity had a 2.5-fold higher risk of undernutrition compared with those from food-secure households.[20]

Building on this evidence, the present study assessed the diet quality of young children in Kulon Progo District, Yogyakarta, using a modified HEI adapted to Indonesian dietary standards. It also examined the associations between HEI, child growth status, and maternal–household factors in a setting with persistently high stunting prevalence.

MATERIALS AND METHODS

Ethical approval

This study was approved by the Ethics Committee of Universitas Alma Ata, Yogyakarta, Indonesia (No: KE/AA/VI/10112667/EC/2025). Written informed consent was obtained from all participating caregivers.

Sample size calculation

Sample size was calculated for proportion studies with 95% confidence level ($\alpha = 0.05$) and 90% power ($\beta = 0.10$). Several key variables were considered, including growth status, household food security, infection history, parenting, maternal knowledge, and dietary intake. The largest minimum sample size was 195. Allowing for a 10% non-response rate, the final required sample was 215 children aged 12–59 months.

Study design, setting, and participants

A cross-sectional study was conducted between May and June 2025 in three sub-districts of Kulon Progo (Samigaluh, Panjatan, and Kokap), Yogyakarta, Indonesia, which report the highest stunting prevalence. Eligible participants were children aged 12–59 months who lived in the study area, were directly cared for by their parents, and did not have special health needs. Parents had to be able to communicate in Indonesian and consent to participation. Exclusion criteria included withdrawal during data collection or incomplete questionnaires.

Sampling followed a multistage approach. In the first stage, three sub-districts with the highest stunting prevalence (Samigaluh, Panjatan, and Kokap) were selected purposively. In the second stage, villages were chosen proportionally to the population of under-five children, ensuring balanced representation across sub-districts. In the third stage, the "posyandu" (integrated health post) with the greatest under-five child population in each selected village was identified using purposive sampling. All eligible children registered in these posyandu were then recruited through total sampling, yielding a final sample of 215 children, consistent with the calculated minimum requirement. As this study employed a cross-sectional design, the associations identified should be interpreted as correlational rather than causal.

Anthropometric measurements

Weight was measured using calibrated digital scales (precision 0.1 kg) with children barefoot and in light clothing. For children unable to stand, the mother‑child weighing method was applied. Height (children ≥24 months) was measured to the nearest 0.1 cm using a stadiometer with the Frankfurt plane, while recumbent length (children <24 months) was measured with an infantometer. Nutritional status indicators (weight-for-age, height-for-age, weight-for-height) were calculated as Z-scores using WHO Anthro software.

Dietary intake assessment

Dietary intake was assessed using two complementary methods. First, a 24-hour dietary recall (conducted on both a weekday and a weekend day) was used to estimate daily intakes of energy and protein intake and to derive the Dietary Diversity Score (DDS). Portion sizes were estimated using household measures and a photographic food atlas, then converted into grams. Nutrient intakes were calculated using the Food Nutrition Content Analysis (FNCA) software, based on the Indonesian Food Composition Table (*Tabel Komposisi Pangan Indonesia*). Dietary diversity was assessed following the WHO guidelines using the DDS, which reflects the number of different food groups consumed in the past 24 hours. Seven food groups were considered: (1) cereals, roots, and tubers; (2) vegetables; (3) fruits; (4) meat, fish, and poultry; (5) eggs; (6) legumes; and (7) milk and dairy products. The DDS was computed as the sum of food groups consumed. Participants were then categorized into 2 Diet Diversity Groups: <4 food groups (low diversity) and ≥4 food groups (adequate diversity).[20]

Second, a semi-quantitative food frequency questionnaire (SQ-FFQ) was applied specifically for assessing diet quality and generating HEI scores. The SQ-FFQ underwent content validation through a Focus Group Discussion (FGD) with 13 mothers of under-five children outside the study sample. The FGD identified locally consumed foods commonly given to children, and several additional food items were incorporated into the SQ-FFQ to reflect local dietary patterns more accurately. In total, the SQ-FFQ included 264 food items covering staple foods, vegetables, fruits, meat and eggs, legumes, fats and oils, as well as various processed foods and snacks. It also included 10 beverage items such as fruit juices (homemade and instant), different types of milk (liquid, powdered, fresh, soy, goat, sweetened condensed), yogurt, and breast milk.

Diet quality

Diet quality was assessed using a modified HEI. The original HEI was developed by the USDA based on the Dietary Guidelines for Americans.[12,13] A previously adapted Indonesian version16 was further modified in this study to align with Indonesian Dietary Reference Intakes and the Balanced Nutrition Guidelines.[21,22] Five additional nutrients critical for child growth—energy, protein, calcium, zinc, and iron—were incorporated, yielding a total of 17 components. Each component was scored against age-specific dietary adequacy standards based on the Indonesian Recommended Dietary Allowances (RDA), and total scores were categorized into tertiles: low (≤116), middle (117-127), and high (≥128).

The modified HEI was further validated against the Mean Adequacy Ratio (MAR), which was calculated as the average adequacy across selected nutrients. Validation was conducted among 19 mothers of under-five children in Yogyakarta. Pearson's correlation analysis showed a significant positive correlation between modified HEI and MAR scores ($r = 0.573$, $p < 0.05$), confirming that higher HEI scores reflected greater overall nutrient adequacy. The instrument demonstrated strong reliability (Cronbach's alpha = 0.93).

Household food security

Household food security was assessed using the nine-item Household Food Insecurity Access Scale (HFIAS). The instrument evaluates household experiences related to food access during the past three months, consistent with the standard recall period used in the questionnaire employed in this study. For each item, respondents indicated the frequency of occurrence in the past three months using the HFIAS response categories: 0 = never, 1 = rarely (1-2 times), 2 = sometimes (3-10 times), and 3 = often (>10 times). The total score (range 0-27) was then dichotomized for analysis into "food secure" (0-1) and "food insecure" (>1).[23] The instrument demonstrated strong reliability (Cronbach's alpha = 0.93).

Maternal knowledge

Maternal nutrition knowledge was assessed with a 30-item true–false questionnaire, was developed by the researchers based on the Indonesian Balanced Nutrition Guidelines for Children and covered nine sub-domains: meal frequency and family meals, consumption of protein-rich foods, intake of vegetables and fruits, limiting unhealthy snacks (high in sugar, salt, and fat), adequate water intake, daily physical activity, nutritional needs of young children, consequences of inadequate nutrition, and factors influencing nutritional status. Each correct response was assigned a score of "1" resulting in a total score of 0-30. Because the score distribution was positively skewed, with most mothers achieving high scores, the total score was categorized into good knowledge (>75% correct responses) and low knowledge (≤75%) for multivariable modelling. The instrument demonstrated acceptable validity and strong reliability (Cronbach's alpha = 0.98).

Statistical analysis

All analyses were performed using SPSS version 26. Descriptive statistics summarized child characteristics, anthropometry, dietary intake, food security, maternal knowledge, and parenting variables. HEI total score was categorized into tertiles representing low, moderate, and high diet quality, and all comparative analyses were performed across these tertile groups. Associations between categorical variables and HEI tertiles were examined using Chi-square tests or Fisher's exact tests, while continuous variables were compared using ANOVA and Kruskal Wallis, depending on data distribution. Variables with $p < 0.25$ in the bivariate analyses were entered into a multinomial logistic regression model to identify independent predictors of HEI categories. The analysis used the HEI tertiles as the dependent variable (T1 = low, T2 = middle, T3 = high), with the highest tertile (T3) designated as the reference group. Results are presented as adjusted odds ratios (aORs) with 95% confidence intervals, and statistical significance was defined as $p < 0.05$.

RESULTS

Characteristics of participants

A total of 215 children aged 12–59 months were included, of whom 52.6% were boys. The mean age was 34.8 ± 14.2 months. Most mothers had completed only primary or secondary education, and the majority of households were categorized as food insecure (Table 1).

Diet quality

Diet quality assessed using the modified HEI showed a mean score of 122±13.3, with values ranging from 88 to 150. Based on tertile classification, 77 children (35.8%) were categorized in the lowest HEI tertile (≤116), while 32.1% were in the middle (117-127) and highest (≥128) tertiles.

Across HEI components, the lowest scores were observed for fruits, vegetables, legumes/nuts, and milk and dairy products. In contrast, grains and oils/fats although still below recommended intake levels in absolute terms showed relatively higher HEI component scores and increased significantly across HEI tertiles. Several HEI components, including grains, vegetables, fruits, meat and eggs, oils and fats, dietary diversity score, energy intake, saturated fat, cholesterol, and sodium, differed significantly across HEI tertiles ($p<0.05$), indicating meaningful variation in overall diet quality (Table 2).

Dietary intake and adequacy patterns

Based on 24-hour recall data, the mean daily energy intake was 1049±359 kcal, and mean protein intake was 39.4±19.9 g. The average DDS was 4.4±1.2, with 74.2% of children consuming foods from 4 or more groups. Indicating generally adequate dietary diversity. However, the pattern of nutrient and food group adequacy revealed specific gaps (Table 2). While the adequacy for protein for protein (212% RDA), fats (80% RDA) and calcium (80.3% RDA) was high, the intake of several key components was notably low: fruits (44.6% of recommended portions), dairy products (39.7%), and zinc (30.7% of RDA). Food frequency data complemented this picture, showing frequent consumption of processed item such as nuggets, sausages, fried snacks, biscuits, and sweetened beverages.

Factors associated with healthy eating index in young children

Table 3 summarizes the factors associated with children's HEI scores. In the bivariate analysis, younger children had significantly higher HEI scores, with mean ages of 31.1 months in T3, 34.2 in T2, and 38.7 months in T1 (p = 0.00). Maternal education and household food security tended to be more favorable among children with higher HEI scores, although these differences did not reach statistical significance.

In the multivariable analysis, child age remained the only significant predictor HEI (aOR 0.93, 95%CI 0.88–0.99; p = 0.03), indicating that older children were less likely to be in the high HEI tertile (Table 4).

DISCUSSION

This study assessed diet quality among children aged 12–59 months living in stunting-prevalent areas of Kulon Progo, Indonesia, using a modified HEI. More than one-third of children fell into the lowest HEI tertile, driven primarily by inadequate consumption of legume/nuts, fruits, vegetables, and dairy products. While staple food and fats/oils were consistently higher. These patterns are consistent with the 2018 Indonesian National Basic Health Research (Riskesdas) and other reports that highlight the persistent inadequacy of fruit and vegetable intake among Indonesian children.[7,24,25] Dairy consumption is also relatively low, reflecting both cultural feeding patterns and limited household access to animal-source foods. These dietary gaps are highly relevant in the stunting area, as inadequate fruit, vegetable, and animal-source food intake has been consistently associated with impaired linear growth and increased odds of stunting in Indonesian and global studies.[26–29]

Based on the dietary assessment, many children preferred processed foods such as chicken nuggets, sausages, fried snacks, biscuits, and sweetened beverages. The food items most frequently consumed reflected common local diets: staple foods such as rice, noodles, bread, and root crops; vegetables like spinach, carrots, cabbage, and chayote; fruits including papaya, banana, watermelon, and orange; and protein sources such as eggs, chicken, catfish, tilapia, tempeh, and tofu. However, alongside these, children were also observed to consume nuggets, sausages, meatballs, biscuits, wafer snacks, cilok (boiled tapioca flour dumplings), and sweetened dairy products such as condensed milk. These foods are widely available, affordable, and palatable for children, but they contribute to excessive intake of sodium, saturated fat, and sugar while displacing healthier nutrient-dense foods. This pattern may partially explain why HEI protein scores appeared adequate, as processed meats were counted toward protein intake, but in reality the quality of protein and accompanying micronutrients was limited. Similar findings have been reported in other low- and middle-income countries, where the increasing consumption of ultra-processed foods among young children has raised concerns about double burdens of malnutrition persistent stunting alongside emerging risks of overweight and metabolic disorders.[30,31]

An important methodological contribution of this study was the use of a modified HEI adapted to Indonesian guidelines and nutritional needs. By incorporating energy, protein, calcium, zinc, and iron—nutrients directly linked to child growth and immune development—the instrument provided a more comprehensive measure of diet quality in young children. The positive correlation between the modified HEI and MAR suggests that the tool adequately captured overall nutrient adequacy, thus strengthening the reliability of the findings.[32,33] Since stunting is largely driven by chronic deficits in diet quality and both macronutrients and micronutrients, the ability of the modified HEI to reflect both dietary diversity and nutrient adequacy supports relevance as a monitoring tool in stunting-prevalent regions.[30,31] Importantly, food-group diversity captures the range of foods consumed, whereas nutrient adequacy reflects whether essential nutrients meet recommended intakes; these two dimensions contributed uniquely to interpreting HEI results in this study.

Although no direct association was observed between HEI scores and linear growth indicators in this study, the conceptual link between diet quality and child linear growth is well-established in global nutrition research. Linear growth depends on sustained adequacy of energy, protein, and micronutrients such as zinc, iron, and calcium, which support bone growth, hormonal regulation, and immune function.[1,34] Diets low in animal-source foods, fruits, vegetables, and legumes as observed in this population are consistently associated with reduced micronutrient intake, increased risk of infections, and impaired growth velocity.[35,36] Evidence from multi-country analyses also shows that poor dietary diversity and low nutrient density are key predictors of stunting, even after controlling for socioeconomic factors.[37] The absence of statistically significant associations in the present study may reflect limited variability in dietary patterns within the population or insufficient statistical power; however, the biological plausibility of diet quality as a determinant of linear growth remains well supported by existing literature.

Interestingly, child age emerged as the only significant independent predictor of HEI, with younger children demonstrating higher diet quality. This is consistent with evidence from a longitudinal study in rural India that found diet diversity and nutrient adequacy were higher in early complementary feeding but declined as children transitioned to family diets, which are often dominated by staple foods with low nutrient density.[17] Similar findings were reported in Ethiopia, where dietary diversity decreased with increasing child age due to household food allocation practices and reliance on family meals.[18] Several mechanisms may explain this pattern. Younger children often receive preferential feeding of nutrient-dense foods such as eggs or milk, whereas older children increasingly consume the same carbohydrate based dishes as the rest of the household. Additionally, as children grow older, parental control over feeding declines, and children become more exposed to processed snacks and sugary beverages. This decline in diet quality is concerning because it overlaps with the critical window for linear growth faltering between 24-59 months reported in Indonesia.[38–40]

By contrast, maternal education, household food security, and maternal knowledge did not show significant associations with HEI in the multivariate analysis. These null associations should be interpreted cautiously. First, the sample was relatively homogenous, most households

were food insecure and most mothers had low to moderate education, reducing variability and limiting statistical power. Second, although maternal knowledge scores were high, previous research shows that knowledge alone does not guarantee improved feeding practices due to barriers such as food affordability, cultural preferences, and limited decision making autonomy.[18,19,41,42] Third, the food security measure used (HFIAS) may not fully captured intrahousehold food distribution or seasonally, which are highly relevant in rural Indonesia. Together, these constraints suggest that structural and environmental barriers may overshadow individual-level factors in determining child diet quality in stunting-endemic settings.

The study highlights several important implications. First, interventions to improve diet quality in stunting-prevalent areas should prioritize increasing access to and affordability of fruits, vegetables, legume/nuts and dairy products. Second, nutrition education programs targeting mothers should not only focus on knowledge but also provide practical skills such as meal planning, food preparation, and strategies for optimizing limited household food budgets within local constraints. Third, public health efforts must extend beyond the first 1000 days to reach older children who experience declining diet quality as they transition to family foods. Lastly, reducing exposure to processed foods through regulation and community based campaigns may support healthier child diets.

This study has several limitations. First, the cross-sectional design precludes causal inference. Although we identified an association between younger age and higher diet quality, we cannot determine the direction of this relationship. Second, dietary data based on maternal recall are subject to measurement error and social desirability bias. Finally, the relatively homogeneous sample in terms of socioeconomic status may limit the generalizability of the findings to other settings and reduce the statistical power to detect associations with household-level factors.

Conclusion

Diet quality among young children in stunting-prevalent areas of Kulon Progo was suboptimal, with particularly low intake of fruits, vegetables, legumes/nuts, and dairy products being the primary contributors to poor HEI scores. One-third of children fell into the lowest HEI tertile. Child age was the only significant predictor of HEI, with younger children showing better diet quality than older children, while maternal education, maternal knowledge, and household food security were not independently associated with HEI.

The modified HEI proved useful for capturing key nutrient-related dietary patterns in Indonesian children. Improving access to nutrient-dense foods, reducing reliance on processed products, and supporting diet quality beyond early complementary feeding remain essential priorities. Integrating HEI-based monitoring into local stunting-reduction strategies may help strengthen nutrition programs and promote healthier growth trajectories.

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CONFLICT OF INTEREST AND FUNDING DISCLOSURE

The authors declare no conflict of interest.

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Table 1. Characteristic of the study participants

Characteristic	(N=215)	(%)
Child gender		
Male	113	52.6
Female	102	47.4
Age (months)		
12-24	63	29.3
25-36	52	24.2
37-49	59	27.4
50-59	41	19.1
Birth weight (kg)		
Low (< 2.5)	17	7.9
Normal (≥ 2.5)	198	92.1
Birth lenght (cm)		
Short (< 48)	15	7
Normal (≥ 48)	200	93
Exclusive breastfeeding		
Yes	151	70.2
No	64	29.8
Family size		
≥ 4	129	60.0
< 4	86	40.0
Maternal occupation		
Housewife	167	77.7
Labor/farmer	9	2.8
Self-employed	9	4.2
Government employee	6	2.3
Private sector employee	24	1.9
Paternal occupation		
Labor/farmer	99	46.0
Self-employed	46	21.4
Government employee	14	6.5
Private sector employee	56	26.0

Table 2. HEI component scores by tertile among children aged 12-59 months†

Variables Component (N=17 groups)	All (n=215)		%RDA	Healthy Eating Index (tertiles)						*p*-value‡
				Low/T1(≤ 116) (n=77)		Middle/T2 (117-127) (n=69)		High/T3 (≥ 128) (n=69)		
	Mean	SD		Mean	SD	Mean	SD	Mean	SD	
Grains (portion)	2.1	0.9	35.3	1.9	0.8	1.9	0.7	2.2	0.8	0.00
Vegetables (portion)	0.7	0.7	11	0.5	0.7	0.6	0.9	0.6	0.5	0.00
Fruits (portion)	2.7	1.9	44.6	1.8	1.5	1.8	1.5	3.1	2.2	0.00
Milk and dairy products (portion)	2.4	2.2	39.7	2.3	2.3	2.4	2.2	2.4	1.9	0.43
Meat and eggs (portion)	3.1	1.7	50.9	2.9	2.0	2.5	1.5	2.4	1.3	0.00
Legume/nuts (portion)	0.7	0.7	12.5	0.5	0.5	0.8	0.7	0.9	0.7	0.22
Oils and fats (portion)	3.4	2.1	56	3.8	2.2	4.1	2.1	3.2	1.8	0.00
Dietary diversity (group)	4.4	1.2	74.2	4.3	1.2	4.3	1.3	4.7	1.0	0.01
Energy (kcal)	1355	400	98.5	1352	449	1255	313	1279	323	0.02
Protein (g)	47.7	17.5	212	44.9	21.4	41.8	13.4	44.9	12.4	0.52
Total fat (%)	38	13.8	80	38.8	13.5	36.3	12.4	31.9	10.4	0.42
Saturated fat (%)	15.3	7.3	-	19	17.5	16.7	7.8	12.9	5.8	0.00
Cholesterol (mg)	431	228	-	453	226	416	226	325	160	0.00
Sodium (mg)	603	493	70.9	589	381	566	570	533	345	0.00
Calcium (mg)	663	481	80.3	663	631	567	302	590	266	0.37
Zinc (mg)	5.9	3.4	30.7	6.7	4.7	5.2	2.3	5.3	1.7	0.22
Iron (Fe) (mg)	9.2	4.4	108	8.7	5.4	8.2	3.7	8.9	2.8	0.69

†Values are mean ± SD. %RDA = percentage of Indonesian Recommended Dietary Allowance.
‡p-values were calculated using one-way ANOVA (for normally distributed variables) and Kruskal–Wallis test (for non-normally distributed variables).
p-values < 0.05 are considered statistically significant.

Table 3. Child, maternal, and household characteristics according to HEI tertiles among children aged 12-59 months†

Variables	All (N=215)	Healthy Eating Index (tertiles)							*p*-value‡
			Low/T1(≤ 116) (n=77)		Middle/T2 (117-127) (n=69)		High/T3 (≥ 128) (n=69)		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Age (months)	34.8	14.2	38.7	13.8	34.2	13.8	31.1	14.0	0.00
Weight (kg)	12.9	6.8	13.5	3.9	13.5	10.8	11.7	2.9	0.01
Height	89	11.9	92.5	10.4	88.3	9.4	85.8	14.7	0.00
Height-for-Age Z-score (HAZ)	-1.2	1.4	-0.9	1.5	-1.6	1.3	-1.1	1.3	0.02
Weight-for-Age Z-score (WAZ)	-0.9	1.2	-0.8	1.3	-1.0	0.9	-1.1	1.3	0.40
Weight-for-Height Z-score (WHZ)	-0.3	1.4	-0.1	1.7	-0.3	1.1	-0.5	1.1	0.19
HAZ (%)									
Stunted (< -2 SD)	25.6		30.9		38.2		30.9		0.50
Not stunted (≥ - 2 SD)	74.4		37.5		30.0		32.5		
WAZ (%)									
Underweight (< -2 SD)	17.7		36.8		26.3		36.8		0.66
Not underweight (≥ - 2 SD)	82.3		35.6		33.3		31.1		
WHZ (%)									
Wasting (< -2 SD)	6.9		46.7		20		33.3		0.52
Not wasting (≥ - 2 SD)	93.0		35		33		32		
Dietary intake 24-H									
Energy (kcal)	1049	359	1121	441	974	325	1044	265	0.07
Protein (g)	39.4	19.9	42.9	26.5	36.4	15.6	38.5	14.0	0.09
Carbohydrate (g)	130	66.4	139	92.7	120	48.6	129	41.8	0.39
Fat (g)	47.1	90.3	60.4	149.5	38.5	14.2	40.8	11.5	0.06
Household food security (score)									
Insecure	58.6		38.1		30.2		31.7		0.66
Secure	41.4		32.6		34.8		32.6		
Household income									
Low (< regional minimum wage)	40.9		34.1		34.1		34.1		0.90
High (≥ regional minimum wage)	59.1		31.5		31.5		31.5		
Maternal age (years)	32.8	6.2	33.6	5.8	31.5	6.3	33.2	6.2	0.06
Maternal nutrition knowledge (%)									
Low (≤ 75)	23.7		27.5		37.3		35.3		0.35
High (> 75)	76.3		38.4		30.5		31.1		
Maternal education (%)									
Low (≤ high school)	79.5		35.1		34.5		30.4		0.3
High (college)	20.5		38.6		22.7		38.6		
Paternal education (%)									
Low (≤ high school)	82.3		36.7		32.2		31.1		0.75
High (college)	17.7		31.6		31.6		36.8		

†Values are presented as mean ± SD for continuous variables and % for categorical variables.
‡p-values were obtained using one-way ANOVA (for normally distributed continuous variables), Kruskal–Wallis test (for non-normally distributed continuous variables), and Chi-square test (for categorical variables).
p-values < 0.05 are considered statistically significant.

Table 4. Multinomial logistic regression of factors associated with HEI tertiles among children aged 12–59 months†

Variable	TI (Low vs High) aOR (95%CI)	*p*-value	T2 (Middle vs High) aOR (95%CI)	*p*-value
Maternal age (years)	0.99 (0.93-1.04	0.66	0.93 (0.88-0.99)	0.03
Child age (months)	1.04 (0.95-1.14)	0.38	1.01 (0.92-1.12)	0.06
Child weight (kg)	0.96 (0.67-1.39)	0.82	1.03 (0.93-1.14	0.58
Child height (cm)	1.02 (0.87-1.19)	0.83	1.01 (0.87-1.16)	0.91
HAZ	1.00 (0.66-1.53)	0.96	0.65 (0.41-1.03)	0.07
WHZ	1.27 (0.88-0.183)	0.2	1.20 (0.89-1.61)	0.21
Energy (kcal)	1.00 (0.97-1.03	0.95	0.99 (0.99-1.00)	0.53
Protein (g)	1.00 (0.97-1.03)	0.65	1.00 (0.97-1.03)	0.83
Fat (g)	1.00 (-.98-1.01)	0.65	0.99 (0.95-1.03	0.74

†Reference category = High HEI (T3 ≥128).
p-values < 0.05 are considered statistically significant