HNUE JOURNAL OF SCIENCE
Natural Sciences 2025, Volume 70, Issue 4, pp. 143-153
This paper is available online at http://hnuejs.edu.vn/ns
DOI: 10.18173/2354-1059.2025-0062

EATING BEHAVIORS ASSOCIATED WITH THINNESS AMONG 9 TO 12-YEAR-OLD STUDENTS AT 915 GIA SANG PRIMARY AND SECONDARY SCHOOL, THAI NGUYEN CITY: A DECISION TREE ANALYSIS

Duong Thi Anh Dao, Nguyen Thi Hong Hanh*, Pham Thao Linh, Le Thi Tuyet, Nguyen Thi Trung Thu, Nguyen Thi Bich Ngoc, Nguyen Phuc Hung, Le Ngoc Hoan and Do Thi Nhu Trang
Faculty of Biology, Hanoi National University of Education, Hanoi city, Vietnam
*Corresponding author: Nguyen Thi Hong Hanh, e-mail: hanhnth@hnue.edu.vn

Received July 29, 2025. Revised November 7, 2025. Accepted December 30, 2025.

Abstract. Thinness is a persistent but understudied form of undernutrition among school-aged children in Vietnam, especially in peri-urban settings. This study focused on students aged 9 – 12 at Gia Sang Primary and Secondary School in Thai Nguyen, aiming to identify key eating behavior patterns associated with thinness using decision tree analysis as a data-driven approach for nutritional risk classification. A cross-sectional study was conducted with 157 students at Gia Sang Primary and Secondary School in Thai Nguyen, Vietnam. Nutritional status was assessed using body mass index-for-age Z-scores in accordance with WHO (2007) standards. Eating behaviors were measured using the validated Children's Eating Behavior Questionnaire (CEBQ), comprising eight behavioral subscales. Anthropometric data were collected following standardized procedures. Pearson correlation analysis, logistic regression, and decision tree modeling were applied to examine associations and classify thinness risk. Results showed that 14.0% of participants were classified as thin and 11.5% as overweight, reflecting the double burden of malnutrition. Logistic regression analysis indicated that Satiety Responsiveness (SR) and Slowness in Eating (SE) were significant predictors of thinness ($P < 0.05$). More notably, decision tree analysis revealed distinct high-risk profiles: children with high Desire for Drinks (DD ≥ 3.8) and low SR (< 2.4) had an 80% probability of being thin, while those with low DD combined with low Food Fussiness (FF), Emotional Overeating (EOE) scores, and SE had a 62% probability. These findings highlight the added value of decision tree modeling in capturing complex interactions among eating behaviors associated with thinness. They also suggest the potential of using behavioral screening tools like the CEBQ for early identification of nutritional risk and for informing targeted, behaviorally tailored interventions within school-based health programs.

Keywords: thinness, eating behavior, decision tree, school-aged children, CEBQ.

1. Introduction

Middle childhood, particularly between the ages of 9 and 12, is a pivotal developmental stage characterized by accelerated physical growth and heightened nutritional requirements. Nutritional status during this period plays a critical role in shaping children's physical health, cognitive development, academic performance, and long-term well-being [1]. Despite growing awareness, ensuring adequate nutrition in this age group remains a persistent challenge, often influenced by socioeconomic disparities, urbanization, and behavioral factors affecting dietary patterns [2], [3]. Thinness, a form of undernutrition defined by a low body mass index-for-age Z-score (BAZ), represents a major public health concern, particularly among school-aged children [4]. Unlike wasting, which is typically assessed by weight-for-height in younger children, thinness better captures nutritional deficits in older children and adolescents. It is associated with impaired immune function, increased susceptibility to infections, reduced concentration, and poorer learning outcomes [5], [6]. In Vietnam, although overall nutritional indicators have improved in recent years, undernutrition remains prevalent, especially in peri-urban and rural settings [7], [8]. Data from the Southeast Asian Nutrition Survey (SEANUTS) II Vietnam indicate that undernutrition remains prevalent among rural children aged 0.5 - 11 years, with stunting rates of 19.6% in rural areas compared to 15.2% in urban areas, and underweight prevalence of 11.8% versus 8.4%, respectively. Among school-aged children (6 - 11 years), rural areas showed particularly elevated rates, with 18.2% stunting and 10.5% underweight compared to their urban counterparts [9]. Thai Nguyen Province, located in northern Vietnam, illustrates these challenges. As a region that straddles both urban and rural landscapes, it experiences substantial variation in healthcare access, food availability, and health literacy. 915 Gia Sang Primary and Secondary School, situated in a peri-urban district of Thai Nguyen City, serves a heterogeneous student population exposed to multiple risk factors for nutritional imbalance, including environmental conditions and individual behaviors.

Eating behaviors are closely associated with the nutritional status of children [10]-[13]. While prior research has primarily explored the physiological and socioeconomic determinants of undernutrition, comparatively less attention has been paid to the role of eating behaviors, particularly in middle childhood - a stage during which children begin to exercise greater autonomy over their food choices. This study addresses this knowledge gap by using decision tree analysis, a data-driven classification approach, to identify specific behavioral predictors associated with thinness in students aged 9 to 12 years. By elucidating these behavioral patterns, the study aims to inform the development of targeted nutritional interventions and promote healthier eating habits among vulnerable school-aged populations.

2. Content

2.1. Subjects and methods

2.1.1. Study design

This study was conducted using a cross-sectional design to investigate the relationship between eating behaviors and wasting malnutrition among school-aged

children in a peri-urban setting. The research took place at 915 Gia Sang Primary and Secondary School, located in Thai Nguyen City, Vietnam. This school is situated in a socioeconomically mixed area that presents both urban and rural characteristics, making it a suitable site for assessing the influence of behavioral and environmental factors on child nutrition.

2.1.2. Study population

The target population included students aged 9 to 12 years, reflecting a key transitional age group in physical growth and behavioral development. A total of 157 students were enrolled in the study, comprising 74 boys (47.13%) and 83 girls (52.87%), using random sampling, stratified by grade level to ensure representative age distribution. Inclusion criteria required participants to be physically healthy, cognitively able to respond to survey questions, and willing to participate with guardian consent. Students with congenital anomalies, acute illness, or those absent during data collection were excluded from the sample.

Post-hoc power analysis indicated that our sample size of 157 students provided approximately 80.2% power to detect medium to large effect sizes.

2.1.3. Anthropometric measurements

Anthropometric data were collected following WHO-recommended measurement procedures. Weight was measured using a SECA 787 electronic scale with a precision of 0.1 kg. Height was measured using a UNICEF-standard wooden three-piece stadiometer accurate to 0.1 cm, following the standardized 9-point contact method: the participant's head (occiput), shoulder blades, buttocks, and calves were positioned against the vertical board, with feet flat on the base plate, knees straight, arms at the sides, and head positioned in the Frankfurt plane. These measurements were taken with students wearing light clothing and no shoes.

2.1.4. Diagnostic criteria

Nutritional status classification was performed using the WHO Anthro Plus software (version 1.0.4) for calculating BAZ according to the WHO 2007 growth reference for children and adolescents aged 5 to 19 years [14]. Students were classified as follows: those with BAZ below –2 standard deviations (SD) were categorized as having thinness; those with BAZ between –2 SD and +1 SD were considered to have normal nutritional status; and those with BAZ above +1 SD were classified as overweight. These classifications formed the basis for defining the study's primary outcome variable.

2.1.5. Eating behavior data collection

Eating behaviors were assessed using the Children's Eating Behavior Questionnaire (CEBQ), a validated tool comprising subscales such as Food Responsiveness (FR), Satiety Responsiveness (SR), Emotional Overeating (EOE), Emotional Undereating (EUE), Enjoyment of Food (EF), Food Fussiness (FF), Slowness in Eating (SE), and Desire for Drinks (DD). Responses were recorded on a 5-point Likert scale, ranging from 1 ("never") to 5 ("always"), enabling quantitative analysis [15].

2.1.6. Statistical analysis

Data were processed and analyzed using R Studio (version 4.3.0). Descriptive statistics summarized participant characteristics. Pearson correlation coefficients were

computed to assess linear relationships among body mass index (BMI), weight, height, and eating behavior scores. The correlation matrix was visualized using the ggplot2 package, producing a heatmap of Pearson coefficients to highlight significant associations. Post-hoc power analysis was conducted using the pwr package in R, calculating that our sample size of 157 provided 80.2% power to detect medium effect sizes (OR ≥ 2.0) at α = 0.05 using pwr. chisq.test (w = 0.3, N = 157, df = 1, sig.level = 0.05).

2.1.7. Machine learning model: Decision tree

To identify key behavioral predictors of wasting malnutrition, a decision tree model was built using the rpart package in R. The dependent variable was nutritional status (thin vs. normal), while the independent variables were eating behavior subscale scores and selected lifestyle factors. The tree was trained using the Classification and Regression Tree (CART) algorithm and visualized with the rpart. plot package to show node splits, decision thresholds, and class probabilities. The decision tree was pruned using a complexity parameter (cp = 0.01) and a minimum split (minsplit = 10) to optimize performance.

2.1.8. Ethical considerations

Ethical approval was obtained from the Ethics Review Committee of Hanoi National University of Education. Written informed consent was obtained from all students' parents or legal guardians. Data collection procedures complied with ethical standards for research involving minors.

2.2. Results and discussion

2.2.1. Nutritional status of the participants

Among a total of 157 students aged 9 - 12 years, the majority (74.5%) had normal nutritional status based on BAZ. Meanwhile, 14.0% were classified as having thinness, and 11.5% were identified as overweight. This distribution highlights the coexistence of both undernutrition and overnutrition within the same population, underscoring the need for comprehensive and balanced nutritional interventions.

This pattern can be better understood in the context of rapid linear growth during this age period, when children typically gain 8 - 12 cm in height annually [16]. Such accelerated growth markedly increases energy and nutrient requirements, which may not always be adequately met by prevailing dietary patterns, thereby contributing to nutritional imbalances.

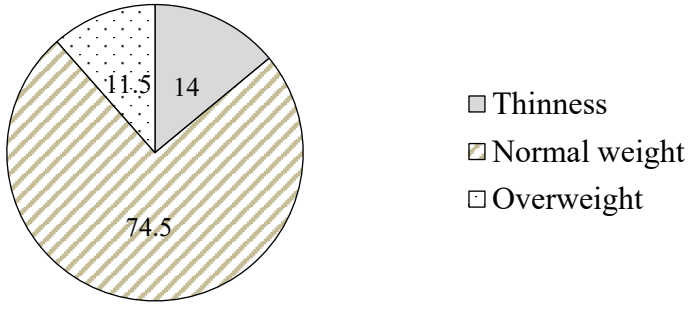

Figure 1. Distribution of nutritional status based on BMI-for-age z-scores among students aged 9 – 12 at Gia Sang primary and secondary school, Thai Nguyen

This finding is consistent with recent national estimates for Vietnamese school-aged children, where the stunting and wasting rates remain elevated, especially in peri-urban and rural areas [8]. Similarly, a prior study conducted among school-aged children and adolescents in Ho Chi Minh City also reported that 6 - 18% of high school students were classified as having thinness [17], reinforcing the persistence of undernutrition across diverse settings.

2.2.2. Group characteristics

Table 1 displays the anthropometric characteristics of students stratified by nutritional status. Compared to their peers with normal weight (n = 117), students with thinness (n = 22) had significantly lower weight and BMI ($P < 0.001$ for both). Additionally, they exhibited substantially lower scores in weight-for-height, BMI-for-age, and weight-for-age Z-scores, with all differences being highly statistically significant ($P < 0.001$). In contrast, no significant differences were found between the two groups in terms of age, sex distribution, height, or height-for-age Z-scores ($P > 0.05$). These findings suggest that thinness in this population is characterized primarily by deficits in weight-related indicators rather than linear growth.

Table 1. Anthropometric indicators of study subjects

Characteristics	Normal (n = 117)	Thinness (n = 22)	*P*-value
Age (years)	10.65 ± 0.95	10.91 ± 0.29	0.191[a]
Male (n, %)	54 (46,2)	8 (36,36)	0.148
Weight (kg)	40.51 ± 5.45	35.45 ± 6.26	**< 0.001**
Height (m)	1.51 ± 0.13	1.52 ± 0.14	0.161
BMI (kg/m²)	18.35 ± 2.39	12.07 ± 1.63	**< 0.001**
Weight-for-Height Z-score	1.05 (0.26 – 1.93)	-0.38 (-0.66 – 0.01)	**< 0.001**
BMI-for-Age Z-score	0.58 (-0.12 – 1.53)	-2.41 (-3.18 – -1.70)	**< 0.001**
Weight-for-Age Z-score	1.13 (0.24 – 1.94)	0.11 (-0.36 – 0.65)	**< 0.001**
Height-for-Age Z-score	0.92 (-0.21 – 2.12)	1.04 (0.06 – 2.35)	0.201

[a]Variables with normal distribution are presented as mean ± standard deviation; P-values derived from Student's t-test; [b]Variables with non-normal distribution are presented as median and interquartile range (25^{th} – 75^{th} percentile); P-values derived from the Mann–Whitney U test; BMI: Body Mass Index. Bolded P-values indicate statistical significance.

2.2.3. Correlation matrix between anthropometric indices and eating behaviors

The correlation matrix illustrates the relationships between anthropometric indicators (height, weight, BMI) and various eating behavior subscales. BMI showed a strong positive correlation with weight (r = 0.78) and a moderate negative correlation with height (r = -0.31). Among eating behaviors, FR and EOE were moderately correlated with BMI (r = 0.54 and r = 0.14, respectively). SR and SE were also positively interrelated (r = 0.44), suggesting that children who are more sensitive to the feelings of fullness tend to eat more slowly. Overall, the associations between anthropometric measures and eating behaviors were weak to moderate, indicating a multifactorial relationship. These results are consistent with international findings that link lower BMI with avoidant eating behaviors and reduced food motivation [18].

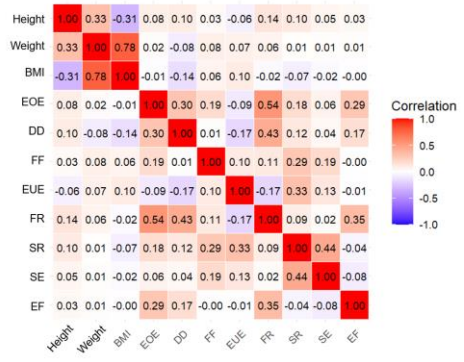

Figure 2. Correlation matrix between anthropometric indices (height, weight, BMI) and eating behavior subscales in children aged 9 - 12 years

BMI: Body Mass Index, FR: Food Responsiveness, SR: Satiety Responsiveness, EOE: Emotional Overeating, EUE: Emotional Undereating, EF: Enjoyment of Food, FF: Food Fussiness, SE: Slowness in Eating, DD: Desire for Drinks. Color intensity indicates correlation strength: red (positive), blue (negative).

2.2.4. Comparison of eating behavior scores between groups

Table 2 compares eating behavior scores between students with normal nutritional status and those with thinness. Across most subscales, there were no statistically significant differences between groups in either the "Desire to eat" or "Food avoidance" sub-scale. However, the thinness group demonstrated significantly higher scores for SE compared to the control group (2.40 ± 1.21 vs. 2.00 ± 0.86, $P = 0.046$). This suggests that slower eating behavior may be associated with thinness in this population, while other behavioral dimensions showed no meaningful group differences.

These behavioral patterns suggest that thin children tend to eat slowly, experience fullness quickly, and derive less pleasure from eating, traits that may be associated with insufficient caloric intake. Findings from the present study align with previous evidence suggesting that eating behaviors play a significant role in shaping dietary intake in children; notably, the use of validated tools like the CEBQ has helped to elucidate how specific eating patterns relate to nutritional outcomes [19].

Table 2. Eating behavior scores between the normal and the thinness groups

Behavioral sub-scale	**Normal (n = 117)**	**Thinness (n = 22)**	***P*-value**
Desire to eat			
FR (Food Responsiveness)	2.28 ± 0.88	2.24 ± 0.79	0.84
EOE (Emotional Overeating)	1.98 ± 0.84	2.27 ± 0.84	0.14
EF (Enjoyment of Food)	2.81 ± 1.09	2.72 ± 0.88	0.79
DD (Desire to Drink)	2.47 ± 1.03	2.79 ± 0.92	0.17
Food avoidance			
SR (Satiety Responsiveness)	2.55 ± 0.69	2.73 ± 0.50	0.23
SE (Slowness in Eating)	2.00 ± 0.86	2.40 ± 1.21	**0.046**
EUE (Emotional Undereating)	3.12 ± 0.95	2.93 ± 0.99	0.39
FF (Food Fussiness)	2.59 ± 1.04	2.68 ± 0.89	0.71

All variables follow a normal distribution and are presented as mean ± standard deviation. P-values were derived from Student's t-test. Bolded P-values indicate statistical significance.

2.2.5. Relationship between eating behaviors and thinness

Table 3 presents the associations between eating behaviors and thinness malnutrition based on logistic regression analysis. Two variables in the Food Avoidance domain were significantly associated with thinness. Specifically, SR was linked to nearly twice the odds of thinness (OR = 1.990, 95% CI: 1.055 - 3.753, P = 0.034), and SE was also positively associated (OR = 1.712, 95% CI: 1.095 - 2.675, P = 0.018). No significant associations were observed for behaviors in the Desire to Eat domain, though DD approached significance (P = 0.059). These findings suggest that avoidance-related eating behaviors, particularly heightened sensitivity to fullness and slower eating, are potential behavioral predictors of thinness in school-aged children.

These findings align with previous international studies suggesting that children who exhibit avoidant eating traits (such as a heightened sensitivity to internal satiety cues and a slower eating pace) are at increased risk of lower energy intake and reduced body mass index [20]. These behaviors may reflect an underlying reduced motivation to eat or an exaggerated response to normal satiety, both of which can limit adequate caloric intake. The use of the CEBQ is a valuable tool for analyzing factors associated with thinness in children; however, studies investigating the relationship between eating behaviors measured by the CEBQ and thinness remain limited, while those focusing on childhood obesity are relatively common [21].

The CEBQ has demonstrated good internal consistency in Asian populations, with Cronbach's α values ranging from 0.70 to 0.90 across various subscales [22]. A preliminary validation study in Vietnamese mothers showed acceptable reliability (Cronbach's α > 0.70) for modified subscales [23].

Table 3. Association between eating behaviors and thinness among students aged 9 - 12 at Gia Sang primary and secondary school, Thai Nguyen

Behavioral sub-scale	OR (95% CI)	*P*-value
Desire to eat		
FR (Food Responsiveness)	1.157 (0.739 – 1.181)	0.524
EOE (Emotional Overeating)	1.703 (1.036 – 2.800)	0.360
EF (Enjoyment of Food)	0.781 (0.501 – 1.216)	0.274
DD (Desire to Drink)	1.466 (0.985 – 2.182)	0.059
Food avoidance		
SR (Satiety Responsiveness)	1.990 (1.055 – 3.753)	**0.034**
SE (Slowness in Eating)	1.712 (1.095 – 2.675)	**0.018**
EUE (Emotional Undereating)	1.055 (0.723 – 1.539)	0.780
FF (Food Fussiness)	1.121 (0.850 – 1.871)	0.249

P-values were obtained from logistic regression analysis.
Bolded P-values indicate statistical significance. 95% CI: 95% Confidence Interval.

2.2.6. Decision tree classification of nutritional status

Figure 3 illustrates a decision tree model used to classify the nutritional status (normal = 1, thinness = 2) of students aged 9 - 12 based on their eating behavior patterns. The model begins with DD as the most influential variable. The decision tree reveals two primary pathways associated with a higher risk of thinness among students. First, children with a high score for DD ≥ 3.8 but a low SR (< 2.4) demonstrate an 80% likelihood of

thinness, suggesting that while they frequently desire beverages, their reduced sensitivity to internal cues of fullness may compromise effective energy regulation. Second, among those with lower DD scores (DD < 3.8), thinness risk reaches 62% when combined with low scores in FF (< 3.3), EOE (< 2.3), and SE (< 1.8). Model performance metrics included overall accuracy (78.3%), sensitivity (72.7%), and specificity (79.5%).

This pattern reflects a constellation of subdued eating behaviors, potentially indicating reduced engagement with food or lower energy intake. Overall, the model underscores the interplay between multiple behavioral dimensions and nutritional status, emphasizing that thinness in children may be associated with complex behavioral profiles rather than isolated factors.

The first group may reflect children whose dietary patterns are dominated by liquid intake, which is oftenlow in energy density, combined with weak internal regulation of hunger, resulting in insufficient total caloric intake. The second group presents a more generalized pattern of disengagement with food, lacking both emotional drive to eat and behavioral cues that promote adequate intake. These behavioral profiles highlight the multifactorial nature of thinness in this age group.

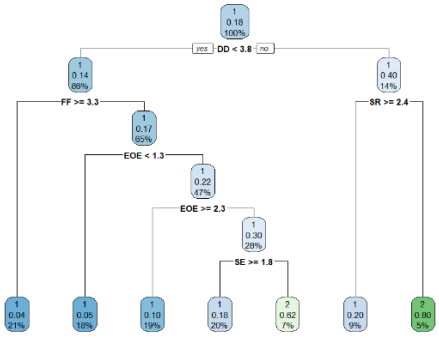

Figure 3. Decision tree classifying nutritional status based on eating behaviors among students aged 9 - 12 at Gia Sang Primary and Secondary School, Thai Nguyen

FR: Food Responsiveness, SR: Satiety Responsiveness, EOE: Emotional Overeating, EUE: Emotional Undereating, EF: Enjoyment of Food, FF: Food Fussiness, SE: Slowness in Eating, DD: Desire for Drinks

A cross-sectional study conducted in three mountainous areas of Northern Vietnam (Cao Bang, Phu Tho, and Thai Nguyen) among 1,556 ethnic minority school-aged children also showed that eating behaviors were associated with the risk of thinness [24]. Besides, a systematic review and meta-analysis of 176 studies across Indonesia, Malaysia, Thailand, and Vietnam found that the triple burden of malnutrition was associated with poor early-life nutrition [25].

Importantly, our findings echo recent national data from SEANUTS II Vietnam [9], which identified significant proportions of children failing to meet recommended energy and micronutrient requirements, particularly in rural and peri-urban settings. While that survey focused primarily on intake and biochemical indicators, our study complements it by integrating behavioral analysis, offering a more comprehensive perspective on why certain children may fall short of nutritional adequacy despite the availability of food.

These findings also carry important practical implications for nutrition interventions. Rather than focusing solely on what children eat, it is crucial to address how they eat.

Behaviorally informed interventions, such as mindful eating training, appetite regulation therapy, or structured mealtime routines, may help correct maladaptive patterns and improve energy intake among children at risk of thinness. Furthermore, the decision tree model used in this study offers a simple, interpretable, and scalable framework that could assist educators and health workers in identifying at-risk children based on readily assessable behavioral cues.

However, this study has several limitations. The cross-sectional design prevents causal inference, and behavioral data were collected through caregivers, which may introduce reporting bias. Additionally, the single-school setting limits generalizability to broader populations. The absence of dietary intake data (e.g., 24-hour recalls, food frequency questionnaires) limits our ability to establish mechanistic links between eating behaviors and energy intake. Cultural factors specific to Vietnamese children's eating patterns may not be fully captured by the CEBQ, despite its validation in Asian populations. Future research should expand to multi-site, longitudinal studies that incorporate dietary records and metabolic indicators to validate and refine behavioral predictors of malnutrition.

In summary, this study demonstrates that thinness among Vietnamese school-aged children is not solely a matter of food access or quantity, but also of behavioral engagement with eating. Decision tree modeling proved useful in elucidating specific combinations of eating traits that elevate thinness risk. Integrating behavioral assessments into school-based nutritional screening and intervention programs may enhance early detection and support tailored, effective responses to undernutrition.

3. Conclusions

This study highlights the double burden of malnutrition among school-aged children in a peri-urban Vietnamese context, with 14.0% classified as thin and 11.5% as overweight. Anthropometric analysis revealed that thinness is primarily driven by deficits in weight-related indices rather than height- or age-related measures, indicating acute undernutrition rather than chronic growth failure. Importantly, behavioral assessments using the validated CEBQ identified distinct eating patterns associated with thinness. Children with higher SR and SE were significantly more likely to be thin, suggesting that heightened sensitivity to fullness and a slower eating pace may contribute to insufficient energy intake.

Critically, the decision tree model provided novel insights into the behavioral predictors of thinness, offering a robust, data-driven framework for risk stratification. Among all behavioral variables, DD emerged as the most influential factor in classifying nutritional status. Two high-risk profiles for thinness were identified: (1) students with high DD (≥ 3.8) combined with low SR (< 2.4) had an 80% probability of thinness; and (2) students with low DD (< 3.8) and concurrently low scores in FF, EOE, and SE exhibited a 62% probability of thinness.

School-based nutrition programs should integrate behavioral components alongside dietary support to more effectively address undernutrition in middle childhood. These findings have important implications for natural sciences education, particularly in

teaching behavioral nutrition concepts in biology curricula. The decision tree approach demonstrated here could serve as an educational tool for students learning about data-driven health risk assessment and the application of statistical modeling in nutritional epidemiology.

REFERENCES

[1] Martins VJ, Toledo Florêncio TM, Grillo LP, Franco MDCP, Martins PA, Clemente APG & et al. (2011). Long-lasting effects of undernutrition. *International Journal of Environmental Research and Public Health*, 8(6), 1817-1846. doi: 10.3390/ijerph8061817.

[2] Rachmi CN, Li M & Baur LA, (2018). The double burden of malnutrition in Association of South East Asian Nations (ASEAN) countries: a comprehensive review of the literature. *Asia Pacific Journal of Clinical Nutrition*, 27(4), 736-755. doi: 10.6133/apjcn.062018.02.

[3] Mason A, Rantanen A, Kivimäki H, Koivisto AM & Joronen K, (2017). Family factors and health behaviour of thin adolescent boys and girls. *Journal of Advanced Nursing*, 73(1), 177-189. Doi: 10.1111/jan.13096.

[4] Spinelli A, Buoncristiano M, Nardone P, Starc G, Hejgaard T, Júlíusson PB & et al, (2021). Thinness, overweight, and obesity in 6- to 9-year-old children from 36 countries: The World Health Organization European Childhood Obesity Surveillance Initiative–COSI 2015–2017. *Obesity Reviews*, 22, e13214. Doi: 10.1111/obr.13214.

[5] Mwene-Batu P, Bisimwa G, Baguma M, Chabwine J, Bapolisi A, Chimanuka C & et al, (2020). Long-term effects of severe acute malnutrition during childhood on adult cognitive, academic, and behavioural development in African fragile countries: The Lwiro cohort study in the Democratic Republic of the Congo. *PLOS ONE*, 15(12), e0244486. Doi: 10.1371/journal.pone.0244486.

[6] Christian P & Smith ER, (2018). Adolescent undernutrition: global burden, physiology, and nutritional risks. *Annals of Nutrition and Metabolism*, 72(4), 316-328. Doi: 10.1159/000488865.

[7] Nguyen THH & Duong TAD, (2023). Double burden of malnutrition in 6–14-year-old students: a cross-sectional study in Thai Nguyen city. *HNUE Journal of Science: Natural Sciences*, 68(2), 196-206. doi: 10.18173/2354-1059.2023-0034.

[8] Tan X, Tan PY, Som SV, Nguyen SD, Tran DT, Tran NT & et al., (2024). Micronutrient deficiencies and the double burden of malnutrition in Vietnamese female adolescents: a national cross-sectional study in 2020. *The Lancet Regional Health – Western Pacific*, 50, 101164. doi: 10.1016/j.lanwpc.2024.101164.

[9] Tran NT, Tran DT, Nguyen TTN, Nguyen SD, Nguyen HT, Nguyen TS & et al., (2024). Triple burden of malnutrition among Vietnamese 0.5–11-year-old children in 2020–2021: Results of SEANUTS II Vietnam. *Public Health Nutrition*, 27(1), e259. Doi: 10.1017/S1368980024001186.

[10] Webber L, Hill C, Saxton J, Van Jaarsveld CHM & Wardle J, (2009). Eating behaviour and weight in children. *International Journal of Obesity*, 33(1), 21-28. Doi: 10.1038/ijo.2008.219.

[11] Kimin LS, Lin CLS, Avoi R, Hayati F, Daud MNM, Mandrinos S & et al., (2022). Children's eating behaviour: A comparison between normal, overweight and obese children. *Annals of Medicine and Surgery (London)*, 84, 104890. Doi: 10.1016/j.amsu.2022.104890.

[12] Nguyen THH, Nguyen DAT & Nguyen DAH, (2023). Prevalence and association of eating behaviors with overweight and obesity among students aged 11–15 at Nguyen Tat Thanh middle and high school, Hanoi city. *HNUE Journal of Science: Natural Sciences*, 68(3), 175-186. Doi: 10.18173/2354-1059.2023-0001.

[13] Jani R, Irwin C, Rigby R, Byrne R, Love P, Khan F & et al, (2024). Association between picky eating, weight status, vegetable, and fruit intake in children and adolescents: systematic review and meta-analysis. *Childhood Obesity*, 20(8), 553-571. doi: 10.1089/chi.2023.0196.

[14] World Health Organization, (2007). Growth reference data for 5-19 years: BMI-for-age (5-19 years). https://www.who.int/tools/growth-reference-data-for-5to19-years.

[15] Wardle J, Guthrie CA, Sanderson S & Rapoport L, (2001). Development of the children's eating behaviour questionnaire. *Journal of Child Psychology and Psychiatry*, 42(7), 963-970. Doi: 10.1111/1469-7610.00792.

[16] Reyes MP, Barahona EC, Cahuich MB, Barragan A & Malina RM, (2002). Growth status of children 6-12 years from two different geographic regions of Mexico. *Annals of Human Biology*, 29(1), 11-25. Doi: 10.1080/03014460110047964.

[17] Mai TMT, Pham NO, Tran TMH, Baker P, Gallegos D, Do TND & et al., (2020). The double burden of malnutrition in Vietnamese school-aged children and adolescents: a rapid shift over a decade in Ho Chi Minh City. *European Journal of Clinical Nutrition*, 74(10), 1448-1456. Doi: 10.1038/s41430-020-0587-6.

[18] Carnell S & Wardle J, (2008). Appetite and adiposity in children: evidence for a behavioral susceptibility theory of obesity. *American Journal of Clinical Nutrition*, 88(1), 22-29. Doi: 10.1093/ajcn/88.1.22.

[19] Maneschy I, Jimeno-Martínez A, Miguel-Berges ML, Rupérez AI, Ortega-Ramiréz AD, Masip G & et al., (2024). Eating behaviours and dietary intake in children and adolescents: a systematic review. *Current Nutrition Reports*, 13(3), 363-376. Doi: 10.1007/s13668-024-00544-w.

[20] de Souza Cavalcanti AMT, de Arruda IKG, Moreno de Lima EAC, Neto WB, Meirelles Monteiro EML, de Lima LS & et al., (2017). Characterization of eating behavior disorders in school-aged children and adolescents: a population-based study. *International Journal of Adolescent Medicine and Health*, 29(3), 20150087. Doi: 10.1515/ijamh-2015-0087.

[21] Manzano MA, Strong DR, Kang Sim DE, Rhee KE & Boutelle KN, (2021). Psychometric properties of the Child Eating Behavior Questionnaire (CEBQ) in school age children with overweight and obesity: A proposed three-factor structure. *Pediatric Obesity*, 16(10), e12795. doi: 10.1111/ijpo.12795.

[22] Mou J, Zhou H, Huang S & Feng Z, (2024). Factorial validation of the children's eating behavior questionnaire and the association between the eating behaviors assessed and BMI Z score in Chinese preschoolers aged 2–5 years. *Journal of Health, Population and Nutrition*, 43(1), 145. Doi: 10.1186/s41043-024-00634-z.

[23] Ayre S, Gallegos D, Nambiar S, Tran CQ, Do DN & Jansen E, (2022). Preliminary exploration of the use of the Children's Eating Behaviour Questionnaire (CEBQ) and Feeding Practices and Structure Questionnaire (FPSQ) in Vietnamese mothers. *European Journal of Clinical Nutrition*, 76(3), 442-449. Doi: 10.1038/s41430-021-00947-w.

[24] Truong DTT, Tran THT, Nguyen TTT & Tran VHT, (2022). Double burden of malnutrition in ethnic minority school-aged children living in mountainous areas of Vietnam and its association with nutritional behavior. *Nutrition Research and Practice*, 16(5), 658-672. Doi: 10.4162/nrp.2022.16.5.658.

[25] Tan PY, Chan CL, Som SV, Dye L, Moore JB, Caton S & et al., (2024). Prevalence and key determinants of the triple burden of childhood malnutrition in Southeast Asian countries: a systematic review and meta-analysis within an adapted socio-ecological framework. *Critical Reviews in Food Science and Nutrition*, 1-15. Doi: 10.1080/10408398.2024.2419539.