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Food environment determinants on the intake of children with Attention-Deficit/Hyperactivity Disorder (ADHD) and Down Syndrome (DS) in Indonesia, Lao PDR and Malaysia

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ABSTRACT

Introduction: The nutritional status of children with Attention-Deficit/Hyperactivity Disorder (ADHD) and Down Syndrome (DS) is influenced by multiple food environment determinants. However, the precise relationship between food environment determinants and nutritional outcomes in these children remains unclear. This study aimed to understand the food environment determinants that are associated with the intake and nutritional status of these children in Malaysia, Lao PDR, and Indonesia. **Methods:** This cross-sectional study involved 7- to 18-year-old students with ADHD and DS in three Southeast Asian countries. Sociodemographic characteristics, dietary habits, and repeated 24-hour food recall data were collected through a structured questionnaire. Anthropometric data were obtained through direct measurements and analysed using the WHO AnthroPlus software. Further analyses were done using descriptive statistics and chi-square tests. **Results:** Total participants were 284 children, comprised of 37.7% with ADHD and 62.3% with DS; 62.3% of the children were boys and 37.7% were girls. Among the food environment determinants collected during the study, monthly household income and school food assistance status had significant associations ($p<0.05$) with BMI-for-age z-score category and total energy, protein, zinc, and calcium intakes. While the country, type of residence, and type of school had significant associations with total energy, protein, zinc, and calcium intakes. **Conclusions:** Food environment determinants, particularly household income and access to school food assistance, significantly influence the nutritional status and intake of children with ADHD and Down Syndrome. Thus, strengthening inclusive nutrition programmes may improve outcomes for this vulnerable group in Southeast Asia.

Keywords: Attention-Deficit/Hyperactivity disorder, Down Syndrome, food environment, nutrition, Southeast Asian

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INTRODUCTION

Contemporary society increasingly recognises the importance of maintaining a balanced and nutritious diet, emphasising its critical role in promoting overall health and well-being (WHO, 2020). For children, proper nutrition is even more imperative, as their dietary habits significantly influence physical growth, cognitive development, and long-term health outcomes (Abdoli *et al.*, 2023). However, studies indicate that children commonly exhibit lower intakes of essential nutrients such as zinc, iron, calcium, and folate, influenced by familial practices, health conditions, and environmental factors (Global Nutrition Report, 2021; Suskind, 2009; Fahmida *et al.*, 2022; Scaglioni *et al.*, 2011). Many countries, including Indonesia, Malaysia, and Lao PDR, face a triple burden of malnutrition, where undernutrition, overnutrition, and hidden hunger coexist (Poh *et al.*, 2023; Tan *et al.*, 2024; UNICEF EAPRO, 2021). This paradox reflects a complex nutritional landscape, particularly affecting vulnerable populations such as children with disabilities, who may experience unique challenges in maintaining optimal nutrition.

Among vulnerable populations, children with developmental or neurogenetic conditions are at heightened risk of nutritional imbalance. Attention-Deficit/Hyperactivity Disorder (ADHD) is a neurobiological disorder that has a global prevalence of 5.3% among individuals below 18 years (Polanczyk *et al.*, 2007). Children with ADHD often display food selectivity and difficulty trying new foods, which can lead to nutrient deficiencies (Jamshidnia, Tavallaei & Hosseinzadeh, 2021). In contrast, Down Syndrome (DS) is a genetic disorder characterised by intellectual disability and metabolic differences that can result in an imbalanced diet, often with higher carbohydrate intake and greater risk of obesity (Gruszka & Wlodarek, 2024).

The food environment refers to the physical, economic, policy, and socio-cultural surroundings, opportunities, and conditions that influence people's food choices and nutritional status, such as income and food availability (de Castro & Canella, 2022). The nutritional status of children with ADHD and DS is influenced by multiple food environment determinants (Jamshidnia *et al.*, 2021; Gruszka & Wlodarek, 2024). However, the precise relationship between food environment determinants and nutritional outcomes in these children remains unclear. This gap underscores the necessity of investigating their dietary patterns and the determinants that influence them. Therefore, this study aimed to (1) assess the nutritional status of children with ADHD and DS, (2) evaluate their dietary intake in terms of energy and essential nutrients, and (3) identify food environment determinants that influence these outcomes.

Malaysia, Indonesia, and Lao PDR were purposefully selected for this study due to several strategic considerations. Firstly, these countries represent different stages of economic development and nutritional transition, providing valuable diversity in socioeconomic contexts and food environments. Malaysia represents an upper-middle-income country, Indonesia a lower-middle-income country, and Lao PDR a lower-middle-income country with different healthcare infrastructure development (World Bank, 2021). Secondly, their differing stages in the development and availability of special education programmes. Malaysia has a comprehensive system with numerous special education schools and integrated programmes within mainstream schools, reflecting an advanced inclusive education framework. Indonesia is in a transitional phase, progressively shifting

towards inclusion, yet with limited accessibility and resources in many areas. Lao PDR remains at an early stage of inclusive education development, with few dedicated services and ongoing pilot programmes (Singh, 2022). These differences offer a valuable cross-section of regional special education practices. Additionally, this research was undertaken collaboratively by three SEAMEO regional centres located in the participating countries, facilitating effective coordination and logistics for data collection.

METHODOLOGY

This study employed a cross-sectional design and was conducted across three Southeast Asian countries (Malaysia, Indonesia, and Lao PDR) between August 2021 and April 2022. Participants were selected using systematic sampling from the school registration lists. Children aged 7 to 18 years, diagnosed with either ADHD or DS, based on the information provided by their school and institution, were enrolled. Children with severe physical disabilities affecting feeding were excluded from the study. Participants were recruited from Integrated Special Education Programmes (ISEP) and special education schools across 12 states in Peninsular Malaysia, special education schools in Jakarta, Indonesia, and private associations serving children with ADHD and DS in Vientiane, Lao PDR. These sites were chosen based on accessibility, availability of the target population, and logistical feasibility.

The study received ethical approval from the Ministry of Education Malaysia, numbered KPM.600-3/2/3-eras (11224) and the Ethical Committee of Health Research of the Faculty of Medicine Universitas Indonesia-Cipto Mangunkusumo Hospital, numbered (KET-799/UN2. F1/ETIK/PPM.00.02/2021). Prior to data collection, informed consent was obtained from parents or legal guardians and assent was secured from participating children wherever possible. All procedures followed the standard research ethics guidelines, maintaining strict confidentiality and anonymity.

Data collection involved multiple components. Sociodemographic information was collected from parents or carers. Food environment determinants such as household income (categorised as <573 USD and ≥573 USD per month), type of school (Integrated Special Education Programme, special education school, and other), country of residence (Indonesia, Lao PDR, and Malaysia), and food assistance (received or not received) were included.

Dietary intake was assessed through a repeated 24-hour dietary recall, administered over two weekdays and one weekend day by trained enumerators, to estimate the intakes of energy, protein, iron, calcium, zinc, and vitamin A. Data collection involved direct interviews with primary caregivers (parents or guardians) who were responsible for food preparation and feeding supervision. Portion size estimation was facilitated using validated portion size estimation aids, including standardised household measures (cups, spoons, bowls), food portion photographs, and three-dimensional food models for commonly consumed items. To minimise reporting bias and enhance data quality, several strategies were implemented, such as multiple recall days (two weekdays, one weekend) to capture dietary variability, neutral probing techniques to avoid influencing responses, verification of unusual intake values through follow-up questions, and use of open-ended questioning, followed by specific probes for commonly forgotten foods.

Nutrient analysis for all countries was carried out using the NutriSurvey software version 2007, utilising a

Food Composition Table that has been compiled by the SEAMEO RECFON Laboratory by integrating the Indonesian Food Composition Table (*Daftar Komposisi Bahan Makanan Indonesia*) and regional Southeast Asian values for missing nutrients. Results of the nutrient intake analysis from Malaysia and Lao PDR were compared to the Malaysian Recommended Nutrient Intakes (RNI) since Lao PDR has no published national RNI, while for Indonesia, the intakes were compared to the Indonesian RNI (*Angka Kecukupan Gizi/AKG*). Analyses were stratified by age group to ensure appropriate interpretation of intake adequacy. Anthropometric measurements, including height and weight, were collected according to the World Health Organization (WHO) guidelines by trained enumerators in Indonesia and Lao PDR, while in Malaysia, anthropometric data were collected from the latest school health records measured by health officers. Body mass index (BMI)-for-age *z*-scores were computed using the WHO AnthroPlus software version 2009, Geneva, Switzerland, then categorised into wasting, normal, and overweight (WHO, 2009).

For data analysis, descriptive statistics were used to summarise participants' characteristics. Chi-square tests were conducted to explore associations between various food environment determinants and nutritional outcomes, including BMI-for-age z-scores and nutrient intake levels. A *p-value* of less than 0.05 was considered statistically significant. Any missing data were excluded from the analysis.

RESULTS

The study involved a total of 284 children aged 7–18 years, with 177 (62.3%) being boys. In terms of type of disability, 62.3% of participants were diagnosed with DS, while 37.7% had ADHD. The majority of children lived in urban areas (84.2%) and 111 (40.4%) belonged to a household with a monthly income of less than 573 USD. Moreover, 186 (65.5%) children received food assistance at school. The sociodemographic characteristics of the children can be seen in Table 1.

Tables 2a and 2b present the nutritional intake and status of children with ADHD and DS. Proportion difference was found in BMI-for-age z-scores between the two groups, with a higher proportion of wasting observed in children with ADHD (19.6%) compared to those with DS (7.5%). Additionally, 24.7% of participants were categorised as overweight, indicating a dual burden of malnutrition within the population. Median BMI-for-age z-score was 0.58 (-0.71 to 1.96). Energy intake adequacy was also different, with a greater proportion of children with DS (74.0%) consuming less than the recommended energy intake compared to the ADHD group (51.0%). Median energy intake was significantly higher in children with ADHD at 2010 kcal (1611-2329) compared to children with DS at 1635 kcal (1348-1978). Similarly, the proportion of protein intake adequacy was lower in children with DS (30.1%) than in those with ADHD (11.8%), with a median protein intake of 65.2 g (50.1-79.3) in those with ADHD and 59.2 g (43.9-77.2) in the DS group.

Children with DS also had a lower proportion of adequate iron, zinc, and calcium intakes compared to children with ADHD, with a median iron intake of 15.17 mg (11.66-19.13) vs. 12.22 mg (9.71-15.81), zinc intake of 5.43 mg (3.90-7.78) vs. 4.47 mg (3.24-6.00), and calcium intake of 680.39 mg (513.77-946.92) vs. 595.96 mg (469.03-805.34) for children with ADHD and DS, respectively. In contrast, vitamin A intake did not differ significantly between the

Table 1. Sociodemographic characteristics of the children (N = 284)

Characteristics	*n*	*%*
Gender		
Male	177	62.3
Female	107	37.7
Type of disability		
Attention-Deficit/Hyperactivity Disorder	107	37.7
Down Syndrome	177	62.3
Country		
Malaysia	183	64.4
Indonesia	76	26.8
Lao PDR	25	8.8
Residential area		
Urban	239	84.2
Rural	45	15.8
Age group (n= 275)		
7 – 9 years old	113	41.1
10 – 12 years old	134	48.7
13 – 15 years old	27	9.8
16 – 18 years old	1	0.4
Monthly income (n= 275)		
< 573 USD	111	40.4
≥ 573 USD	164	59.6
Main carer		
Mother	204	71.8
Other than mother	80	28.2
School type		
Integrated Special Education Programme	145	51.1
Special education school	111	39.1
Other	28	9.9
Food assistance from school		
Received	186	65.5
Did not receive	98	34.5

groups, with almost all children in both groups falling below the recommended intake. These descriptive findings reflect the nutritional profile for each group within the study, capturing both shared and unique vulnerabilities shaped by the type of disability. However, they should not be interpreted as direct comparative outcomes, since the study's sampling and analytic approaches did not aim to generalise differences between ADHD and DS groups.

Tables 3 and 4 revealed several significant associations between food environment determinants with the nutritional status and intake of children. Among the food environment determinants, receiving food assistance from school was found to have a significant association with the nutritional status of children. Monthly household income showed a strong relationship with nutritional indicators. Among children from families earning less than 573 USD per month, a significant proportion of these children had inadequate intakes of energy (76.1%) and protein (36.7%), and nearly all had inadequate intakes

Table 2a. Nutritional status and nutrient intake of the children (*N*=275)

Characteristics	*All, n (%)*	*ADHD, n (%)*	*DS, n (%)*
BMI-for-age z-score			
Wasting	33 (12.0)	20 (19.6)	13 (7.5)
Normal	174 (63.3)	54 (52.9)	120 (69.4)
Overweight	68 (24.7)	28 (27.5)	40 (23.1)
Energy intake			
< Recommendation	180 (65.5)	52 (51.0)	128 (74.0)
≥ Recommendation	95 (34.5)	50 (49.0)	45 (26.0)
Protein intake			
< Recommendation	64 (23.3)	12 (11.8)	52 (30.1)
≥ Recommendation	211 (76.7)	90 (88.2)	121 (69.9)
Iron intake			
< Recommendation	92 (33.5)	24 (23.5)	68 (39.3)
≥ Recommendation	183 (66.5)	78 (76.5)	105 (60.7)
Zinc intake			
< Recommendation	220 (80.0)	69 (67.6)	151 (87.3)
≥ Recommendation	55 (20.0)	33 (32.4)	22 (12.7)
Calcium intake			
< Recommendation	215 (78.2)	68 (66.7)	147 (85.0)
≥ Recommendation	60 (21.8)	34 (33.3)	26 (15.0)
Vitamin A intake			
< Recommendation	266 (96.7)	98 (96.1)	168 (97.1)
≥ Recommendation	9 (3.3)	4 (3.9)	5 (2.9)

ADHD: Attention-Deficit/Hyperactivity Disorder; DS: Down Syndrome
Note: The dietary intake recommendations used in this analysis are based on the Malaysian Recommended Nutrient Intakes (NCCFN, 2005) for participants from Malaysia and Lao PDR, and the Indonesian Recommended Dietary Allowances (Ministry of Health of the Republic of Indonesia, 2019) for participants from Indonesia.

of zinc, calcium, and vitamin A ($p<0.05$) compared to children in households earning more than 573 USD per month.

The type of school attended was also associated with nutritional outcomes. Children enrolled in Integrated Special Education Programmes had significantly lower prevalences of energy deficiency (55.3%) and protein deficiency (12.1%) compared to those in special education schools, where 84.3% were energy deficient and 42.6% had inadequate protein intake ($p<0.05$). Notably, children in special education schools had higher rates of energy and protein inadequacies, suggesting institutional or environmental influences on dietary intake.

Cross-country comparisons revealed significant differences in dietary intake patterns. In Indonesia, 93.3% of children had inadequate energy intake and 58.7% had insufficient protein intake, which were substantially higher than their counterparts in Malaysia and Lao PDR. Conversely, children in Lao PDR had the highest recorded energy and protein intakes, with 34.8% and 0.0% meeting less than the recommended intakes, respectively. Children in Malaysia showed intermediate levels of inadequacy but remained significantly affected across most nutrients.

Finally, receiving food assistance from schools was associated with improved nutrient intake. Children

Table 2b. Nutritional status and nutrient intake of the children (*N*= 275)

Characteristics	*All* *Median (25^{th}–75^{th})*	*ADHD* *Median (25^{th} – 75^{th})*	*DS* *Median (25^{th} – 75^{th})*
BMI-for-age z-score	0.58 (-0.71 - 1.96)	0.03 (-1.44 - 2.34)	0.72 (-0.50 - 1.91)
Energy intake	1731 (1422 - 2163)	2010 (1611 - 2329)	1635 (1348 - 1978)
Protein intake	59.9 (46.5 - 77.6)	65.2 (50.1 - 79.3)	59.2 (43.9 - 77.2)
Iron intake	13.30 (10.27 - 17.24)	15.17 (11.66 - 19.13)	12.22 (9.71 - 15.81)
Zinc intake	4.72 (3.59 - 6.70)	5.43 (3.90 - 7.78)	4.47 (3.24 - 6.00)
Calcium intake	634.42 (475.98 - 847.49)	680.39 (513.77 - 946.92)	595.96 (469.03 - 805.34)
Vitamin A intake	24.13 (0.03 - 135.44)	24.39 (0.00 - 151.17)	23.10 (0.08 - 122.08)

ADHD: Attention-Deficit/Hyperactivity Disorder; DS: Down Syndrome

who received food aid had significantly lower rates of energy, protein, and iron deficiencies compared to those who did not (p<0.05), underscoring the potential of school-based nutrition programmes to improve dietary outcomes.

DISCUSSION

Among the key findings is the significant association between household income and both nutritional status and nutrient intake. Children from households earning below 573 USD monthly exhibited higher rates of deficiency in energy, protein, zinc, calcium, and vitamin A, underlining the persistent influence of socioeconomic status on diet quality. These results align with previous research showing that socioeconomic constraints often result in limited access to balanced diets, leading to nutrient deficiencies or reliance on calorie-dense, nutrient-poor foods (Hanandita & Tampubolon, 2015). The result of this study also mirrors earlier findings by Kurotani, Shinsugi & Takimoto (2021) and Kartini (2021), who emphasised the role of family income in shaping children's dietary behaviours.

School food assistance was found to be associated with better nutrition adequacy. Children who received food assistance at school had significantly better nutrient intakes, particularly in terms of energy, protein, zinc, and calcium. This supports findings from a previous study, which noted that structured meal programmes can buffer the adverse effects of poor household food environments. The inclusion of fortified meals or nutrient-dense foods in school feeding programmes may help address common deficiencies observed in this study, such as low intake of vitamin A, a nutrient which is often insufficient in typical Southeast Asian diets (Chakravarty, 2000). Additionally, institutional differences in food provision between integrated and special education schools were linked to disparities in energy and protein intakes, highlighting a need for standardisation and equity in school meal programmes.

Interestingly, while the type of school (integrated vs. special education) was not significantly associated with BMI-for-age z-score, it did show strong associations with micronutrient intake.

Table 3. Associations of food environment determinants with the nutritional status of children (*N*= 275)

Food environment determinants	*BMI-for-age z-score, n (%)*			*p-value*
	Wasting	*Normal*	*Overweight*	
Monthly income (*n*=266)				
<573 USD	11 (8.4)	92 (70.2)	28 (21.4)	0.074
>573 USD	19 (14.1)	77 (57)	39 (28.9)	
School type				
Integrated Special Education Programme	18 (12.9)	81 (57.9)	41 (29.3)	0.360
Special Education School	13 (12.0)	74 (68.5)	21 (19.4)	
Other	2 (7.4)	19 (70.4)	8 (22.2)	
Country				
Malaysia	24 (13.6)	101 (57.4)	51 (29.0)	0.118
Lao PDR	2 (8.3)	18 (75.0)	4 (16.7)	
Indonesia	7 (9.3)	55 (31.6)	13 (19.1)	
Food assistance from school				
Received	26 (14.5)	104 (58.1)	49 (27.4)	0.042*
Did not receive	7 (7.3)	70 (72.9)	19 (19.8)	

*Chi-square; significance at $p<0.05$

Children in special education schools were more likely to be deficient in energy and iron compared to those in integrated special education programmes. One possible explanation for this disparity is the unequal access to school-based food assistance. As shown in the data, 96.6% of students in integrated programmes received food assistance, whereas only 39.6% of students in special education schools received such support (chi-square $p<0.001$) . This suggests that differences in how governments prioritise nutrition for children with special needs, particularly through the implementation and reach of school-based food assistance, may directly influence their nutrient intakes. Evaluating the quality and reach of these school feeding programmes is critical, especially given that children with DS and ADHD often rely heavily on school meals due to limited feeding independence, selective eating habits or the requirements of dietary modification (Gruszka & Wlodarek, 2024).

Country-specific differences in nutrient intake were observed in this study. Children in Indonesia had the highest rates of energy and protein inadequacies, while those in Lao PDR recorded higher intake levels. This may be a result of the support children in Lao PDR received from private institutions involved in this study, which may have placed particular emphasis on nutritional care and monitoring. These variations highlight the need for country-specific nutrition policies, even within relatively similar socioeconomic regions (Polanczyk *et al.*, 2007). Country-specific differences also emphasise the importance of tailoring nutrition interventions to local contexts and resources. Given the vulnerabilities of children with ADHD and DS, such as selective eating and dependence on carers, comprehensive nutrition strategies are essential.

This study has several limitations. Firstly, the sample size for Indonesia and Lao PDR was relatively small,

Table 4. Associations of food environment determinants with the nutrient intake of children (*N*= 275)

Food environment determinants	*Energy*	*Protein*	*Iron*	*Zinc*	*Calcium*	*Vitamin A*
Monthly income (*n*=266) <573 USD	98 (74.2%)*	43 (32.8%)*	46 (35.1%)	114 (87.0%)*	111 (84.7%)*	130 (99.2%)*
School type						
Integrated Special Education Programme	78 (55.3%)*	17 (12.1%)*	44 (31.2%)	107 (75.9%)	103 (73.0%)	136 (96.5%)
Special education school	91 (84.3%)*	46 (42.6%)*	37 (34.3%)	94 (87.0%)	92 (85.2%)	106 (98.1%)
Country						
Malaysia	102 (57.6%)*	20 (11.3%)*	53 (29.9%)	133 (75.1%)*	125 (70.6%)*	170 (96.0%)
Lao PDR	8 (34.8%)*	0 (0.0%)*	9 (39.1%)	16 (69.6%)*	17 (73.9%)*	21 (91.3%)
Indonesia	70 (93.3%)*	44 (58.7%)*	30 (40.0%)	71 (94.7%)*	73 (97.3%)*	75 (100%)
Received food assistance from school	109 (60.6%)*	22 (12.2%)*	55 (30.6%)	136 (75.6%)*	131 (72.8%)*	173 (96.1%)

Note: All nutrient intake values refer to the percentage of children with intake below the recommended dietary allowance. Dietary intake recommendations are based on the Malaysian RNI (2017) for children from Malaysia and Lao PDR, and the Indonesian AKG (2019) for children from Indonesia.

*Chi-square test compares the proportion of inadequate intake across categories of each food environment determinant, significance at $p<0.05$

which may limit the generalisability of findings in these countries. This limitation stemmed from the difficulty in accessing large populations of children with special needs through school-based recruitment. Future research may benefit from hospital-based or community/ organisation-based sampling strategies to improve recruitment. Secondly, during anthropometric measurements, some children, particularly those with DS, were unable to follow the ideal posture required for accurate height assessment due to physical limitations or postural issues.

The use of WHO growth charts designed for typically developing children to assess anthropometric status in children with ADHD and DS, whose growth patterns differ, was also one of the limitations in this study. Children with DS generally have a shorter stature, slower growth, and distinct body composition, with specific DS growth charts showing different percentile distributions. For instance, a BMI classified as normal on WHO charts may indicate overweight when using DS-specific charts, potentially underestimating obesity rates (Kilany *et al.,* 2024; Zemel *et al.,* 2015). Children with ADHD may also present growth variations due to medication effects, feeding issues, or co-morbidities, complicating interpretation using standard charts. Without disability-specific growth references, the nutritional status of these children could be misclassified, especially for growth faltering or excess weight

(Kiddie *et al.,* 2010; Ptacek *et al.,* 2009). Therefore, future studies should use condition-specific charts where available or interpret standard growth data with caution, given the importance of growth monitoring for nutritional care in special needs populations.

Furthermore, this study did not control for potential confounding variables that may influence the observed associations. For example, the type of residence (urban vs. rural) could affect access to food markets, health services, and school feeding programmes, potentially impacting children's dietary intake (Losada *et al.*, 2021). Additionally, the severity of disability (whether in cognitive function, mobility, or feeding capability) was not quantitatively assessed, yet it likely played a critical role in shaping the children's nutritional status (Sahin & Nogay, 2021). Parenting practices, including feeding styles, meal planning, and carer's responsiveness, may also significantly influence children's eating behaviours and nutritional adequacy (Yee, Lwin & Ho, 2017). The absence of data on these variables limits the ability to fully disentangle their effects from the primary food environment determinants analysed in this study.

Finally, this study reinforces the importance of a multi-faceted approach to improving the nutritional status of children with disabilities. Inclusive interventions should not only address household income disparities but also focus on enhancing school food programmes and ensuring micronutrient adequacy through supplementation or food fortification strategies. It is important to note that none of the three countries involved in this study currently have specific national dietary guidelines tailored to children with special needs, such as ADHD or DS. This highlights the need for the development of evidence-based, disability-sensitive nutritional guidelines. Further research is also needed to explore behavioural, cultural, and institutional barriers to optimal nutrition in these populations, especially considering the unique dietary challenges posed by ADHD and DS (Klein *et al.*, 2023).

CONCLUSION

This study highlighted the critical role of food environment determinants in shaping the nutritional status and dietary intake of children with ADHD and DS across Malaysia, Indonesia, and Lao PDR. Findings revealed a dual burden of malnutrition among these children, with significant variations in nutrient intake, influenced by factors such as household income, school type, country of residence, and access to school-based food assistance. The findings confirmed that children with disabilities remain at high risk for both undernutrition and overnutrition, reflecting the complex nutritional challenges facing this vulnerable population in Southeast Asia. However, given that this study did not cover all Southeast Asian countries, the results may not be representative of all children with disabilities within this region.

In conclusion, addressing the nutritional challenges faced by children with disabilities requires a multi-dimensional approach involving socioeconomic support, more inclusive school-based feeding programmes, and evidence-based public health policies. Targeted interventions can help ensure that these children receive adequate nutrition to support their growth, development, and overall well-being.

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Authors' contributions

All authors contributed to the conceptualisation and design of the study. Hidayat AT, wrote the original draft, involved in data curation and analysis; Februhartanty J, advised on data analysis and interpretation, review and editing; Widyahening IS, advised on data analysis and interpretation, review and editing; Chen ST, advised on data analysis and interpretation, review and editing; Ounmany K, advised on data analysis and interpretation, review and editing; Phomtavong S, advised on data analysis and interpretation, review and editing; Zainurin MFI, advised on data analysis and interpretation, review and editing; Mansor F, advised on data analysis and interpretation, review and editing; Zainuddin AA, advised on data analysis and interpretation, review and editing; Abd Rashed A, advised on data analysis and interpretation, review and editing; Jopri HS, advised on data analysis and interpretation, review and editing; Azizan CR, advised on data analysis and interpretation, review and editing; Yang WY, advised on data analysis and interpretation, review and editing; Fernandez JC, advised on data analysis and interpretation, review and editing; Mansyur M, advised on data analysis and interpretation, review and editing.

Conflict of interest

The authors declare no conflict of interest.

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