ASSOCIATION BETWEEN DIET CHARACTERISTICS, PHYSICAL ACTIVITY HABITS AND STUNTING IN PRESCHOOL CHILDREN IN DONG ANH, HANOI

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ABSTRACT

The objective of this study was to evaluate the effect of dietary characteristics and physical activity habits on stunting in preschool children in Dong Anh district, Hanoi. A case-control study involving 375 stunted children and 3,445 children with normal height was derived from a cross-sectional study under the project B2018-SHP-50. The classification of children's stunting status was based on the height-for-age Z-score according to the World Health Organization standards. The results indicated that several factors were associated with stunting in children: less than 8 hours of nighttime sleep (OR = 2.15), more than 60 minutes of sedentary time at home per day (OR = 1.72), meal durations longer than 40 minutes (OR = 1.43), preference for sweet foods (OR = 1.51), and preference for fatty foods (OR = 0.67). However, the study found no association between bedtime, active physical activity at school, moderate to vigorous physical activity time at home, preferences for lean meat, eggs, and vegetables, and drinking milk before bedtime. These findings suggested recommendations in child care to engage in physical activities to reduce the risk of stunting from an early stage.

MỐI LIÊN HỆ GIỮA ĐẶC ĐIỂM ĂN UỐNG, THÓI QUEN HOẠT ĐỘNG THỂ CHẤT VÀ TÌNH TRẠNG THẤP CÒI Ở TRẺ MẦM NON ĐÔNG ANH, HÀ NỘI

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Đông Anh
Hoạt động thể chất
Thấp còi
Trẻ mầm non

TÓM TẮT

Mục tiêu của nghiên cứu này là đánh giá ảnh hưởng của đặc điểm ăn uống và thói quen hoạt động thể chất đối với tình trạng thấp còi ở trẻ mầm non huyện Đông Anh, Hà Nội. Một nghiên cứu bệnh-chứng bao gồm 375 trẻ thấp còi và 3.445 trẻ có chiều cao bình thường được lấy từ nghiên cứu cắt ngang thuộc đề tài B2018-SHP-50. Phân loại tình trạng thấp còi của trẻ được dựa trên giá trị Z-score chiều cao theo tuổi theo tiêu chuẩn của Tổ chức Y tế Thế giới. Kết quả cho thấy một số yếu tố liên quan đến tình trạng thấp còi ở trẻ gồm: thời gian ngủ tối ít hơn 8 giờ (OR = 2,15), thời gian ngồi ở nhà nhiều hơn 60 phút mỗi ngày (OR = 1,72), thời gian ăn/bữa dài hơn 40 phút (OR = 1,43), sở thích đồ ngọt (OR = 1,51) và sở thích đồ béo (OR = 0,67). Tuy nhiên, nghiên cứu không tìm thấy mối liên quan giữa giờ đi ngủ, hoạt động thể chất tích cực tại trường, thời gian hoạt động thể chất tích cực tại nhà, sở thích ăn thịt nạc, trứng, rau và việc uống sữa trước khi đi ngủ với thấp còi ở trẻ. Những phát hiện này là cơ sở đưa ra những khuyến nghị trong nuôi dưỡng trẻ giảm bớt nguy cơ bị thấp còi ngay ở giai đoạn sớm.

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1. Introduction

Stunting in children is a condition characterized by a height significantly below the average for their age. This form of malnutrition is prevalent among children and is a major concern globally, as it can result in reduced physical stature, strength, and cognitive abilities in the future workforce of a country [1], [2]. According to a WHO report, in 2019, there were 144 million children under five years old worldwide suffering from stunting [3]. In Vietnam, although the rate of child stunting is decreasing, it remains high compared to global averages [4]. A 2018 survey in several northern provinces of Vietnam found that about 14% of preschool-aged stunted [4].

Stunting in children can be attributed to various genetic and environmental factors, including pollution, poverty, micronutrient deficiencies, and diseases [5], [6]. Among these, physical activity habits and dietary characteristics are particularly noteworthy because they are modifiable factors that can help reduce the risk of stunting [7]. However, the relationship between these factors and stunting varies across different populations, influenced by genetic and regional social factors [8], [9]. Hence, it is crucial to study the effects of physical activity and dietary habits on stunting in specific regions to develop targeted policies and interventions.

Dong Anh, a suburban district of Hanoi, covers an area of 185.68 km² and consists of 24 commune-level administrative units. Despite its developing economic conditions, 8.7% of preschool children in Dong Anh are still stunted [10]. Therefore, this study aims to determine the influence of physical activity habits and daily dietary characteristics on stunting among preschool children in Dong Anh district. The findings will serve as a basis for recommending child feeding practices in preschools, helping to prevent stunting.

2. Material and Methods

2.1. Study design and participants

A case-control study was sampled from a cross-sectional survey conducted as part of project B2018-SPH-50, which included all children from nine preschools in Dong Anh district, Hanoi. Children who were absent on the survey day or had acute or chronic diseases (such as tuberculosis, HIV, congenital heart disease, etc.), or those with spinal deformities or bone disorders affecting height, were excluded from the study. A total of 5,236 children had their weight and height measured to assess their nutritional status, and children with normal height and those with stunting were included in the case-control study. Consent forms and questionnaires regarding daily dietary and physical activity characteristics were sent to all parents of the selected children. A total of 3,445 parents from the control group and 375 parents from the case group agreed to participate in the study and provided complete information about their children's dietary and physical activity characteristics.

2.2. Collection of Anthropometric Data

Anthropometric measurements were conducted in the morning within a climate-controlled room. The children, dressed in light clothing, were weighed and measured following the standard procedures set by the Vietnam National Institute of Nutrition. An electronic scale with a precision of 100 grams was used to measure weight, and a stadiometer with an accuracy of 0.1 cm was used to measure standing height.

2.3. Classification of Nutritional Status

For children under 60 months of age, the weight-for-age Z-score (WAZ), height-for-age Z-score (HAZ), BMI-for-age Z-score (BAZ), and weight-for-height Z-score (WHZ) were determined using the 2006 World Health Organization (WHO) criteria. For children older than 60 months, the 2007 WHO criteria were used to assess WAZ, HAZ, and BAZ. These analyses were automatically

calculated using WHO Anthro software version 3.2.2 for children under 60 months, and AnthroPlus® software version 1.0.4 for children over 60 months (Geneva, Switzerland).

Stunting status was classified using a cut-off of HAZ < -2 SD. Children with HAZ < -2 SD were categorized as stunted (case group), while those with HAZ ≥ -2 SD were categorized as having normal height (control group).

2.4. Data Analysis

Statistical analyses were conducted using SPSS version 16.0 (SPSS, Chicago, USA). Differences in proportions were analyzed using the Chi-square test. Quantitative variables were tested for normality and presented as mean ± standard deviation if they followed a normal distribution, or as median (25th–75th percentile) if they did not. The student's t-test was employed to compare normally distributed groups, while the Mann-Whitney U test was utilized for groups that were not normally distributed. The effects of risk factors on stunting were assessed through univariate and multivariate logistic regression analyses. A two-tailed p-value of less than 0.05 was considered statistically significant.

2.5. Research ethics

This study was approved by the Ethical Committee in Biomedical Research of the National Institute of Nutrition (Decision No. 343/VDD-QLKH, 27/7/2018). The parents of all participating children were fully informed about the study's aims and procedures, and they provided signed informed consent after receiving comprehensive information.

3. Results and Discussion

3.1. Results

3.1.1. Characteristics of the study subjects

Table 1 presents anthropometric characteristics of normal and stunted group. There were no statistically significant differences in sex ratio, BMI, BAZ, and WHZ between the two groups (P > 0.05). Children in the stunted group had significantly lower values of weight, height, WAZ, and BAZ compared to normal-height children (P < 0.0001). Additionally, the stunted group had a lower average age than the normal group (41.2 months versus 47.2 months, P < 0.0001), with a higher prevalence of stunting observed in children aged 24–48 months. Therefore, in subsequent analyses of factors related to stunting, we will adjust for age and sex.

Table 1. *Characteristics of case-control study subjects*

Indices		Normal group (n = 3,445)	Stunted group (n = 375)	p-value
Gender (n,%)[a]	Male	1910 (90.9%)	192 (9.1%)	0.126
	Female	1535 (89.3%)	183 (10.7%)	
Age group (n,%)[a] months	24.0 – 36.0	521 (86.1%)	84 (13.9%)	**< 0.0001**
	36.0 – 48.0	960 (86.6%)	149 (13.4%)	
	48.0 – 60.0	1328 (93.1%)	98 (6.9%)	
	60.0 -71.9	636 (93.5%)	44 (6.5%)	
Age (month)[b]		47.2 (38.5 – 55.2)	41.2 (35.8 – 50.1)	**< 0.0001**
Weight (kg)[b]		15.0 (13.4 – 17.0)	12.3 (11.2 – 13.6)	**< 0.0001**
Height (cm)[b]		100 (95 – 105)	89.8 (85.0 - 93.5)	**< 0.0001**
BMI (kg/m^2)[b]		15.2 (14.3 – 16.3)	15.4 (14.4 – 16.6)	0.064
WAZ[b]		-0.40 (-1.05 – 0.32)	-1.65 (-2.07 - 1.16)	**< 0.0001**
HAZ[b]		-0.57 (-1.13 – 0.16)	-2.39 (-2.80 - 2.15)	**< 0.0001**
BAZ[b]		-0.15 (-0.85 – 0.65)	-0.06 (-0.80 – 0.81)	0.153
WHZ[b]		-0.15 (-0.85 – 0.65)	-0.33 (-0.99 – 0.48)	0.173

[a] *Variables are expressed as n, % of the total study population; P is obtained from the χ 2 test.*

[b] *Variables expressed as median (25th -75th percentile); P is obtained from the Mann-Whitney U test.*

3.1.2. The association of daily activity characteristics and stunting in preschool children in Dong Anh, Hanoi

Table 2 presents the results of the influence of daily activity characteristics on stunting in preschool children in Dong Anh, Hanoi, based on univariate and multivariate logistic regression analyses adjusted for age and sex.

Table 2. *Influence of daily activity characteristics on stunting*

Factors		OR (95%CI)	p-value	OR* (95%CI)	P*-value
Night sleeping hours	≥ 9 hours	1		1	
	8 – 9 hours	0.98 (0.79 – 1.22)	0.825	1.08 (0.86 – 1.36)	0.517
	< 8 hours	1.78 (1.13 – 2.80)	0.013	2.15 (1.35 – 3.42)	**0.001**
Time goes to sleep at night	Before 9 PM	1		1	
	From 9 PM to 11 PM	0.78 (0.60 – 1.01)	0.059	0.83 (0.64 – 1.09)	0.177
	After 11 PM	1.71 (0.63 – 4.63)	0.294	2.08 (0.76 – 5.69)	0.154
Active physical activity at school	Yes	1		1	
	No	0.86 (0.57 – 1.29)	0.455	0.90 (0.60 – 1.35)	0.599
Sedentary activity time at home	< 30 min/day	1		1	
	30 – 60 min/day	0.76 (0.54 – 1.06)	0.104	0.75 (0.54 – 1.05)	0.098
	> 60 min/day	1.82 (1.25 – 2.63)	**0.002**	1.72 (1.19 – 2.50)	**0.004**
Moderate and vigorous physical activity time	> 1 hour/day	1		1	
	≤ 1 hour/day	0.74 (0.49 – 1.13)	0.168	0.79 (0.52 – 1.21)	0.275

OR, P were obtained from univariate logistic regression analysis
OR, P* were obtained from multivariable logistic regression analysis, adjusted for age and sex.*

Table 2 shows that there is no relationship between the time of starting to sleep each night, preferences for physical activity, time spent on moderate and vigorous physical activities (such as running, jumping, playing soccer, etc.), and stunting in children in both univariate and multivariate analyses (P > 0.05). Compared to children who sleep 9 hours/night or more, children who sleep less than 8 hours/night have a 2.15 times higher risk of stunting (95% CI = 1.35 – 3.42). Children with more than 60 minutes of sedentary time per day were 1.72 times more likely to be stunted (P* = 0.004) than children with less than 30 minutes of sedentary time per day.

3.1.3. The relationship of dietary characteristics to stunting in preschool children in Dong Anh, Hanoi

Table 3 shows the results of the relationship between some dietary characteristics and stunting in preschool children in Dong Anh, Hanoi.

Table 3. *Relationship of dietary characteristics to stunting*

Factors		OR (95%CI)	p-value	OR* (95%CI)	P*-value
Meal time (minutes)	20 - 40	1		1	
	< 20	0.68 (0.45 – 1.04)	0.076	0.68 (0.44 – 1.04)	0.073
	> 40	1.40 (1.08 – 1.83)	**0.012**	1.43 (1.09 – 1.86)	**0.009**
Sweet-food favorite	No	1		1	
	Yes	1.54 (1.03 – 2.30)	0.035	1.51 (1.01 – 2.25)	0.046
Fat-food favorite	No	1		1	
	Yes	0.66 (0.52 – 0.85)	**0.001**	0.67 (0.52 – 0.86)	**0.002**
Lean-meat favorite	No	1		1	
	Yes	0.85 (0.68 – 1.08)	0.183	0.89 (0.71 – 1.13)	0.344
Eggs favorite	No	1		1	

Factors		OR (95%CI)	p-value	OR* (95%CI)	P*-value
	Yes	0.87 (0.62 – 1.22)	0.415	0.88 (0.63 – 1.24)	0.466
Vegetables	No	first		first	
favorite	Yes	0.98 (0.74 – 1.30)	0.882	0.93 (0.70 – 1.23)	0.594
Drinking milk	No	1		1	
before sleeping	Yes	0.85 (0.64 – 1.14)	0.288	0.96 (0.72 – 1.29)	0.804

OR, P were obtained from univariate logistic regression analysis
OR, P* obtained from multivariable logistic regression analysis, adjusted for age and sex.*

Results from the logistic regression analysis indicate that longer meal times (>40 minutes/meal) and a preference for sweet foods are factors that increase the risk of stunting in children (OR = 1.43 and 1.51, respectively). Conversely, a preference for fatty foods is associated with a reduced risk of stunting, with an OR of 0.67. However, the analysis did not identify any relationship between preferences for lean meat, eggs, vegetables, fruits, or drinking formula milk before bed and stunting in children.

3.2. Discussion

When analyzing the relationship between sleep duration and stunting, our study shows that children who sleep less than 8 hours per night have a high risk of stunting. However, no relationship was found between stunting and sleep onset time (Table 2). This result is consistent with studies on Chinese children [11] and Indonesian children [12]. The classification of sleep duration and bedtime categories in our study was based on previous research on children's sleep needs and its impact on growth. The reference group (≥ 9 hours per night) was chosen based on the recommendations of the National Sleep Foundation [13]. The cut-off of 8 hours was selected because studies have shown that sleeping below this threshold is associated with eating disorders in children, which may affect overall nutrient intake and growth [14]. Regarding bedtime, we classified sleep onset into three groups: before 9 PM, between 9–11 PM, and after 11 PM. The 9 PM reference point was selected because studies have found that earlier sleep onset is associated with better growth outcomes in children, as it maximizes deep sleep phases where growth hormone (GH) secretion peaks [15]. The 9–11 PM range was chosen as it represents the most common bedtime for young children in urban Asian settings [16]. Meanwhile, sleeping after 11 PM has been linked to circadian rhythm disruptions and elevated cortisol levels, both of which negatively affect GH secretion and impair height growth. A possible explanation is that growth hormone (GH), which plays a crucial role in bone and muscle development, is predominantly secreted during deep sleep. Shortened sleep duration may disrupt this process, leading to impaired growth [17]. As for sleep onset time, there is not much difference between the normal and stunted groups. This may be because the children in our study attend public preschools in Dong Anh district and likely follow a similar daily schedule, including bedtime.

The classification of sedentary time at home into three levels (<30 minutes/day as reference, 30–60 minutes/day, and > 600 minutes/day) and was the reference threshold of moderate to vigorous physical activity was >1 hour/day based on recommendations from the World Health Organization (WHO) [18]. Our study in Dong Anh, Hanoi, found that children who engaged in more than 60 minutes of sedentary activities per day had a 1.7 times higher risk of stunting (Table 2). This association may be explained by the fact that prolonged sedentary behavior reduces circulatory and respiratory system activity, leading to decreased nutrient delivery to body tissues and suppressed appetite, which in turn lowers overall food intake [19]. In contrast, children who spend less than 30 minutes per day in sedentary activities tend to exhibit better postural control and greater muscle engagement—both of which are crucial for bone growth and overall physical development [19], [20].

When analyzing the relationship between meal duration and stunting, the results show that main meals lasting more than 40 minutes increase the risk of stunting compared to children who eat between 20 and 40 minutes (Table 3). The classification of meal duration into three levels (20–40 minutes as reference, <20 minutes, and >40 minutes) was based on studies examining optimal eating behaviors in young children. Research suggests that a typical meal duration of 20–40 minutes allows for adequate food intake while maintaining efficient digestion and nutrient absorption [21]. Our findings are consistent with the research by Zhang Y et al. [11], which showed that the rate of malnutrition and stunting was high in the group of children who ate slowly (OR = 1.85). Prolonged eating time reduces the secretion of the hormone ghrelin (a hormone that induces hunger), leading to reduced appetite, anorexia, and reluctance to finish meals [22]. This ultimately decreases food intake and can cause malnutrition.

Food preferences also show a relationship with stunting in Dong Anh preschool children. Children who like fatty foods are less likely to be stunted than children who do not like fatty foods (OR = 0.67). In contrast, children who like sweet foods have a 1.51 times higher risk of stunting compared to children who do not like sweet foods. However, our study did not find a statistically significant association between liking lean meat, eggs, vegetables, and stunting (Table 3). This result differs from research on Iranian children, which demonstrated that a high-protein diet reduces the risk of stunting [8], as well as research on Mexican children, which showed that a diet high in sweets reduces the risk of stunting and a diet rich in fruits and vegetables increases the risk of stunting [9]. Results vary across different populations and cultures, which may also explain the heterogeneity in findings between studies. Fatty foods are often nutrient-dense, including not only lipids but also proteins, so children who like fatty foods tend to consume more energy and nutrients, thereby reducing the risk of malnutrition. On the contrary, sweet foods often contain little protein. When sweets enter the body, they are absorbed quickly, causing a rapid increase in blood sugar, which stimulates the pancreas to secrete insulin—a hormone that induces a feeling of fullness [23]. Therefore, eating sweets, especially before meals, creates a feeling of fullness before the meal, leading to reduced food intake. This may explain why children who like sweets have an increased risk of stunting.

The addition of formula has been reported to help supplement nutrients for children, reducing the risk of malnutrition [24], [25]. However, a study on Mexican children do not show a relationship between a diet rich in milk and children's nutritional status [9]. Our study showed similar results to those in Mexican children [9]: there was no association between drinking formula before bed and stunting (Table 3). This can be explained by the fact that the majority of preschool children in Dong Anh, Hanoi, are in areas with developed economic conditions, so there is no significant difference in milk consumption at home between families.

The strength of our study is the analysis of the relationship between physical activity, eating habits, and stunting in a large sample of study subjects (3,820 preschool children). However, the limitation of the study is its cross-sectional design, so cause-effect conclusions cannot be drawn. Additionally, the uniform school schedule of children in public preschools may influence the relationship between physical activity and stunting that we observed.

4. Conclusion

A case-control study in Dong Anh preschool children, adjusted for age and sex, identified key factors associated with stunting: nighttime sleep < 8 hours (OR = 2.15), sedentary time > 60 min/day (OR = 1.72), meal duration > 40 min (OR = 1.43), preference for sweet foods (OR = 1.51), and preference for fatty foods (OR = 0.67). No significant associations were found with bedtime, school physical activity, moderate-to-vigorous exercise at home, or preferences for lean meat, eggs, vegetables, and milk before bed.

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