

INFLUENCE OF NUTRITION IN THE INFANT PERIOD ON OVERWEIGHT AND OBESITY OF CHILDREN AGED 24 TO 60 MONTHS IN SOME NORTHERN PROVINCES OF VIETNAM: A CASE-CONTROL STUDY

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ARTICLE INFO	ABSTRACT
Received: 01/3/2021	This study assessed the effect of nutrition in infancy on overweight and obesity of preschool aged children. This study was conducted on 126 obese and overweight children aged 24-60 months and 306 normal children in the control group (according to WHO 2006 criteria). The statistical significance for overweight and obesity in preschool children was not shown in the results of univariate and multivariate analysis of nutritional characteristics in the infant period, as such factors: breastfeeding (p = 0.24), the addition of formula in the first 6 months (p = 0.992), duration of breastfeeding (before 12 months: p = 0.81, after 24 months: p = 0.97), age of the beginning of complementary foods (before 4 months: p = 0.25, after 6 months: p = 0.78). Infants attracted to complementary foods had a risk of being overweight and obese in preschool age with OR = 2.08 in univariate analysis and OR = 2.12 in multivariate analysis (p = 0.004). Therefore, exclusive breastfeeding or consumption of the mixture nutrition during the first 6 months, the age of the beginning of complementary feeding, duration of breastfeeding did not affect the development of overweight and obesity in children. Complementary food liked children showed the possibility of being overweight and obese by 24 to 60 months.
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NGHIÊN CỨU BỆNH CHỨNG VỀ ẢNH HƯỞNG CỦA DINH DƯỠNG GIAI ĐOẠN BÚ MẸ ĐẾN THỪA CÂN VÀ BÉO PHÌ Ở TRẺ EM 24 ĐẾN 60 THÁNG TẠI MỘT SỐ TỈNH MIỀN BẮC VIỆT NAM

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THÔNG TIN BÀI BÁO	TÓM TẮT
Ngày nhận bài: 01/3/2021	Mục tiêu của nghiên cứu là đánh giá ảnh hưởng của chế độ dinh dưỡng giai đoạn bú mẹ đến tình trạng thừa cân, béo phì ở trẻ mầm non. Nghiên cứu được thực hiện trên 126 trẻ béo phì và thừa cân độ tuổi 24 - 60 tháng tuổi và 306 trẻ bình thường thuộc nhóm chứng (theo tiêu chí WHO 2006). Phân tích thống kê đơn biến và đa biến về đặc điểm dinh dưỡng trong thời kỳ trẻ sơ sinh tác động lên thừa cân béo phì ở trẻ mầm non không có ý nghĩa thống kê bao gồm: đặc điểm bú mẹ hoàn toàn (p = 0,24), bổ sung sữa công thức trong 6 tháng đầu (p = 0,992), thời điểm cai sữa (trước 12 tháng: p = 0,81, sau 24 tháng: p = 0,97), tuổi bắt đầu ăn dặm (trước 4 tháng: p = 0,25, sau 6 tháng: p = 0,78). Ở giai đoạn trẻ bú mẹ có biểu hiện thích ăn dặm làm tăng nguy cơ bị thừa cân béo phì khi trẻ 24 - 60 tháng với OR = 2,08 (phân tích đơn biến) và OR = 2,12 (phân tích đa biến) (p = 0,004). Như vậy, ở giai đoạn bú mẹ, đặc điểm bú mẹ hoàn toàn hoặc ăn bổ sung sữa công thức trong 6 tháng đầu, tuổi bắt đầu ăn dặm, thời điểm cai sữa không ảnh hưởng đến tình trạng thừa cân béo phì ở trẻ mầm non. Trẻ bú mẹ háu ăn có nguy cơ bị thừa cân và béo phì khi trẻ 24 đến 60 tháng.
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1. Introduction

Overweight and obesity is raising as a global medical problem as the prevalence of overweight and obesity among children in the world has grown rapidly and reached 40 million in children under five years of age and over 330 million in children aged 5–19 years [1]. In Vietnam, the number of overweight and obese children is growing rapidly, especially in urban areas [2]. Thus, according to Le Thi Hop, in 2012, about 460,000 children under the age of 5 were obese (5.6%), which is 6 times higher than the same indicators in 2000, and currently this growth trend continues [3].

Obesity causes many adverse medical and psychological effects, even in children, such as increased risk of metabolic disorders (dyslipidemia, hepatosis, hypertension, diabetes mellitus), scoliosis, early puberty, low self-esteem, mental disorders up to the development of mental disorders [4]. In addition, about 80% of obese and overweight children continue to suffer from it in adulthood and increase disability and mortality in general [5]. Thus, prevention of obesity in children will help reduce the incidence of obesity in adults, reducing the risk of chronic diseases associated with obesity.

Many current studies suggest that there is a positive relationship between overweight at birth and a negative relationship between exclusive breastfeeding and the risk of obesity in children, but there are also some studies that disprove this relationship [6] - [10]. There is evidence that “programming” nutrition in infancy has long-term effects on children's health [11]. This is also supported by the First 1000 Days of Nutrition study, which demonstrates the effects of breast milk and complementary foods in the development and prevention of obesity [12]. Thus, we conducted a study entitled “The Effects of Nutrition During Breastfeeding on Overweight and Obesity in Children 24 to 60 Months of Age in Selected Northern Provinces of Vietnam: A Case-Control Study.” Objective of this study was to assess the effect of nutrition during infancy on overweight and obesity in preschool children.

2. Material and method

2.1. Participants

A cross-sectional study on 2035 children aged under 60 months, randomly collected from 6 preschool institutions in the northern provinces of Vietnam (Hanoi, Nam Dinh, Thanh Hoa) was carried out in september 2017. The results, according to criteria of WHO 2006, included 1697 normal infants and 163 overweight and obese children. Participant selection for our study was among these children.

Selection criteria:

- Boys and girls aged 24-60 months old;
- Signed informed voluntary consent for inclusion by the child's parent / legal representative.

Exclusion criteria:

- Children who are overweight and obese are associated with verified diagnoses or drug exposure;
- Incomplete filling of the questionnaire.

The “case” group included 126 overweight and obese children and the “control” comparison group of 306 children with normal nutritional status, which is a sufficient sample size for a case-control study.

2.2. Method

Information about the date of birth, gender of the child was taken from the school database. All measurements were taken with children dressed in light underwear and no shoes. The height of the children was measured with a wooden stadiometer (the data was recorded with an accuracy of 0.1 cm). Body weight was measured with a SECA 890 electronic weighing cabinet (UNICEF), calibrated after transportation (the data was recorded with an accuracy of 0.1 kg).

The criteria for determining the nutritional status of children were the WHO 2006 standards for children under 5 years of age using the Z-score. In particular: weight deficit, when the Z-score of weight for age $< -2SD$; stunted when Z-score for height-for-age $< -2SD$; wasted with Z-score of weight for height $< -2SD$; overweight, when the Z-score for weight for height $> 2SD$ and $\leq 3SD$; obesity when the Z-score for weight for height $> 3SD$ [13].

Information on birth weight and nutritional characteristics during infancy (duration of breastfeeding, age of initiation of complementary foods and diet during infancy) of the studied children was collected from questionnaires completed by the parents or guardians of the child. The questionnaire was compiled by specialists from the National Institute of Nutrition, Hanoi Medical University and Hanoi University of Education (Vietnam) and was approved under the grant project No. B2018-SPH-50.

2.3. Statistical data processing

The collected data was imported and managed using the Epidata program. Excel 2010 and SPSS 16.0 were used to process the statistical data as follows: Qualitative variables (gender, nutritional characteristics in infancy) were expressed in % and compared using χ^2 criteria. Quantitative variables (age, height, Z-score for height/ age, weight, birth weight, Z-score for weight/ age, BMI and Z-score for BMI/ age, Z-score for weight/ height) were tested by distribution type. For a normal distribution, the variable was expressed as the arithmetic mean $\pm$ standard deviation ($M \pm SD$). If the distribution was not standard, a new variable would be created with a log base of 10 ($\lg$). If the new variable was with a standard distribution, then it would be expressed as the type of mean (95% CI). If the new variable had a non-standard distribution, then it would be expressed as a median type (25 - 75 percentile). Comparison between two quantitative variables was carried out according to the Student's test or the Mann-Whitney test. The influence of risk factors on obesity was analyzed using univariate and multiple logistic regression. P values ≤ 0.05 on both sides were considered statistically significant.

3. Results

3.1. Characteristics of participants

A cross-sectional study was conducted to determine the nutritional status of 2035 children aged 24 to 60 months at 6 randomly selected preschools in Hanoi (Thuy Phuong Kindergarten, Yen So Kindergarten), Nam Dinh province (Giao Hai Kindergarten, Xuan Hong Kindergarten), Thanh Hoa province (Hoang Hoa Kindergarten, Yen Dinh Kindergarten). The nutritional status of the study population is shown in Table 1, which includes underweight children, normal weight children, and overweight and obese children.

Table 1. Nutritional status in children from 24 to 60 months in the surveyed kindergartens in Hanoi, Nam Dinh, Thanh Hoa

Nutritional status	Hanoi n = 738	Nam Dinh n = 612	Thanh Hoa n = 685	Total n = 2035
Underweight	39 (5.28)	63 (10.29)	74 (10.8)	176 (8.65)
Normal	624 (84.55)	513 (83.82)	560 (81.75)	1697 (83.39)
Overweight and obesity	75 (10.16)	36 (5.88)	51 (7.45)	162 (7.96)

Data presented as number n and percentage (%)

Table 1 showed 7.96% of overweight and obesity and 8.65% of underweight children in total. Preschool children had the highest obesity rates (10.16%) in Hanoi and the lowest in Nam Dinh (5.88%). The prevalence of malnutrition was highest (10.8%) in Thanh Hoa preschools and lowest in Hanoi (5.28%).

The characteristics of the children in case – control study, including height, weight, BMI, Z-score for height/ age, Z-score for weight/ age, Z-score for BMI/ age, Z-score for weight/ height, were shown in Table 2.

Table 2. *Characteristics of participants*

Characteristics	Normal group (n = 306)	Overweight and obese group (n = 126)	p
Male gender (%)	65.4	68.3	0.563
Age (month)	55.53 ± 8.78	55.5 ± 9.21	0.968
Birthweight (gr)	3200 ± 560	3300 ± 620	0.753
Height (cm)	104.9 ± 6.5	106 ± 9.08	< 0.0001
Z-score height/age	-0.47 ± 1.01	-0.074 ± 1.37	0.004
Weight (kg)	17.16 ± 2.65	22.72 ± 3.91	< 0.0001
Z-score weight/age	-0.22 ± 0.95	1.84 ± 0.94	< 0.0001
BMI (kg/m ²)	15.51 ± 1.37	19.9 ± 2.47	< 0.0001
Z-score BMI/age	0.98 ± 0.94	2.63 ± 0.81	< 0.0001
Z-score weight/height	0.14 ± 0.93	2.83 ± 0.71	< 0.0001

Compare the sex ratio between the 2 groups by χ^2 test.

Variables are represented by mean ± standard deviation, p obtained from Student's t test.

The results of the analysis showed that the group of overweight and obese children had height, weight, BMI, Z-score for height/age, Z-score for weight/age, Z-score for BMI/age which were significantly higher than in the control group with $p < 0.0001$ and weight at birth of children had no effect on overweight, obesity in preschool children ($p = 0.753$).

3.2. Analysis of the influence of infant nutrition on overweight and obesity in preschool children

Univariate and multivariate analysis of the influence of certain nutritional characteristics in infancy on overweight and obesity in preschool children was shown in Table 3.

Table 3. *Impact of infant nutrition and overweight and obesity in preschool children*

Risk factor		Univariate analysis		Correlation by age and gender	
		OR	p	OR*	p*
Breastfeeding	Yes	1		1	
	No	1.83	0.24	1.85	0.23
Formula intake in the first 6 months old	No	1		1	
	Yes	1.998	0.992	1.001	0.995
Age of weaning	12 - 24 months old	1		1	
	< 12 months old	1.08	0.81	1.1	0.76
	> 24 months old	0.98	0.97	0.98	0.97
Age of initiation complementary foods	4 – 6 months old	1		1	
	< 4 months old	1.89	0.25	1.86	0.27
	> 6 months old	0.78	0.54	0.79	0.54
Enjoyment complementary food	No	1			
	Yes	2.08	0.005	2.122	0.004

p obtained from logistic regression analysis.

p* obtained from multivariate logistic regression analysis.

The results from the table showed that in univariate analysis, p values less than 0.05 were statistically significant when children enjoyed complementary foods. Other factors, such as breastfeeding, formula intake in the first 6 months, age of child weaning breastfeeding, age at initiation complementary feeding in infants had no effect on overweight or obesity in preschool age.

Multivariate analysis, after correlating for age and sex, also showed that when infants consumed complementary foods with pleasure, it could cause overweight and obesity in preschool age 2.1 times more likely than children who did not enjoy complementary foods (the difference was statistically significant with $p = 0.004$).

4. Discussion

The proportion of children with overweight and obesity in the provinces of Hanoi, Thanh Hoa, Nam Dinh was 10.16%; 7.45% and 5.88%, respectively. It was noted that the proportion of children with underweight in rural schools (Nam Dinh, Thanh Hoa) was higher than Hanoi, on the contrary, the prevalence of overweight and obesity in urban schools was higher. This can be explained by the fact that the level of childcare of parents in rural areas was more limited than in schools in Hanoi, but rural mothers may have more time and conditions to prolong breastfeeding than mothers in urban areas.

The results of the analysis showed that the overweight and obese group of children had height, weight, BMI, Z-score for height/age, Z-score for weight/age, Z-score for BMI/age higher compared to the normal group, $p < 0.0001$ and the similarity of two groups in gender and age ($p > 0.05$). It was clear due to participant selection processing, in which children were specially selected for groups of cases and control groups that had no discrepancy in age and sex characteristics (case-control study in pairs with a ratio of 1:2).

The results of the study showed no influence of inclusive breastfeeding in infancy on overweight and obesity in preschool age children, both in univariate analysis and after adjustment for age and sex. Likewise, the presence or absence of artificial formula during the first 6 months of life, the age at which breastfeeding was stopped, and the age at which complementary foods were started in this study also did not affect the development of overweight and obesity in children ($p > 0.05$). In this study, the result was contrast with the longitudinal series of observations conducted by Contarato and colleagues (2016) for 435 Brazilian infants aged 12-24 months, where infants without exclusively breastfeeding were at increased risk of being overweight and obese compared to infants who were fully breastfed on 2.6 times ($p = 0.043$) [14]. Grzybowski's study noted that in fifteen-year-old children who were breastfed for less than 2 months, BMI was 1.2 kg/m^2 higher (95% CI: 0.1 - 2.4) compared with those who were breastfed for 6 months or longer [10]. Also, a study of 526 children aged 4 to 5 years in urban preschools in Ho Chi Minh City concluded that breastfeeding was associated with a decrease in overweight and obesity in children [15]. These differences can be explained by the fact that our study was carried out according to the "case-control" method, differed from the cross-sectional method of other studies, and also the age of the subjects was different. A longitudinal study by Sabanayagam and colleagues in 797 children showed that there was no relationship between breastfeeding or not breastfeeding with overweight and obesity [16]. Similarly, another study of British children by Brion and colleagues found no effect of breastfeeding on overweight or obesity in low-income settings [17]. According to WHO, exclusive breastfeeding is recommended up to 6 months and breastfeeding should be continuing up to 24 months or longer, as breast milk is an almost ideal mixture of vitamins, protein and fat for the baby and also brings psycho-emotional well-being between baby and mother.

The age of weaning in children also affects the risk of being overweight, obesity later in the child in several studies. For example, a study conducted by Le Thi Tuyet in 2014 on primary school children (Hanoi) found that compared with children who stopped breastfeeding before 12 months of age, weaning after 18 months increased the risk of obesity by 2.3 times ($P^* = 0.009$) [18]. This result could be explained by the fact that cow formulas are richer in energy than breast milk, weaning and giving cow formula for children would gain weight faster for children, but in breast milk they have biologically active substances that help control the amount of food intake at an older age [19], which reduces the risk of obesity for children who grew up in a family with a

balanced diet. However, in some reports, a difference in BMI between the study and control group was not found in the study of American children with a change in the time of breast termination [20]. Our study in preschool children did not show an association between time to stop breastfeeding and the risk of being overweight ($P > 0.05$).

On univariate analysis and after adjusting for age and sex, it was found that there was an association between the consumption of complementary foods with pleasure in infancy and the risk of overweight and obesity in preschoolers ($P < 0.05$). Compared to children who found it difficult to feed complementary foods, those who found it easier to feed were 2.08 times more likely to be overweight or obese ($P^* = 0.004$). The cause was due to the ease of feeding, resulting in faster weight gain and a higher risk of overweight and obesity than babies who are difficult to feed. While this is a good sign that every parent has a good feeding experience in infancy, if not well controlled, it can easily lead to a higher risk of overweight and obesity in later age of the child.

This study was conducted on a case-control basis with similar groups of children, which could clearly identify risk factors for obesity. The limitation was that it was retrospective and did not consider a specific vigorous diet for each child, that more in-depth research should be carried out in the future.

5. Conclusion

A case-control study and multivariate regression analysis of obesity did not show the risk of overweight predominance infants influenced by factors such as overweight at birth, nutritional characteristics of breastfed or formula-fed infants, early age of initiation of complementary foods, the age of weaning. During breastfeeding, when the children are given complementary foods, if they willingly eat complementary foods, they have a significantly increased risk of developing overweight and obesity later in preschool age, so parents should keep good control over the real components and portions of food for children to avoid excess obesity weight in children aged 24-60 months.

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Conflict of interest.

The authors declare no conflicts of interest.

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