ASSOCIATION BETWEEN BODY MASS INDEX AND STOOL QUALITY IN PRESCHOOL CHILDREN FROM NORTHERN VIETNAM

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ABSTRACT

Introduction: Malabsorption, marked by impaired nutrient absorption, affects both macronutrients and micronutrients, leading to deficiencies and gastrointestinal (GI) symptoms. Constipation, a prevalent GI issue in children, increasingly impacts pediatric nutritional health, affecting both weight and height and influencing long-term development. This study investigates the correlation between body mass index (BMI) and stool quality in children, aiming to inform nutritional interventions in preschoolers in Northern Vietnam.. *Methods:* A stool sample survey of over 285 children aged 2-5 years from a preschool in Northern Vietnam in 2023 was conducted. Child weight, height, and BMI were analyzed with means and standard deviations, and chi-square tests were employed for correlation analysis with gender, ages and stool via SPSS 20. *Results:* The study included 52% male and 48% female participants.. The proportion of children with a BMI between 13,5-16,5 was 76%, accounting for a larger proportion. Gender, age, and stool quality showed no statistically significant relationship. However, a significant correlation was found between BMI and stool quality. Children with normal BMI had better stool quality compared to children at risk of obesity or underweight. *Conclusions:* While a significant relationship between BMI and stool quality was identified, further research, including larger cohort studies and clinical trials, is needed to support weight management strategies for children.

Keywords: Body mass index (BMI), children, stool

I. INTRODUCTION

Numerous investigations have indicated that constipation significantly impacts digestion, particularly among children [1]. Although the precise influence of constipation on gastrointestinal (GI) symptoms remains uncertain, gastrointestinal dysfunction is believed to stem from initial inflammatory injury to the gastrointestinal tract, which alters visceral mobility and/or sensitivity [2]. Moreover, the link between constipation and lifestyle behaviors such as unhealthy dietary habits and inadequate physical activity has been documented. Multiple studies have demonstrated an association between constipation and body mass index (BMI), with both BMI and age correlating with rectosigmoid transit time in constipated individuals. Conversely, there are conflicting reports indicating that constipation may not be linked to BMI. A recent review of constipation studies revealed inconclusive findings regarding prevalence and associated factors in constipation populations [2], [3].

Consequently, it leads to fecal nutrient excretion, nutritional deficiencies, and a spectrum of gastrointestinal (GI) symptoms

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[5], [6], [7]. Its adverse effects on pediatric nutritional health are multifaceted, potentially impacting both weight and height, thereby shaping long-term developmental pathways. This study endeavors to investigate the potential correlation between body mass index (BMI) and stool quality in children. By establishing this relationship among preschoolers in Northern Vietnam, we aim to provide a foundation for nutritional interventions tailored for this population.

II. MATERIALS AND METHODS

2.1. Research subjects

285 preschool students from 2 to 5 years old studying at the Kindergarten in Hai Duong, Vietnam with the permission of their parents, teachers and school leaders.

2.2. Research time and location

The research was conducted from May 2023 to October 2023.

Location: Kindergarten in Hai Duong, Vietnam

2.3. Research design: Cross-sectional descriptive study

2.4. Research sample size

Apply the formula for calculating sample size for a proportion:

$$n = Z^2_{(1-\alpha/2)} \frac{p\,(1-p)}{d^2}$$

In which: n is the number of students to be studied; p is the proportion of students (p = 0.75); d is the absolute accuracy (d = 0.05); Z= 1.96 (α=0.05).

Substitute into the formula and round the result, the calculated sample size is: n=285

2.5. Sampling method

Each grade 2, 3, 4, 5 years old participated in the study. Criteria for excluding students: Individuals with a history of chronic ailments; Subjects currently under medication regimen.

- Non-participation as indicated by guardians' dissent;

2.6. Tools and methods of data collection

A pre-designed self-administered questionnaire was used for parents to answer questions about knowledge related to the research content. The self-administered questionnaire consisted of 3 parts, 15 questions with content related to the research content. The research team directly guided parents to read and fill out the survey. Stool samples were collected and refrigerated at 4-8ºC in 20% glycerol.

2.7. Calculation of mean values: Chi-square test methodology was employed for analysis.

2.8. Research ethics

The entire survey process on volunteers complies with the research ethics principles approved by the Appraisal Council, including the Scientific Council approving the implementation content and research ethics of the Department of Science and Technology of Hai Duong province, Vietnam in Decision 563/QD-UBND dated February 25, 2022.

III. RESULTS AND DISCUSSION

Table 1. *BMI analysis of sample subjects*

Variable		Value	Frequency	Percent (%)	Percentage of sample
BMI index	Male	From 13.5 – 16.5	117	79	41
		Under 13.5	3	2	1
		Over 16.5	29	19	10
		Total male	**148**	**100**	

Variable	Value		Frequency	Percent (%)	Percentage of sample
	Female	From 13.5 – 16.5	106	77	35
		Under 13.5	5	4	2
		Over 16.5	26	19	10
		Total female	**137**	**100**	
	Total		**285**	**100**	**100**

The group of children aged 2-5 years old with BMI of {13,5 – 16,5} are children with good nutrition (male: 41%, female: 35%; accounting for 76% of the total sample). The group of children with high BMI from 16,5 or more accounts for 20%. The group of children with very low BMI (under 13,5) accounts for 3%.

Table 2. *Analysis of digestive health characteristics of sampled subjects*

Variable	Value	Frequency	Percent (%)	Percentage of sample
Had health problems	Irregular eating	31	12	12
	Often stressed	21	8	8
	Not enough water or fiber in the diet	5	2	2
	Pollution in the living environment	0	0	0
	Unscientific lifestyle (little exercise, sleeping late, not getting enough rest, etc.)	5	2	2
	Total	**62***	**100.0**	**100.0**
Level of gastrointestinal symptoms	1 – Very rarely	52	18	18
	2 – Rarely	36	13	13
	3 – Normal	93	33	33
	4 – Regularly	52	18	18
	5 – Very often	52	18	18
	Total	**285**	**100**	**100**
Common symptoms	1-2 times/day	210	74	74
	More than 3-4 times/day	23	8	8
	Many times/day	0	0	0
	Go to the toilet less than 3 times a week	26	9	9
	Have to "strain" too much, pain when defecating	10	4	4
	See blood in stool	0	0	0
	Diarrhea	10	4	4
	Stools are very hard, dry and difficult to pass.	5	2	2
	Total	**285**	100	100
Waste status (feces)	Oblong, pale green, yellow, to brown	119	42	42
	Stool is not oblong, dark yellow to green	39	14	14
	Loose stools, color changes depending on food/day	26	9	9
	Red stools with fresh blood	0	0	0
	Dark brown, dark red, *black or white stools, greasy stools*	0	0	0
	Stools that are separate, dry, and difficult to pass	10	4	4
	Clumps and sausage shaped	0	0	0
	Sausage shaped and has cracks on the surface	0	0	0
	Sausage-like and soft	**145**	**51**	**51**
	Each lump is soft, with distinct edges.	26	9	9
	Fine, lumpy stools.	10	4	4
	Completely liquid.	5	2	2

Note: The characteristics of waste (feces) status can have more than 1 answer in the selection.

Through exploiting information on children's digestive health characteristics, it was found that 62* children (22%) had experienced digestive symptoms, of which only 145 stool samples (51%) met the requirements (sausage-shaped and soft).

3.1. Age Distribution of Research Participants

Table 3. *Age Distribution and sex of Research Subjects*

Years	Number of children	%	Male	Female	Years	Number of children	%	Male	Female
2	65	22,73	44	21	4	65	23,64	39	29
3	65	22,73	23	41	5	88	30,91	54	34
The average age: 3,62 years					**Total**	285	100	148	137

The average age of the research subjects is, the lowest is 2 years old, the highest is 5 years old. People sampled at the age of 2 to 3 accounted for the highest proportion: 39,2%. Next is the group of children aged 3 to 4, accounting for 24,3%. The group of children from up to 4 years old accounts for 13,5%. The group of children over accounts for the lowest rate of 7,5%. In terms of gender, the male group outnumbered the female group in all age groups, except for the 3-4 year old group. The male group accounted for a higher proportion than the female group, 52% and 48%, respectively.

3.2. The relationship between BMI and stool quality, gender, and age of children
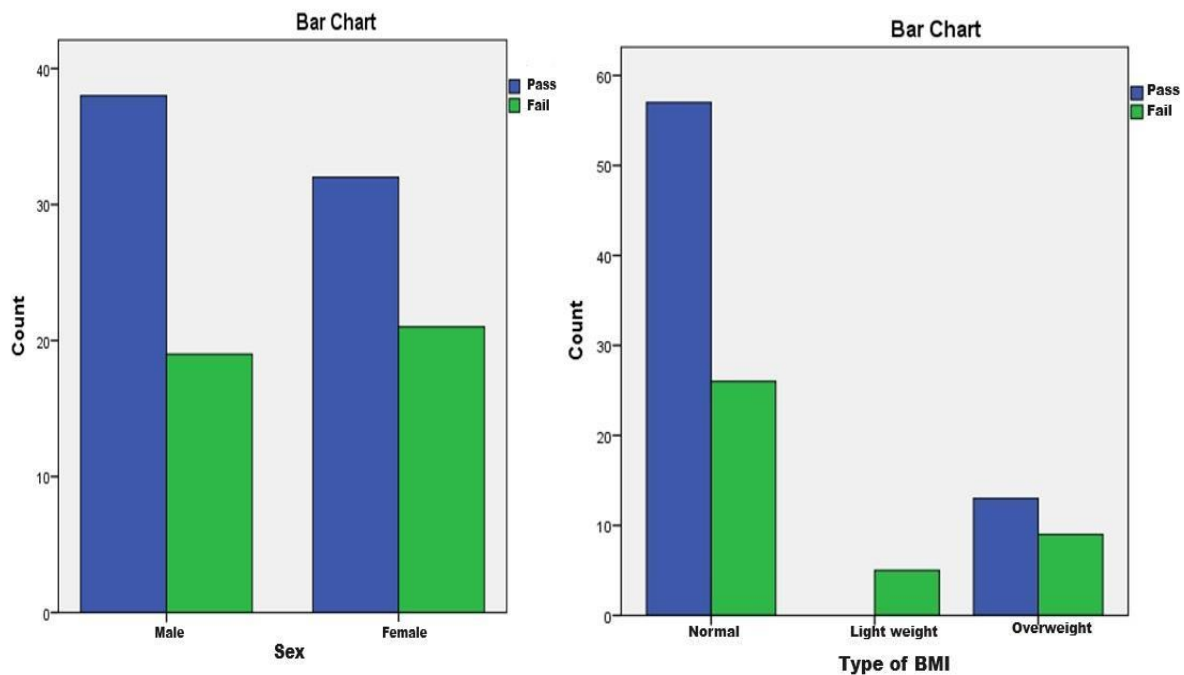
Figure 1. *The Bar chart of relationship between BMI and gender and stool quality, respectively*

The test results in the Chi-Square Tests table show that the Asymptotic Significance value (2-sided) in Pearson Chi-Square is 0,007 <0,05. Therefore, we can conclude that the two categorical variables BMI and stool quality have a statistically significant relationship with each other.

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Table 4. *The relationship between body mass index and constipation*

n = 285		With constipation	Without constipation	p value
BMI (mean ± SD)	Male (n =148)	15,14 ± 2,11	14,88 ±2,54	>0.05
	Female (n = 137)	14,20 ± 2,21	13,37 ± 2,33	>0.05

The statistical data also showed that the constipated and non-constipated groups did not have a statistically significant relationship with the difference in BMI.

IV. DISCUSSION

4.1. Age and gender of the study group.

The group of children aged 2-5 years old with the ratio of boys (52%) and girls (48%) showed that the number of boys was higher than that of girls. However, this was only the number in one school, so more extensive studies are needed to further evaluate the anthropological correlation.

4.2. Relationship between BMI, gender and stool quality

The test results showed that there was no relationship between gender and BMI. However, the statistical results showed that the stool quality of children with normal BMI was better than the stool quality of children with overweight BMI and children with underweight BMI. The group of children aged 2-5 years old with BMI of {13,5 – 16,5} are children with good nutrition (male: 41%, female: 35%; accounting for 76% of the total sample). It is imperative to evaluate nutritional assessments comprehensively, encompassing both home and school environments, as deemed necessary. So, the recommendations of the research group are maintaining to balance nutrition and activities for children with BMI {13,5 – 16,5} because this is the group of children with BMI meeting the target [7], [8]. The group of children with a high BMI of 16,5 or more accounts for a relatively large percentage (20%), proving that children are having an over-nutrition, overweight, so they should have a more reasonable diet, such as increasing fiber, reducing fat and starch; and increasing exercise. Children with a very low BMI (under 13,5) are in the stunted malnutrition group and need more special care, combining food and medical nutritional supplements.

V. CONCLUSION

The study was conducted on 285 children aged 2-5 years old at Duc Chinh Kindergarten, Cam Giang, Hai Duong. Of which, the proportion of boys was 52%, and of girls was 48%. The proportion of children with a BMI between 13,5-16,5 was 76%, accounting for a larger proportion. The statistical results showed that BMI was not related to age or gender, but was related to stool quality.

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