Original Research

PREVALENCE OF MALNUTRITION AND RELATED FACTORS IN PEDIATRIC PATIENTS WITH BILIARY ATRESIA TREATED AT CHILDREN'S HOSPITAL 2

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ABSTRACT

Aims: To determine the prevalence of malnutrition and related factors in children with biliary atresia being treated at Children's Hospital 2.

Methods: A cross-sectional study was conducted on 120 children with biliary atresia being monitored and treated at the Hepatology Department of Children's Hospital 2 from March to April 2024.

Results: The prevalence of malnutrition according to MUAC was 47.7%, stunting was 30.8%, wasting was 12.4%, and malnutrition based on BMI was 10%. Factors related to malnutrition according to MUAC included younger age groups and blood albumin levels. Stunting was related to blood albumin levels. Wasting malnutrition was related to Kasai surgery, and younger age groups were related to malnutrition based on BMI. Supplementation with MCT was associated with stunting and BMI based-on malnutrition. Maltose supplementation was associated with all four types of malnutrition. Tube feeding was associated with wasting and BMI based-on malnutrition. Nutritional counseling was associated with stunting.

Conclusion: The screening, assessment, and nutritional support for children biliary atresia have not received adequate attention. Regular monitoring of the nutritional status, using both overall anthropometric indices and specific anthropometric indices is crucial to early identify the risk of malnutrition in this group. It is important to enhance educational efforts to ensure caregivers recognize the crucial role of nutrition and nutritional counseling for children with biliary and cholestatic jaundice in general.

Keywords: *malnutrition, stunting, biliary atresia, nutritional support, MUAC.*

I. INTRODUCTION

Malnutrition (MN) commonly occurs in children with biliary atresia (BA) due to poor intake, food intolerance or malabsorption of fats, and abnormal metabolism of nutrients. These issues significantly impact the treatment, growth, and development of children, even after Kasai surgery [1]. However, the screening, assessment, and nutritional support for this group of children have not received adequate attention. In 2019, Pratiwi FC et al conducted a study at Dr. Sardjito General Hospital, Indonesia with children undergoing the Kasai procedure and found a malnutrition rate of 56.4% [2]. Therefore, early research and intervention in MN are essential to

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improve the quality of life and prognosis for these children. Additionally, the use of indices such as weight, height, and mid-upper arm circumference (MUAC) in assessing nutritional status plays a crucial role in the early detection of MN. However, there are currently very few studies on the general rate of malnutrition and related factors in children with biliary atresia in Vietnam. For this reason, this study was conducted to determine the prevalence of malnutrition and identify related factors in children with BA treated at Children's Hospital 2.

II. METHODS

2.1. Study design

The cross-sectional study was conducted on children with biliary atresia treated at Children's Hospital 2 from March to April 2024. The study received the approval from the Ethics Committee in Biomedical Research of the University of Medicine and Pharmacy at Ho Chi Minh City (Approval No. 88/HĐĐĐ-ĐHYD, dated January 9, 2024) and the Ethics Committee in Biomedical Research of Children's Hospital 2 (Approval No. 374/GCN-BVNĐ2, dated April 5, 2024).

2.2. Study subjects

The study subjects were children diagnosed with biliary atresia, including inpatient or outpatient treated at Children's Hospital 2 during the study period.

Inclusion criteria: Pediatric patients diagnosed with biliary atresia who were under follow-up or treatment at the Hepatology Department of Children's Hospital 2; and caregivers of these children who gave consent for their participation in the study.

Exclusion criteria: Incomplete interview responses, children currently in the emergency department or with severe acute conditions, those preparing for surgery, or those in postoperative intensive care.

2.3. Sample size and sampling method

The sample size was calculated using the formula:

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

n is the required sample size; α is the type I error probability, Z=1.96 with =0.05; d=0.1 is the margin of error; *p* is the rate of malnutrition according to Phan Thi Tuong Van [3], which is 41.9%. Substituting these values into the formula, the sample size was calculated to be 93.

All pediatric patients diagnosed with biliary atresia (inpatient or outpatient) at Children's Hospital 2 in Ho Chi Minh City, meeting the inclusion criteria from March to April 2024, were invited to participate in the study. A total of 120 patients were selected for the study.

2.4. Data collection

The caregivers of children were directly interviewed using questionnaire about patient information, nutritional support (additional MCT and additional maltose), whether beans were added to the milk porridge, whether the child was fed via a feeding tube, and whether there was nutritional assessment.

Anthropometric measurements

Weight is measured using a Nhon Hoa scale with an accuracy of 0.1kg. The scale is placed on a stable and flat surface. Children are weighed without clothes or with very light clothing. Children aged ≥ 24 months have their height measured using a fixed wall stadiometer, and children < 24 months have their length measured using a wooden board, with an accuracy of 0.5cm.Mid-upper arm circumference (MUAC) is measured at the midpoint of the upper arm using a non-elastic tape measure with an accuracy of 1mm.

Clinical record

Disease characteristics and blood albumin levels were collected from medical record and health check-up book. The nutritional status of the children is classified according to the WHO 2006 standards with acute malnutrition or stunting if WHZ (children ≤ 60 months), BMIZ (children > 60 months), or WAZ < -2SD [4], and malnutrition according to MUAC (< 12.5 cm) is applied to children aged 6-60 months [5].

2.5. Statistical analysis

Data were entered using Epidata 3.1 and analyzed using STATA 17. Anthropometric indices and age in months of the study sample were calculated using WHO Anthro and WHO AnthroPlus software. Qualitative variables were described using frequencies and percentages. Quantitative variables were described using mean and standard deviation; If the distribution was not normal, they were described using the median and interquartile range. Chi-square test and Fisher's Exact Test were applied to examine the association between qualitative variables. Fisher's Exact Test was used when > 20% of the cells have expected counts < 5. Statistical significance was considered when the p-value < 0.05.

III. RESULS

Table 1. *Characteristics of the children (n = 120)*

Characteristics		n	%
Gender	Male	58	48.3
	Female	62	51.7
Age	< 12 months	53	44.2
	12 - 60 months	44	36.6
	> 60 months	23	19.2
Residence	Ho Chi Minh City	23	19.2
	Other provinces	97	80.8
Birth weight	Normal weight	110	91.7
	Low birth weight	10	8.3
Gestational age	Full term	101	84.2
	Preterm	19	15.8

**Median (Interquartile Range)*

Table 2. *Prevalence of malnutrition in children with biliary atresia*

Type of malnutrition	*n*	%
Malnutrition by MUAC (n = 88)	42	47.7
Stunting malnutrition (n = 120)	37	30.8
Wasting malnutrition (n = 97)	12	12.4
Malnutrition by BMI (n = 120)	12	10.0

Table 1 shows that the male to female ratio was approximately equal. The highest proportion of children was found in children aged 12 months (44.2%), while the lowest proportion was in children over 60 months old (19.2%). Majority (80.8%) of the children were living in other provinces. Most children were born with normal birth weight and at full term.

The highest rate of malnutrition was according to MUAC, followed by stunting malnutrition at 30.8% (Table 2).

Table 3. *Clinical and paraclinical characteristics*

Characteristics		*n*	%
Kasai Surgery	Kasai	108	90.0
	No Kasai	12	10.0
Age at Kasai Surgery	< 60 days	27	25.0
	60 – 90 days	69	63.9
	> 90 days	12	11.1
Albumin (g/L)	Low (<35 g/L)	50	41.7
	Normal	70	58.3

Table 4. *Correlation Between Malnutrition Rates and Investigated Characteristics*

Characteristics		Malnutrition by MUAC n (%)	Stunting malnutrition n (%)	Wasting malnutrition n (%)	Malnutrition by BMI n (%)
Age group	≥ 12 months	16 (36.4)	23 (34.3)	3 (6.8)	3 (4.5)
	< 12 months	26 (59.1)	14 (26.4)	9 (17.0)	9 (17.0)
	p	0.033	0.351	0.130	0.023
Kasai Surgery	Yes	37 (45.1)	34 (31.5)	8 (9.4)	9 (8.3)
	No	5 (83.3)	3 (25.0)	4 (33.3)	3 (25.0)
	p	0.099*	0.753*	0.040*	0.100*
Blood Albumin	Normal	12 (26.1)	14 (20.0)	5 (9.6)	6 (8.6)
	Low	30 (71.4)	23 (46.0)	7 (15.6)	6 (12.0)
	p	< 0.001	0.002	0.376	0.537

** Fisher's exact test*

Table 3 shows that most of the children in the study had undergone Kasai surgery, with the majority having the surgery after 60 days of age. The highest proportion of surgeries occurred between 60 to 90 days of age (63.9%). Additionally, 41.7% of the children had hypoalbuminemia.

In the Table 4, there was a statistically significant correlation between age group and malnutrition by MUAC and by BMI (p <0.05). Kasai surgery was significantly associated with wasting (p <0.05). A statistically significant correlation was found between blood albumin levels and malnutrition by MUAC and stunting (p <0.05).

Table 5. *Nutritional support and its correlation with nutritional status (n = 120)*

Characteristic		Malnutrition by MUAC n (%)	Stunting Malnutrition n (%)	Wasting Malnutrition n (%)	Malnutrition by BMI n (%)
MCT Supplementation (n = 35)	Yes	19 (59.4)	17 (48.6)	6 (18.8)	7 (20.0)
	No	23 (41.1)	20 (23.5)	6 (9.2)	5 (5.9)
	p	0.098	0.007	0.202*	0.039*
Maltose Supplementation (n = 16)	Yes	12 (80.0)	10 (62.5)	5 (33.3)	6 (37.5)
	No	30 (41.1)	27 (26.0)	7 (8.5)	6 (5.8)
	p	0.006	0.007*	0.019*	0.001*
Beans Supplementation (n = 48)	Yes	15 (40.5)	15 (31.2)	5 (13.5)	7 (14.6)
	No	27 (52.9)	22 (30.6)	7 (11.7)	5 (6.9)
	p	0.250	0.936	0.763*	0.218*
Tube Feeding (n = 26)	Yes	11 (50.0)	10 (38.5)	6 (27.3)	6 (23.1)
	No	31 (47.0)	27 (28.7)	6 (8.0)	6 (6.4)
	p	0.805	0.341	0.026*	0.022*
Nutritional Counseling (n = 57)	Yes	23 (51.1)	26 (45.6)	7 (15.2)	7 (12.3)
	No	19 (44.2)	11 (17.5)	5 (9.8)	5 (7.9)
	p	0.516	0.001	0.419	0.428

**Fisher's Exact Test*

Table 5 shows that there was a statistically significant correlation between MCT supplementation and stunting malnutrition as well as malnutrition by BMI (p <0.05). Maltose supplementation was significantly associated with all four types of malnutrition (p < 0.05). Tube feeding showed a significant correlation with wasting malnutrition and malnutrition by BMI (p <0.05). Nutritional counseling was significantly related to stunting malnutrition (p <0.05).

IV. DISCUSSION

The gender ratio in our study is approximately equal with a ratio of 1:1.07, similar to the study by Pei Yin Hung [6], which reported a ratio of 1:1.01. This differs from the study by Phan Thi Tuong Van [3], which had a ratio of 1:1.7, and the study by Dang Tran Hoang Oanh [7], which also had a ratio of 1:1.7. The discrepancy may be due to the fact that previous studies primarily included children who had undergone Kasai surgery, whereas our study included all children with biliary atresia (BA).

The prevalence of malnutrition according to MUAC in our study higher than the prevalence of malnutrition based on overall anthropometric. Using MUAC as an indicator minimizes dependence on weight, which can be affected by hepato-splenomegaly and ascites in children with BA, making weight and BMI less accurate and leading to delayed detection of malnutrition. Height is only affected after prolonged weight-related malnutrition. The prevalence of stunting malnutrition in our study is lower compared to the studies by Huynh Thi Thao Nguyen (39.3%) [8] and Phan Thi Tuong Van (41.9%) [3]. This difference may be because our study had a larger sample size, primarily including outpatients whose nutritional status might be better than that of the inpatients in Huynh Thi Thao Nguyen's study and the children who had undergone Kasai surgery in Phan Thi Tuong Van's study. However, our prevalence is higher than the 2020 report from the National Institute of Nutrition, which reported a stunting rate of 19.6% for children under 5 years and 14.8% for children aged 5-19 years. This higher prevalence in our study can be attributed to the BA children being more significantly affected in terms of digestion and absorption capabilities.

A higher percentage of children in our study had undergone Kasai surgery (90%). The age at Kasai surgery in our study was predominantly between 60 and 90 days, similar to the domestic studies by Dang Tran Hoang Oanh (61-80 days) [7] and Phan Thi Tuong Van (60-90 days) [3]. In contrast, children worldwide generally undergo Kasai surgery before 60 days of age [9 -10]. Earlier Kasai surgery improves bile drainage and increases the survival rate with the native liver [11]. In our study, 41.7% of children with BA had hypoalbuminemia, consistent with literature that indicates metabolic liver disorders in children with BA often lead to reduced albumin levels.

Correlation between malnutrition rates and some factors

The age group of the children is significantly associated with malnutrition according to MUAC ($p = 0.033$) and BMI ($p = 0.023$). This could be because these groups include children in the post-Kasai surgery or not Kasai. If the surgery is successful, complications are fewer, and cirrhosis progresses more slowly, which has less impact on growth. Children who are overdue for Kasai surgery or have unsuccessful surgeries experience rapid progression of cirrhosis with many complications, significantly affecting their growth and development.

Additionally, the current diet may not be appropriate for the children's condition, lacking in both quality and quantity. Our study also found that children who had undergone Kasai surgery had a lower rate of wasting malnutrition (9.4%) compared to those who had not undergone the surgery (33.3%), with this difference being statistically significant (p = 0.040). This suggests that Kasai surgery may effectively reduce the rate of wasting malnutrition in children and improve their early development. There is also a noticeable difference in malnutrition rates by BMI between the operated and non-operated groups, with a malnutrition rate of 25% in children without Kasai surgery compared to 8.3% in those who had the surgery. However, the p-value of 0.1 is not sufficient to conclude a statistically significant association.

Hypoalbuminemia in children with BA indicates impaired liver function, which significantly affects the ability to absorb and metabolize nutrients. Our study found a statistically significant association between malnutrition by MUAC (p < 0.001) and stunting malnutrition (p = 0.002) with blood albumin levels.

Nutritional support and its relationship with malnutrition prevalence

Children with Biliary Atresia (BA) often do not absorb enough fat due to a lack of bile, making malnutrition a common issue in this group. To help prevent malnutrition, medium-chain triglycerides (MCT) are incorporated into specialized formula milk or can be added separately to formula milk, expressed breast milk, or meals. In our study, we found a significant association between MCT supplementation and stunted growth (p = 0.007) as well as BMI-related malnutrition (p = 0.039). Specifically, among the group receiving MCT supplementation, 48.6% of children experienced stunted growth, which is higher compared to the group without MCT supplementation. BMI-related malnutrition in the MCT-supplemented group was 20% higher than in the non-supplemented group.

Our study also found a statistically significant relationship between Maltose supplementation and various forms of malnutrition: MUAC-related malnutrition (p = 0.006), stunted growth (p = 0.007), wasting (p = 0.019), and BMI-related malnutrition (p = 0.001). Supplementing with Maltose helps provide additional carbohydrates to increase the energy content of porridge/milk, particularly important for BA children who have significantly higher energy needs compared to healthy children. Biliary atresia patients need early supplementation with maltose and MCT to improve nutritional status, but research results show that the malnourished or stunted group received more supplementation. This indicates that nutritional support is primarily focused on those who already have growth retardation complications. Thus, early nutritional support has not been adequately addressed to prevent acute and chronic malnutrition.

Plant-based proteins, particularly those from beans, contain lower levels of methionine compared to animal-based proteins and have been suggested as a specific nutritional therapy for children with liver disease. However, our research results showed no statistically significant relationship between various

forms of malnutrition and bean supplementation ($p > 0.05$). This could be because beans are an easily accessible food that does not require prescription or guided usage like MCT and Maltose supplementation.

In the group fed via a feeding tube, the rates of wasting and BMI-related malnutrition were 27.3% and 23.1%, respectively, with statistically significant differences. Given the high energy needs of children with BA, tube feeding can help meet these energy requirements and improve nutritional status. However, most children with wasting and BMI-related malnutrition are newly introduced to tube feeding, indicating that awareness of nutritional needs is still lacking.

Among the children who had nutritional consultations, the rate of stunted growth was 45.6%, higher than in the group without nutritional consultations, with a statistically significant difference ($p = 0.001$). This highlights that nutritional consultations are not adequately addressed, leading to delayed and ineffective nutritional support for children with BA.

Strengths and Limitations of the Study

The strengths of this study include the use of both overall and segmental anthropometric indices to determine the nutritional status of children with biliary atresia. Additionally, the study highlights the current awareness and nutritional support provided to this group of children. However, the study has certain limitations. We only evaluated the nutritional status at a single point in time, which prevents us from observing the developmental changes at different stages of the disease. Moreover, the nutritional issues discussed are a general overview of the current feeding practices and nutritional support. The study does not assess the impact of nutritional interventions or the detailed dietary intake of the children.

V. CONCLUSION

The study conducted on 120 children with biliary atresia at Children's Hospital 2 revealed that the malnutrition rate remains very high, especially malnutrition based on MUAC and stunted growth in children under 12 months old and those with hypoalbuminemia. Attention to nutrition and nutritional support remains delayed and limited. Regular monitoring of the nutritional status in children with biliary atresia is necessary, using both overall and segmental anthropometric indices to identify malnutrition risks early. This early identification can facilitate timely and effective nutritional support.

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