EFFECTS OF ACUTE MALNUTRITION ON THE RESULTS OF PNEUMONIA TREATMENT IN CHILDREN FROM 2 MONTHS TO 5 YEARS OLD

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ABSTRACT
Background: Pneumonia is a very common disease in children, especially children under 5 years old, due to their immature immune system not being able to fight against environmental

pathogens. Malnutrition affects the severity and outcome of pneumonia treatment. **Objectives:** *1) To describe the results of pneumonia treatment in acute malnutrition children from 2 months to 5 years old. 2) To determine the relationship between acute malnutrition and the results of pneumonia treatment in children from 2 months to 5 years old.* **Materials and method:** *174 children with pneumonia with acute malnutrition from 2 months to 5 years old are receiving inpatient treatment at Can Tho Children's Hospital, Disease group: Children diagnosed with pneumonia according to the Ministry of Health 2014: Children with cough, fever accompanied by at least one of the signs of rapid breathing according to age, chest indrawing (the lower part of the chest indents during inhalation), or rales lung abnormalities (moisture rales, bronchial rales, crackles, etc.) [6]. AND children diagnosed with acute malnutrition according to the Ministry of Health 2016: Children have 1 of 2 anthropometric conditions: arm circumference (MUAC) or weight for height (CN/CC) lower than the normal threshold for age and gender (in which, severe malnutrition with MUAC<115 mm or CN/CC<-3SD, moderate malnutrition with 115mm≤MUAC<125mm or -3SD≤CN/CC<-2SD) [7]. Control group: children diagnosed with pneumonia without acute malnutrition. Disease control research.* **Results:** *Some characteristics after treatment: antibiotic combination was 28.2%, antibiotic change counted for 31.6%, respiratory support was 19.0%, intensive care unit transfer was 6.9%, curative treatment results was 98.7%. There is a significant correlation between acute malnutrition with pneumonia and the characteristics of treatment outcomes: severe pneumonia (p<0.001), combined with antibiotics (p<0.001), respiratory support (p=0.012) and transfer to Intensive Care Unit (p=0.017). Acute malnutrition with pneumonia was not significantly different from changing antibiotics (p<0.625) and death after treatment (p=0.560).* **Conclusion:** *Acute malnutrition is statistically significantly different from the severity of pneumonia, antibiotic combination, respiratory support, and transfer to the Intensive Care Unit.*

Keywords: *pneumonia, level of pneumonia, acute malnutrition, children.*

I. INTRODUCTION

Pneumonia is a very common disease in children, especially children under 5 years old, due to the immature immune system not being able to fight against environmental pathogens [1], [2]. The rate of malnutrition in Vietnamese children under 5 years old in 2017, according to the Institute of Nutrition, was 13.4% underweight, 23.8% stunting, and 7% wasting. These rates in the Mekong Delta are 11.6%, 22.5%, and 5.9%, respectively, and in Can Tho City, these rates are 10.1%, 20.6%, and 3%, respectively [3]. Malnutrition affects the severity and outcome of pneumonia treatment. More than half of children who die from pneumonia are malnourished. Malnourished children are 3.8 times more likely to get pneumonia than normal children [1], [4]. In fact, the rate of children suffering from malnutrition and pneumonia is still very high and is related to each other [5]. Starting from the above-mentioned bases, we conduct research with the following goals:

1) To describe the results of pneumonia treatment in acute malnutrition children from 2 months to 5 years old.

2) To determine the relationship between acute malnutrition and the results of pneumonia treatment in children from 2 months to 5 years old.

II. MATERIALS AND METHODS

2.1. Subjects/ Study participant

All children with pneumonia with acute malnutrition from 2 months to 5 years old are receiving inpatient treatment at Can Tho Children's Hospital

Inclusion criteria:

Disease group: Children diagnosed with pneumonia according to the Ministry of Health 2014: Children with cough, fever accompanied by at least one of the signs of rapid

breathing according to age, chest indrawing (the lower part of the chest indents during inhalation), or rales lung abnormalities (moisture rales, bronchial rales, crackles, etc.) [6].

AND children diagnosed with acute malnutrition. According to the Ministry of Health 2016, acute malnutrition is a medical condition in which the body does not receive enough energy and protein according to the needs due to lack of supply or disease, causing children to lose weight rapidly, stunted or edematous:

Children have 1 of 2 anthropometric conditions: arm circumference (MUAC) or weight for height (CN/CC) lower than the normal threshold for age and gender (in which, severe malnutrition with MUAC<115 mm or CN/CC<-3SD, moderate malnutrition with 115mm≤MUAC<125mm or -3SD≤CN/CC<-2SD) [7].

Control group: children diagnosed with pneumonia without acute malnutrition.

Exclusion criteria: Children with pneumonia with birth defects; previous chronic diseases: nephrotic syndrome, chronic blood diseases,...; diarrhea; Family members did not agree to participate in the study.

2.2. Research Methods

Research design: Case-control study

Location and time of research: Can Tho Children's Hospital, July 2022-October 2023.

Sample size: Calculated according to the formula:

$$n = \frac{\left\{ Z_{1-\frac{\alpha}{2}} \sqrt{2P_2(1-P_2)} + Z_{1-\beta} \sqrt{P_1(1-P_1) + P_2(1-P_2)} \right\}^2}{(P_1 - P_2)^2}$$

$\alpha=0.05$, then $Z_{0.975}=1.96$, $d=0.09$ and $\beta=0.2$, then $Z_{(1-\beta)}=1.04$, $P_1=0.39$ $P_2=0.48$ (P_1, P_2 taken from Gamal Y study (2023)). We estimated the minimum sample size to be 77 samples. In fact, we collected 87 samples for the disease group and 87 samples for the control group (174 patients in total).

Sampling method: Convenience sampling.

Research content: Characteristics of treatment results and the correlation between these characteristics and acute malnutrition in children with pneumonia from 2 months to 5 years old.

The method of data collection: All children were asked about their illnesses and evaluated for treatment results. Data collected on the survey form was unified.

Data processing: Data were entered and processed using SPSS 18.0 software. Descriptive analysis of frequencies and percentages; Determine the relationship using $\chi2$ test and Fisher's Exact Test with significance level $\alpha= 0.05$ to reduce the bias.

III. RESULTS

From July 2022 to August 2023, our study recorded 174 cases (87 disease cases and 87 control cases) of pneumonia from 2 months to 5 years old, with the following results:

3.1. Research object characteristics

Table 1. General characteristics of study subjects (n=174)

Characteristic		Frequency (n)	Percentage (%)
Gender	Boys	66	37.9
	Girls	108	62.1
Age group	2 - <12 months	69	39.7
	12 - 60 months	105	60.3

Regarding gender, there are more girls than boys (62.1% girls, 37.9% boys). Regarding the age group, 60.3% of subjects belonged to the 12-60 months group.

3.2. Severity of pneumonia

In 174 cases of pneumonia in children, our study recorded a rate of pneumonia and severe pneumonia of 62.6% and 37.4%, respectively.

3.3. Characteristics of treatment results in children from 2 months to 5 years old with pneumonia

Table 2. Results of the treatment (n=174)

Variable	Frequency (n)	Percentage (%)
Antibiotic combination	49	28.2
Antibiotics changing	55	31.6
Transfer to Intensive Care Unit	12	6.9
Respiratory support	33	19.0
Result of treatment: death	3	1.7

The percentage of children needing combination antibiotics was 28.2% and 31.6%, respectively. Transfer to the Intensive Care Unit accounts for 6.9%, and requiring respiratory support accounts for 19.0%. As a result of treatment, death accounts for 1.7%.

3.4. The correlation between acute malnutrition and some results of pneumonia treatment in children from 2 months to 5 years old

Table 3. Relation between acute malnutrition and severity of pneumonia and antibiotic combination

Study group	Severity of pneumonia		Antibiotic combination	
	Severe n (%)	No n (%)	Yes n (%)	No n (%)
Disease group	43 (49.4)	44 (50.6)	35 (40.2)	43 (49.4)
Control group	22 (25.3)	65 (74.4)	14 (16.1)	22 (25.3)
OR (95%CI)	2.89 (1.52-5.46)		3,51 (1.72-7.17)	
p	<0.001*		<0.001*	

* χ2 Test

The level of severe malnutrition in the acute malnutrition group with pneumonia was 49.4%, higher than the non-acute malnutrition group with pneumonia, which was 25.3%; this difference was statistically significant (p<0.001). The rate of antibiotic combination in the acute malnutrition group with pneumonia was 40.2%, higher than the group without acute malnutrition with pneumonia, which was 16.1%; this difference was statistically significant (p<0.001).

Table 4. Association between acute malnutrition and changing antibiotics and respiratory support

Study group	Changing antibiotics		Respiratory support	
	Yes n (%)	No n (%)	Yes n (%)	No n (%)
Disease group	29 (33.3)	58 (66.7)	23 (26.4)	64 (73.6)
Control group	26 (29.9)	61 (70.1)	10 (11.5)	77 (88.5)
OR (95% CI)	1.17 (0.69-2.22)		2.76 (1.23-6.24)	
p	0.625*		0.012*	

* χ2 Test

The rate of needing to change antibiotics in the disease group was 33.3%, higher than the control group with pneumonia, which was 29.9%; the difference was not

statistically significant (p=0.625). 26.4% of the disease group required higher respiratory support than the control group, 11.5%, and this difference was statistically significant (p=0.012)

Table 5. Association between acute malnutrition and transfer to the Intensive Care Unit and treatment results

Researchers	Transfer to the Intensive Care Unit		Results of the treatment	
	Yes n (%)	No n (%)	Death n (%)	Recuperate n (%)
Disease group	10 (11.5)	77 (88.5)	2 (2.3)	85 (97.7)
Control group	2 (2.3)	85 (97.7)	1 (1.1)	86 (98.9)
OR (95% CI)	**5.51 (1.17-25.98)**		2.02 (0.18-22.73)	
p	**0.017***		0.560**	

* $\chi 2$ Test, ** Fisher's Exact Test

The rate of transfer to the Intensive Care Unit in the disease group was 11.5%, higher than the control group, which was 2.3%, and the difference was statistically significant (p=0.017). The mortality rate in the acute malnutrition group with pneumonia was 2.3%, higher than the non-acute malnutrition group with pneumonia, which was 1.1%; however, this difference was not statistically significant (p=0.560).

IV. DISCUSSION

4.1. Research object characteristics

In terms of gender, girls comprise 62.1%, and boys account for 37.9%. These findings diverge significantly from the research conducted by Lu Tri Dien (2023), where men constituted 61.1% and women accounted for 38.9% [8]. Regarding age groups, 39.7% of the participants fell within the 2-<12 months category, while 60.3% belonged to the 12-60 months age group. Our study exhibits a notable resemblance to the findings of Vo Minh Tan, who reported that malnourished children with pneumonia aged 2-<12 months accounted for 27.7%, and those aged 12-60 months in the year 2018 accounted for 72.3% [9]. Lu Tri Dien's study (2023) demonstrated that 25% of the participants belonged to the 2-<12 months age group, whereas 75% fell within the 12-60 months age group [8].

4.2. Severity of pneumonia

In 174 cases of pneumonia in children in our study, the rates of pneumonia and severe pneumonia were 62.6% and 37.4%, respectively. The results of our study are higher than those of other studies. This rate is higher than that of Vo Minh Tan (2018). Severe pneumonia accounts for 17%, and pneumonia is 83% [8]. Susila INW (2021) recorded 26.8% of severe pneumonia and 73.2% of v and lower than the study of Kharisma DS (2022) [10]. Kharisma's study showed that severe pneumonia was 73.5%, mild pneumonia was 26.5% [11]. This difference may be due to different geographical studies as well as different time of year conditions.

4.3. Characteristics of treatment results in children from 2 months to 5 years old with pneumonia

Our study documented that 28.2% of children required combination antibiotics, and 31.6% needed the antibiotics changed. These findings bear a resemblance to the observations made by Lu Tri Dien, who reported that out of 87 studied children, 35 (40.2%) required combination antibiotics, and 29.9% needed to change antibiotics [8]. These results indicate that pneumonia in acute malnutrition children often exhibits a high degree of

antibiotic resistance, necessitating aggressive and potent antibiotic treatment from the onset. Furthermore, we noted that 6.9% of children were transferred to the Intensive Care Unit and 19.0% required respiratory support. Our study reported lower percentages compared to Lu Tri Dien's research, which found that 11.5% were required to transfer to the Intensive Care Unit for treatment, and 26.4% needed respiratory support [8]. Consequently, treating pneumonia in acute malnutrition children incurs higher costs and places an increased burden on families and society. In terms of treatment results, we also recorded a mortality rate of 1.7% among the children. These findings align with the study conducted by Vo Minh Tan, which reported a relatively high rate of 2.2% of children developing severe illness and succumbing to the disease.

4.4. The correlation between acute malnutrition and some results of pneumonia treatment in children from 2 months to 5 years old

Our research reveals that 49.4% of children with acute malnutrition experience severe pneumonia, a higher percentage compared to 25.3% of children without malnutrition. This difference is statistically significant, with an odds ratio (OR) of 2.89, a 95% confidence interval (CI) of 1.52-5.46, and a p-value of less than 0.001. This finding aligns with the study conducted by Nguyen Dinh Tuyen (2021), which also demonstrates a statistically significant association between acute malnutrition and the severity of pneumonia [12]. Similarly, Susila INW (2021) observed that the group of acute malnutrition children with severe pneumonia accounted for 54.5%, which was 3.27 times higher than the group of non-acute malnutrition children with severe pneumonia, at 16.7%. This difference was statistically significant (OR=3.27; 95% CI=1.25-8.59; p=0.015) [10]. Overall, acute malnutrition contributes to the severity of pneumonia in several ways. In children with acute malnutrition, the ability to regenerate the respiratory epithelium is impaired, making them more susceptible to pneumonia and increasing its severity [13]. Therefore, it is essential to prioritize and provide dedicated attention to the treatment of malnourished children.

The prevalence of antibiotic combination usage in the disease group is 40.2%, which is higher than the control group at 16.1%. This disparity is statistically significant, with an odds ratio (OR) of 3.51, a 95% confidence interval (CI) of 1.72-7.17, and a p-value of less than 0.001. Our findings closely resemble with the study conducted by Lu Tri Dien, where the rate of antibiotic combination in the severe acute malnutrition group with pneumonia was 54.5%, higher than the moderate acute malnutrition group with pneumonia at 35.4%. This difference, nevertheless, was not statistically significant [8].

The proportion of patients requiring a change in antibiotics within the acute malnutrition group with pneumonia is 33.3%, slightly higher than the group without acute malnutrition with pneumonia at 29.9%. However, this difference is not statistically significant, as indicated by an odds ratio (OR) of 1.17, a 95% confidence interval (CI) of 0.69-2.22, and a p-value of less than 0.625. Our findings closely resemble the research conducted by Lu Tri Dien, where the rate of antibiotic change in the severe acute malnutrition group with pneumonia was 50%, higher than the moderate acute malnutrition group with pneumonia at 23.1%. In this case, the difference between the two groups is statistically significant [8]. A total of 26.4% of acute malnutrition children with pneumonia required a higher level of respiratory support compared to 11.5% in the group without acute malnutrition with pneumonia. This difference was found to be statistically significant, with an odds ratio (OR) of 2.76, a 95% confidence interval (CI) of 1.23-6.24, and a p-value of

0.012. Our study closely aligns with the findings of Lu Tri Dien, who reported a rate of 59.1% for respiratory support in the severe acute malnutrition group with pneumonia, which was higher than the rate of 15.4% in the moderate acute malnutrition group with pneumonia. Additionally, the difference between the two groups was statistically significant [8]. The proportion of patients transferred to the Intensive Care Unit within the acute malnutrition group with pneumonia was 11.5%, which was higher than the non-acute malnutrition group with pneumonia at 2.3%. This difference was found to be statistically significant, with an odds ratio (OR) of 5.51, a 95% confidence interval (CI) of 1.17-25.98, and a p-value of 0.017. However, our research differs from that of Lu Tri Dien, who reported a transfer rate of 31.8% to the intensive care unit in the severe acute malnutrition group with pneumonia, compared to 4.6% in the moderate acute malnutrition group with pneumonia. Furthermore, the difference between the two groups was statistically significant [8].

In terms of treatment results, the mortality rate in the acute malnutrition group with pneumonia was 2.3%, slightly higher than the non-acute malnutrition group with at 1.1%. However, this difference was not statistically significant, as indicated by an odds ratio (OR) of 2.02, a 95% confidence interval (CI) of 0.18-22.73, and a p-value of 0.560. These findings are similar to the study conducted by Vo Minh Tan, which reported a cure rate of 97.8% with no complications. It was observed that children with severe VAP had longer treatment duration and antibiotic usage compared to children with pneumonia, but this difference was not statistically significant (p>0.05) [9]. The research subjects in this study were children with severe pneumonia, respiratory failure, and heart defects, which may account for the lower treatment success rate and longer treatment duration.

V. CONCLUSION

Malnutrition demonstrates a statistically significant association with the severity of pneumonia, the need for antibiotic combination, respiratory support, and transfer to the Intensive Care Unit . However, there is no significant correlation between acute malnutrition and the need to change antibiotics or treatment results.

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