# AN EVALUATION OF HYPOALBUMINEMIA
# AND IRON DEFICIENCY ANEMIA IN CHILDREN
# AGED FROM 2 MONTHS TO UNDER 5 YEARS OLD WITH PNEUMONIA

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**ABSTRACT**

*Background: Pneumonia is a potentially fatal disease that greatly compromises the health of children. Utilizing laboratory tests is extremely beneficial in the diagnosis, monitoring, and prognosis determination of the condition. In the realm of pediatric pneumonia, effective diagnostic procedures include assessments for albumin levels and iron deficiency anemia. Objectives: (1) Determine the proportions of hypoalbuminemia and iron deficiency anemia in children aged from 2 months to under 5 years old with pneumonia at Ca Mau Obstetrics and Pediatrics Hospital in 2022-2023 (2) Evaluate the association between hypoalbuminemia, iron deficiency anemia and pneumonia in children aged from 2 months to under 5 years old at Ca Mau Obstetrics and Pediatrics Hospital in 2022-2023. Materials and methods: a cross-sectional descriptive study on 177 pediatric patients from 2 months to under 5 years old who were diagnosed with pneumonia and received inpatient treatment at Ca Mau Obstetrics and Pediatrics Hospital during the research period. Results: The percentage of patients aged 2 months to 2 years was 59.9%, which was more than the percentage of patients aged 2 years to 5 years, which was 40.1%. The average age was 22.5±15.82 months old. The male patients constituted 56.5% of the total, whilst the female patients with pneumonia accounted for 43.5%. Children with pneumonia made up 88.1% of the patient population; children with severe pneumonia made up 11.9% of the patient population. The average albumin concentration was 38.47±2.39g/L. The proportion of hypoalbuminemia was 26% and the proportion of iron deficiency anemia was 41.8%. Children with iron deficiency anemia had a higher rate of severe pneumonia (20.3%) than those without (5.8%). Compared to 2.9% of children without iron deficiency anemia, 12.2% of those with the condition required more than two antibiotics to treat pneumonia. Conclusion: When hypoalbuminemia is present, the severity of pneumonia is significantly increased. Inadequate iron levels cause anemia, which worsens pediatric pneumonia and necessitates supplementary antibiotic therapy.*

*Keywords: pneumonia, hypoalbuminemia, iron deficiency anemia, children.*

## I. INTRODUCTION

Pneumonia is a highly lethal illness that significantly impairs the health of children [1]. Albumin in the blood is a crucial indicator for determining the nutritional status and liver function of a child [2]. It had been demonstrated that decreased serum albumin and anemia due to iron deficiency affect the prognosis of respiratory infections and inflammatory diseases [3], [4], [5]. Nevertheless, the existing study on hypoalbuminemia in pneumonia among children under the age of five, particularly at Ca Mau Obstetrics and Pediatrics hospital, was restricted. We conducted a study to examine the impact of hypoalbuminemia and iron deficiency anemia on pneumonia in children, with the aim of

enhancing our comprehension of this topic. Objectives of the research:

1. Determine the proportions of hypoalbuminemia and iron deficiency anemia in children aged from 2 months to under 5 years old with pneumonia at Ca Mau Obstetrics and Pediatrics Hospital in 2022-2023

2. Evaluate the association between hypoalbuminemia, iron deficiency anemia and pneumonia in children aged from 2 months to under 5 years old at Ca Mau Obstetrics and Pediatrics Hospital in 2022-2023

## II. MATERIALS AND METHODS

**2.1. Research subjects.** During the research period, all pediatric patients aged 2 months to less than 5 years who were diagnosed with pneumonia were admitted to Ca Mau Obstetrics and Pediatrics Hospital for treatment.

**Patient selection criteria** [6]

All children from 2 months to under 5 years old were diagnosed with pneumonia.

The diagnosis of pneumonia was based on the WHO diagnostic criteria for pneumonia in children under 5 years old. Children had symptoms including:

Child had cough and/or difficulty breathing and/or fever.

Accompanied by rapid breathing or chest indrawing

Tachypnea compared to age according to the WHO

Ages from 2 months to <12 months: ≥50 beats/minute.

Ages from 12 months to 60 months: ≥40 beats/minute.

Or small moist rales, whistling rales or snoring rales in the lungs with examination

Or cardiopulmonary X-ray: showed pneumonia.

**Patient exclusion criteria**

Children with diseases that caused albumin reduction, chronic diseases such as tuberculosis, liver and kidney diseases, birth defects (bronchopulmonary dysplasia, pulmonary hypoplasia, etc...), nephrotic syndrome,...

Other causes of anemia and/or low iron stores

**Location and time of research:** the research was done at the respiratory department of Ca Mau Obstetrics and Pediatrics Hospital, from November 2022 to May 2023.

**2.2. Research methods**

**Research design:** cross-sectional descriptive study.

**Sample size and sample selection**

With convenience sampling method, the sample size was calculated by formula to estimate a proportion $n = Z^2_{(1-\frac{\alpha}{2})} \frac{p(1-p)}{d^2}$

n: minimum required research sample size;

Z: confidence coefficient at 95% probability level (α=0.05) corresponding to Z=1.96;

d: is the acceptable error. We choose d=0.07.

p: is the proportion of patients with hypoalbuminemia in children in the study of María Elena Álvarez Andrade et al at Dr. Ángel Arturo Aballí Hospital, p=67.4% [7].

Applying the formula, the sample size after calculation was 177 patients.

**Research content**s

General characteristics of research subjects: gender, age group, average age.

Hypoalbuminemia:<37g/L;

Iron deficiency anemia:

6 months and older: Hb <110g/dL;

2 months: Hb <9.4g/dL;

3-5 months: Hb <10.3g/dL.

And at least 3 of the test symptoms:

(1) Hypochromic anemia and small red blood cell size when observed on glass slide;

(2) Mean Corpuscular Volume-MCV<80fL;

(3) Red cell Distribution Width-RDW>14.5

(4) MCV/ small red blood cell>13.5

(5) Transferrin saturation <15%.

The relationship of hypoalbuminemia and iron deficiency anemia with pneumonia

**Data processing method:** using SPSS 20.0 statistical software.

**2.3. Institutional Review Board Statement:** The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of Can Tho University of Medicine and Pharmacy for studies involving humans (number: 2.122.HV/PCT.HĐĐĐ).

# III. RESULTS

## 3.1. General characteristics of research subjects

Table 1. General characteristics of research subjects

| Characteristics | | n | % |
|---|---|---|---|
| Age<br>Average: 22.5±15.82 months | 2 months - 2 years | 106 | 59.9 |
| | 2 years to 5 years | 71 | 40.1 |
| Gender | Male | 100 | 56.5 |
| | Female | 77 | 43.5 |
| Severity of pneumonia | Pneumonia | 156 | 88.1 |
| | severe pneumonia | 21 | 11.9 |

The majority of patients belong to the group of 2 months - 2 years (59.9%). The proportions of male and female patients were 56.5% and 43.5%. The percentage of patients with severe pneumonia was 11.9%.

## 3.2. The proportions of hypoalbuminemia and iron deficiency anemia in children aged from 2 months to under 5 years old with pneumonia

26% of patients had hypoalbuminemia..

Hypoalbuminemia was seen in 28.3% of children aged 2 months to 1 year, and in 25% of children aged 1 to less than 5 years. The proportion of hypoalbuminemia was 34% in males and 15.6% in females.

Iron deficiency anemia was responsible for 41.8% of the cases in children.

## 3.3. The association between hypoalbuminemia, iron deficiency anemia and pneumonia in children aged from 2 months to under 5 years old

Table 2. The association between hypoalbuminemia and the severity of pneumonia

| Hypoalbuminemia | Severity of pneumonia | | Total | p |
|---|---|---|---|---|
| | Severe | Pneumonia | | |
| Yes | 10 (21.7%) | 36 (78.3%) | 46 (100%) | 0.016 |
| No | 11 (8.4%) | 120 (91.6%) | 131 (100%) | |

In the group of children with hypoalbuminemia, the percentage of severe pneumonia was 21.7%, higher than the group of children without hypoalbuminemia (8.4%).

Table 3. The association between hypoalbuminemia and the number of antibiotics used to treat pneumonia

| Hypoalbuminemia | Number of antibiotics | | Total | p |
|---|---|---|---|---|
| | ≥2 types | 1 type | | |
| Yes | 6 (13%) | 40 (87%) | 46 (100%) | 0.081 |
| No | 6 (4.6%) | 125 (95.4%) | 131 (100%) | |

In the group of children with hypoalbuminemia, the percentage of children using more than 2 types of antibiotics was 13%, the rate in the group of children without hypoalbuminemia was 4.6%.

Table 4. The association between iron deficiency anemia and the severity of pneumonia

| Iron deficiency anemia | Severity of pneumonia | | Total | p |
|---|---|---|---|---|
| | Severe pneumonia | Pneumonia | | |
| Yes | 15 (20.3%) | 59 (79.7%) | 74 (100%) | 0.003 |
| No | 6 (5.8%) | 97 (94.2%) | 103 (100%) | |

Severe pneumonia was more prevalent in the group of children with iron deficiency anemia (20.3%) compared to the group of children without iron deficiency anemia (5.8%).

Table 5. The association between iron deficiency anemia and the number of antibiotics used to treat pneumonia.

| Iron deficiency anemia | Number of antibiotics | | Total | p |
|---|---|---|---|---|
| | ≥2 types | 1 type | | |
| Yes | 9 (12.2%) | 65 (87.8%) | 74 (100%) | 0.016 |
| No | 3 (2.9%) | 100 (97.1%) | 103 (100%) | |

The proportion of children in the group with iron deficiency anemia who used more than two types of antibiotics to treat pneumonia was 12.2%, which was significantly higher than the proportion of children in the group without iron deficiency anemia (2.9%).

# IV. DISCUSSION

## 4.1. General characteristics of research subjects

### Gender

Based on the findings of our investigation, the proportion of pneumonia among pediatric patients was 43.5% for females and 56.5% for males. This result was comparable to that of a study conducted in 2017 at Saint Paul General Hospital by Nguyen Thi Hong Nhan and Nguyen Van Long, in which boys comprised 56.94% and girls comprised 43.06% [8]. Similar findings were reported in 2019 by Nguyen Duc Tri of Can Tho City Children's Hospital regarding 188 hospitalized children with pneumonia; males comprised 57.4% (108 cases) and females comprised 42.6% [9]. The author of a 2020 study on community-acquired pneumonia in children conducted by Nguyen Thi Ha et al at the International Department of National Children's Hospital observed that male children comprised a greater proportion (44.0%) than female children (56.0% versus 44.0%) [10].

### Age group

The two months and two years age group comprised the majority of the patients with 59.9%. This result was comparable to that of lvarez AME and colleagues (69.7%) in their study. Consistent with the findings of Nguyen Thi Ha et al., the majority of children afflicted with community-acquired pneumonia were under the age of two [10]. As opposed to the 47.3% found in the study by Nguyen Duc Tri and colleagues [9]. The mean age of the

participants in our study was 21.75 ± 15.59 months. This result was comparable to that of Nguyen Thi Hong Nhan et al.'s study (2.15±1.92 years old), and the preponderance of infants and toddlers with pneumonia were younger than 2 years old [8]. This age group was particularly vulnerable to respiratory diseases as a result of factors including the child's developing immune system, direct contact with others, and the practice of gnawing and suckling on objects. Variations in rates across studies could potentially be attributed to factors such as the sampling technique employed and the demographic attributes of the respective geographic regions.

The majority of pediatric patients with pneumonia was 88.1%, and the percentage of pediatric patients with severe pneumonia was 11.9%.

**4.2. The proportions of hypoalbuminemia and iron deficiency anemia in children aged from 2 months to under 5 years old with pneumonia**

According to the findings of our research, 26% of the patients who presented with pneumonia had hypoalbuminemia. With a prevalence of 67.4%, our results were unquestionably inferior to those documented in the study by Mara Elena Álvarez Andrade and colleagues. In our study, the proportion of hypoalbuminemia was 25% in children under the age of five and 28.3 percent in children ages two months to one year. The rate of decrease in albumin concentration in the blood was inversely correlated with age, according to research published in 2021 by Lumin Chen and colleagues [3]. In our study, the proportion of hypoalbuminemia was 34% in males and 15.6% in females. Meanwhile, Yavuz Otal et al [11] found no statistically significant distinction between the sexes in the two categories.

In our study, 41.8% of children with pneumonia were diagnosed with iron deficiency anemia. Iron deficiency anemia accounted for 41.5% of children aged 2 months to 1 year old and 41.9% of children aged 1 to under 5 years old. Iron deficiency anemia affected 41% of male children and 42.9% of female children. According to research conducted by Nguyen Dinh Chung, 54.6% of children with pneumonia had anemia [12].

**4.3. The association between hypoalbuminemia, iron deficiency anemia and pneumonia in children aged from 2 months to under 5 years old**

Hypoalbuminemia worsens the severity of pneumonia. A higher proportion of severe pneumonia was observed in the group of children with hypoalbuminemia (21.7% vs. 8.4% in the group of children without hypoalbuminemia), according to our findings. Hypoalbuminemia is one of the factors in determining the prognosis and course of a disease. In hospitalized patients, the presence of hypoalbuminemia was a predictor of morbidity and mortality [2]. The study conducted by Jae Hyuk Lee et al observed a statistically significant difference in albumin concentrations between the cohort of patients diagnosed with pneumonia and the control group [13]. According to Lumin Chen's research findings, patients diagnosed with severe pneumonia experienced a greater reduction in albumin by 10.87% compared to the non-severe pneumonia group, which experienced a decrease of 2.79% [3]. In the group of children with hypoalbuminemia, the rate of children using more than two types of antibiotics was 13%, the rate in the group of children without hypoalbuminemia was 4.6%. Decreased blood albumin levels were identified by Meganathan P and colleagues as a risk factor for severe pneumonia complications [14]. Thus, hypoalbuminemia worsens the severity of pneumonia, thereby leading to more antibiotic use.

Severe pneumonia occurred at a higher rate of 20.3% in the group of children with pneumonia and iron deficiency anemia in our study, compared to 5.8% in the group of children

with pneumonia without iron deficiency anemia (p<0.05). In the study of Nguyen Dinh Chung, the severity of pneumonia in the group of severe pneumonia patients had a higher proportion of iron deficiency anemia (19.4%) compared to the pneumonia group (14%) [12].

The results of our study indicated that among children diagnosed with pneumonia and iron deficiency anemia, 12.2% of the children utilized two or more types of antibiotics to treat pneumonia. This rate was significantly higher compared to the group of children with pneumonia who did not have iron deficiency anemia. 2.9% had iron-deficiency anemia. A statistically significant difference (p<0.05) exists. Author Nguyen Dinh Chung asserted that the presence of iron deficiency anemia worsened the severity of pneumonia, resulting in a greater need for antibiotics. Similarly, I-Fan Chang et al., reached the conclusion that iron deficiency anemia significantly influenced the prognosis of pneumonia [12], [15].

## V. CONCLUSION

The majority of patients admitted to Ca Mau Obstetrics and Children's Hospital with pediatric pneumonia were under the age of two. The proportion of male patients with hypoalbuminemia is higher than in female patients.

The proportion of patients having severe pneumonia with hypoalbuminemia was higher than that of patients without hypoalbuminemia. The proportion of patients having severe pneumonia with iron deficiency anemia was higher than that of patients without hypoalbuminemia. The proportion of patients requiring antibiotic combination when having iron deficiency anemia was higher than in the group without iron deficiency anemia.

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