Original Research

MALNUTRITION IN PEDIATRIC PATIENTS WITH LOW RESPIRATORY TRACT INFECTIOINS AT NATIONAL LUNG HOSPITAL, VIETNAM

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ABSTRACT

Aims: To determine the nutritional status and the dietary intake of inpatient children with lower respiratory infections.

Methods: This cross-sectional study was conducted in 106 children aged under 5 years admitted to the Pediatric Department of the National Lung Hospital in Hanoi, Vietnam, from August to December 2018. Body weight, height/length were measured; nutritional status was evaluated by using World Health Organization criteria and Subjective Global Assessment (SGA). Dietary intake was daily recorded during the first week of hospitalization.

Results: The prevalence of malnutrition was 30.1%, 25.7%, and 17.8% respectively for underweight, stunting and wasting. According to the SGA, 20% of the patients were at risk for malnutrition. From the first day to seventh day of hospitalization, the rate of chidlren given 100% of requirement had a fluctuating upward trend from 30% to 40% in energy intake and from 66% to 84% in protein intake; the rates of energy intake under 80% of requirement were from 31% to 54% in patients, while the rates of protein intake over 1.5-fold requirement were from 37% to 50% in patients.

Conclusions: The study indicated the alarmingly high prevalence of malnutrition in children aged under 5 years and the contrast between under energy intake and over protein intake in the hospitalized children.

Keywords: *lower tract respiratory infection, pediatric patients, SGA, malnutrition, dietary intake*

I. INTRODUCTION

Pneumonia and malnutrition are the most frequent causes of mortality in children in developing countries, including Vietnam [1]. The pathological spiral between infection and childhood malnutrition is well known. Malnutrition causes decreased immunity and food consumption, increasing the frequency of infections, while bacterial infections increase nutritional requirements and catabolic status [2]. As a result, children are more severely malnourished and more susceptible to infections [3, 4].

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Moreover, the children's alveoli continue to develop from birth through adolescence [5, 6]. Therefore, malnutrition affects the formation and development of alveoli in children [6].

Studies have shown that hospitalized children with lower respiratory infections and tuberculosis are often associated with malnutrition [7]. The rate of malnourished children in hospitals is high in Vietnam [8,9]. In addition, hospitalized children often only maintain nutritional status or they may lose weight, which increases their risk of malnutrition. The Pediatric department of National Lung hospital (NLH) is the last stream treatment for TB and other respiratory infection in pediatric patients in Northern area of Vietnam, but no such above data have been reported. In order to improve the health status of hospitalized children, the study was conducted to determine the nutritional status and the dietary intake of inpatient children with lower respiratory infections.

II. METHODS

2.1. Subjects and study design

This cross-sectional study included pediatric patients younger than 60 months admitted to the National Lung Hospital (NLH) with a diagnosis of lower respiratory disease from August to December 2018.

Children with hemodynamic instability or with birth defects and congenital malformations or those whose caregivers had mental disorders or intellectual disabilities, or who were indirectly taking care of children prior to their hospitalization were excluded.

Among the 106 surveyed children, there were 3 children whose body weight could not be measured and 5 whose body height/weight could not be measured accurately due to their fussiness. Therefore, their measurements were excluded from data analysis.

The study was approved by the Human Research Ethics Committee of the National Institute of Nutrition Vietnam, conforming to the provisions of the Declaration of Helsinki in 1995, as revised in Edinburgh in 2000.

2.2.Data collection

Within 24 hours of admission to the Pediatrics ward, the enrolled patients' caregivers were asked to sign the informed consent form for participating in the study. Then we obtained general information and conducted a subjective global assessment (SGA) as described in our previous study [10, 11].

Early the next morning, information on anthropometric measures was collected. Information on the previous 24 hours' diet was collected every day by trained investigators, from the time the child was admitted to the pediatrics ward until 7th day of hospitalization.

Each child's age was calculated according to the guidelines of the World Health Organization (WHO), in which age is calculated by the year of completion (full 12 months) and the complete month since birth. For preterm children (up to 24 months), adjusted age was calculated by actual age minus months of preterm.

Anthropometric measurements

Body weight was measured early in the morning using an electronic scale (LAICA S.P.A., Italy) with a precision of 100g. Body length/height was

measured using a stadiometer with a precision of 1 mm.

Nutritional status was evaluated by using WHO standards 2006 [12], WHO Anthro software version 3.2.2 [13]. The assessment of nutritional status included 3 indicators: weight-for-age z-score (WAZ), height-for-age z-score (HAZ) or length-for-age z-score (LAZ), weight-for-height z-scores (WHZ) or weight-for-length z-scores (WLZ). LAZ and WLZ were used for children aged under 24 months; HAZ and WHZ were used for children aged 2-5 years. Acute malnutrition was defined as wasting (or underweight based on age with severity as a degree of thinness) while chronic malnutrition was defined as stunting (shortness) or obesity (over-nutrition). Wasting was classified when WHZ or WLZ < –2SD. Stunting was classified when HAZ or LAZ < –2SD. Underweight was classified when WAZ < –2SD. Overweight was identified when WHZ or WLZ > +1SD.

Gastrointestinal (GI) symptoms including nausea, vomiting, diarrhea, and anorexia were recored.

2.3.Subjective global assessment

The SGA tool was evaluated by using (AFINS) guideline. The tool included two major components: (1) a history of weight loss (or not gaining enough weight), changes in dietary intake, GI symptoms, functional capacity, and metabolic demand associated with the underlying disease; and (2) a physical examination focused on the detection of muscle wasting, a loss of subcutaneous fat, and the presence of edema. Each patient was classified as either (A) well-nourished, (B) moderately (or suspected of being) malnourished, or (C) severely malnourished [14].

2.4. Dietary intake: oral, tube feedings

Caregivers were interviewed about food the patient consumed using the traditional 24-hour recall method [15]. The dietary intake of each patient was collected continuously for the first seven days, including that which was prepared by the hospital kitchen and food brought into the hospital by family members. Data on 24-hour dietary intake were analyzed using the dietary analysis software of the Vietnam NIN, based on Vietnamese food composition tables [16]. Estimates were made for the amount that a child may have been breastfed, with references on protein and energy requirements using guidelines for breastfeeding estimation based on the nutritional requirements for the Vietnamese population [17].

There was no pediatric patient given parenteral nutrition during hospitalization.

2.5.Statistical analysis

Data were analyzed by using the SPSS. 16 software. As values of z-scores and dietary energy and protein intake were not normal distributied, the data on were expresed as median (interquartile range, IQR) and compared using Mann Whitney U test of Wilcoxon Signed Ranks test. Categorical variables were presented as number (%) and compared using Chi-square test of Fisher's Exact test when appropriate.

III. RESULTS

3.1. Demographic data

Among the 106 children selected for the study, 66% were male and 77.4% were older than 12 months. The prevalence of children with acute tuberculosis

pneumonia was 50.9% (Table 1). Most children (81.1%) required normal care; no children required special nursing care.

Table 1. *The characteristics of the pediatric subjects at National Lung Hospital*

Age group	*n* (%)	.	Admitting diagnosis	*n* (%)
< 6 months	8 (7.5)		Non-tuberculosis pneumonia	40 (37.7)
6 - 12 months	16 (15.1)		Acute tuberculosis pneumonia	54 (50.9)
13 - 24 months	48 (45.3)		Others lower tract respiratory infection	12 (11.3)
25 - 60 months	34 (32.1)			

3.2. Nutritional status among pediatric patients

Table 2. *The nutritional indices of the pediatric patients*

Classification	Total	<24 months (*n*=55)	24-59 months (*n*=46)	*p-value by Mann-Whitney U test*
WAZ	2.0 (2.0; 3.0)	2.0 (2.0; 3.0)	2.5 (2.0; 3.0)	0.300
HAZ	2.0 (1.0; 3.0)	2.0 (1.0; 3.0)	2.0 (1.0; 3.0)	0.873
WHZ	2.0 (1.0; 3.0)	2.0 (1.0; 3.0)	1.8 (1.0; 4.0)	0.287
BAZ	2.0 (1.0; 3.0)	2.0 (1.0; 3.0)	2.0 (1.0; 3.3)	0.479

WAZ: weight-for-age z-score; HAZ/LAZ: height-for-age/length-for-age z-score; WLZ: weight-for-length z-score; BMIZ: body mass index z-score

Table 2 shows that the nutritional indices (WAZ, HAZ, WHZ, and BAZ) of patients were not significantly different between two age groups (p>0.05).

Figure 1 shows prevalence of pediatric malnutrition in National Lung Hospital. Of the total 99 children, the prevalences of underweight, stunting, and wasting were 30.1, 25.7, and 17.8%, respectively; and the rate of BMI for age < -2SD was 16.8%. There was no difference in malnutrition prevalence between the children with tuberculosis and the others with common respiratory infections.

In 33 cases with discharge weight, a median (interquatile) of weight loss was 0.2 (0.0–0.7) kg in the pre-discharge time compared to the admitted time (p = 0.001, Wilcoxon Signed Ranks test).

Using the SGA, 75.5% had SGA level A; 24.5 % had level B; and no one had level C. Of all children with tuberculosis (n = 54), 24.1% were at risk of malnutrition (SGA-B), and the rest were assessed at SGA-A.

A classification of weight and dietary history showed children gaining weight appropriately according to their age (45.3%), having no weight gain or weight loss in the past 6 months (43.4%), and maintaining their weight over the previous 2 weeks (no gain or loss [45.3%]); it also showed that 10.4% of children lost > 5% of their body weight in the past 4 months and that nearly one-third (27.4%) continued to lose weight for 2 weeks prior to admission.

In terms of diet, more than one-third of the children (34.9%) had a mild deficiency (< 25% of nutrition requirement) and lacked > 25% of their nutritional needs for more than 2 weeks.

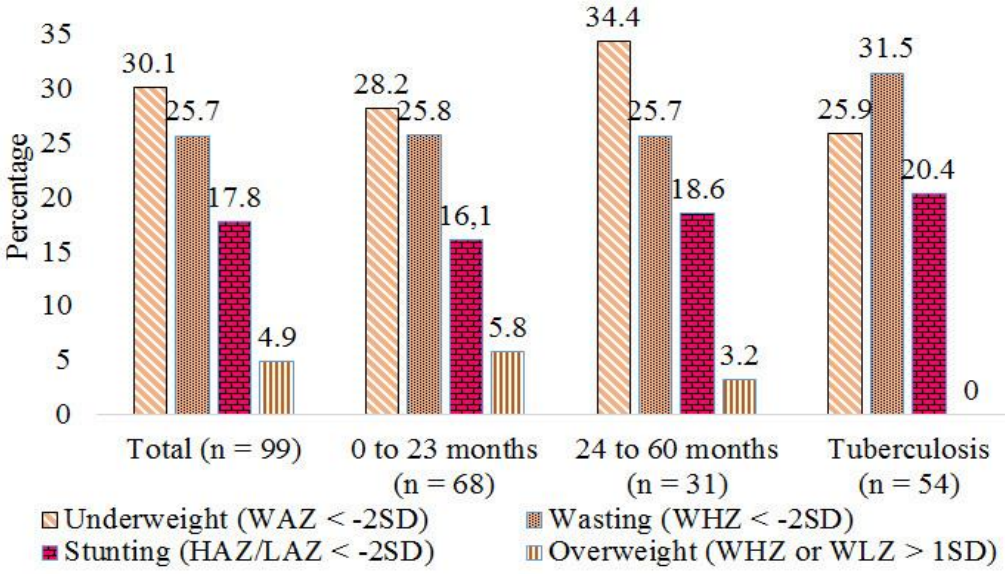

Figure 1. *Prevalence of pediatric malnutrition in National Lung Hospital.*

Gastrointestinal symptoms

Most children had no signs of gastrointestinal symptoms (84.9%). Some had nausea (6.6%), vomiting (9.4%), diarrhea (9.4%), and/or anorexia (15.1%). Most symptoms appeared within 2 to 3 days prior to their admission (77.4%); 18.9% of their caregivers reported symptoms lasted less than two weeks, while only 3.7% of the children had symptoms lasting for more than two weeks.

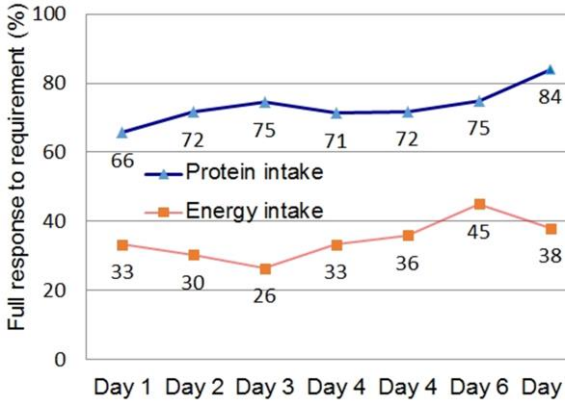

Figure 2. *Rate of full response to requirement of energy and protein intake*

Functional status

Most children had no sign of decrease in their functional status related to nutrition (93.4%) and 89.6% were without metabolic stress in terms of the SGA assessment. Of all the children, 20.8% lost subcutaneous fat and 9.4% had signs of muscle loss. No child had malnutrition edema/ascites.

Dietary intake during hospitalization

Figure 2 shows the percentage of full response to requirement of energy and protein intake during the first 7-day hospitalizaion. The rate of chidlren given 100% of requirement had a fluctuating upward trend from 30% to 40% in energy intake and from 66% to 84% in protein intake.

Table 3 shows the difference between requirement and dietary intake of energy and protein from the first day to the seventh day of hospitalization. In comparision to the requirement, median of energy intake had negative values (min: –200 kcal in the first day; max: –200 kcal in the seventh day) while median of protein intake had positive values (min: +3.2g in the first day; max:

+8.9g in the seventh day). The dietary energy intake slightly increased from the first day to the seventh day; and no significant difference of energy intake was found in the 6th and 7th day as compared with requierment. From the first day to the seventh day of hospitalization, the rates of energy intake under 80% of requirement were from 31% to 54% in patients, while the rates of protein intake over 1.5-fold requirement were from 37% to 50% in patients.

The significantly higher values of energy and dietary protein intake was found in tuberculosis groups compared to the common pneumonia group ($p < 0.05$) (Figure 3).

More visuable details in energy and protein intake of pediatric patients are shown in Figure 4 and Figure 5, including densityplots per day on intake values per day, difference from requirement and response to requirement. The weakly increased trend of energy and protein intake was found from the first day to the seventh day. The under energy intake and over protein intake were recognised.

Table 3. *Difference between requirement and dietary intake of energy and protein from the first to the seventh day of hospitalization*

Day	*n*	Energy (kcal)		Protein (gram)	
		Median (interquartile range)	*p-value*	Median (interquartile range)	*p-value*
Day 1	105	-200 (-442; 49)	0.000	3.2 (-3.4; 11.4)	0.000
Day 2	106	-110 (-366; 41)	0.000	4.3 (-0.5; 12.8)	0.000
Day 3	106	-132 (-327; 18)	0.000	5.4 (-0.3; 14.4)	0.000
Day 4	87	-120 (-269; 109)	0.006	7.4 (-1.0; 17.1)	0.000
Day 5	78	-61 (-251; 55)	0.002	7.0 (-0.8; 15.9	0.000
Day 6	60	-75 (-327; 232)	0.335	5.2 (-0.3; 19.6)	0.000
Day 7	50	-38 (-270; 120)	0.181	8.9 (+2.5; 19.1)	0.000

p-value by Wilcoxon Signed Ranks test compared with energy or protein requirement.

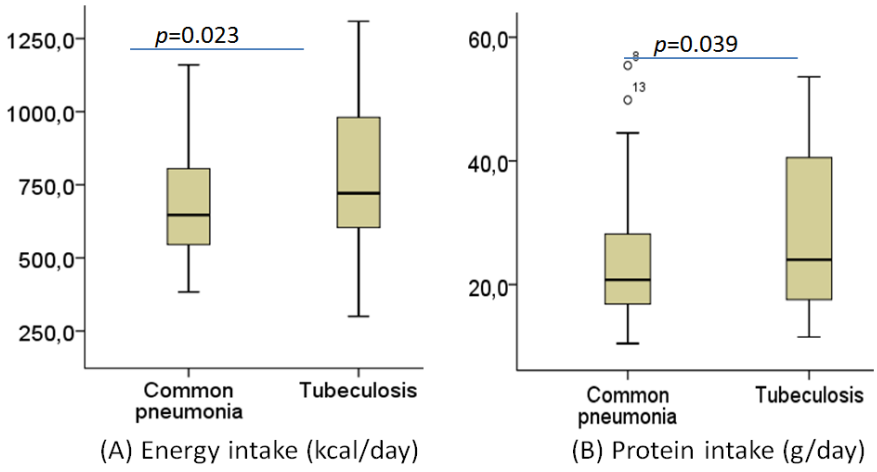

Figure 3. *Values of dietary energy (A) and protein (B) intake between common pneumonia and tuberculosis groups. p-values by Manwithney U test.*

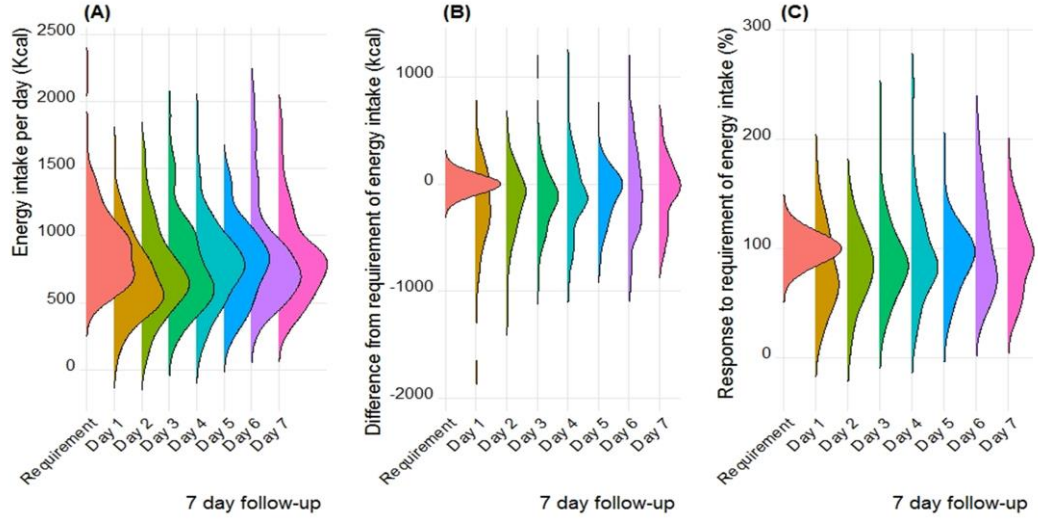

Figure 4. *Energy intake from first day to seventh day of hospitalization*

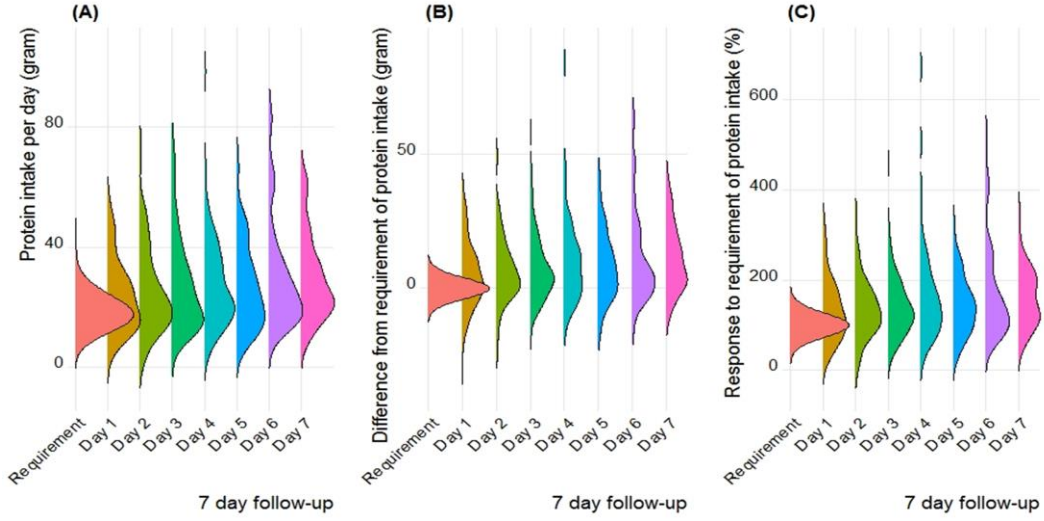

Figure 5. *Protein intake from first day to seventh day of hospitalization*

IV. DISCUSSION

This study indicated that malnutrition is common among hospitalized pediatric patients with lower respiratory tract infections in the tertiary lung hospital of Vietnam. According to the WHO classification, one-third of the total number of children (30.1%) were underweight; 25.7% were stunted; 17.8% were wasted; and the BMI classification of < -2SD was 16.8%. Among 54 children admitted to the hospital with a tuberculosis diagnosis, one-third of the children were underweight for their age (25.9%); stunted growth occurred in one-third (31.5%); and wasting occurred in 20.4%. There was no difference in anthropometric classification between the group of children with a TB diagnosis and the group of children

diagnosed with common respiratory infections.

Compared with the other surveys in Vietnam, the results of the NIN program implemented nationwide in six ecological regions in 2013 showed that the rate of malnourished children, according to WAZ (< –2SD), was, in general, 15.3%; HAZ malnutrition was 25.9%; and wasting malnutrition (WHZ < –2D) was 6.6% [18]. Research by Huong et al. (2015) showed that the percentage of underweight patients was 18.2%; the percentage of stunted patients was 22.5%; the percentage of those dealing with acute malnutrition was 18.1%; and the percentage of those who were overweight was only 1.5% [8]. In another study by Huong et al. (2014) showed that the rate of acute malnutrition was 19%; the rate of WHZ < −2 SD was 19% in the 6 months to 2 years old group and 6.3% in the 2 years old to 5 years old group. The rate of stunting (HAZ < −2 SD) in the group < 2 years old was 11.1%, but 6.3% in the group that was 2 to 5 years old. No children ages 6 months to 2 years were classified as obese and only 7.4% of the children were overweight, based on WHZ > 2SD [9]. Mai et al. (2014) showed the proportion of children who were underweight was 37.5%; stunting accounted for 28.2% of those in the group; and wasting accounted for 26.9% [19]. Thus, the pediatric population in this study had a higher rate of malnutrition in terms of weight (both weight for age and weight for height) than those in the national survey and those who participated in the research of Huong et al., but it was lower than that of those who participated in the research of Mai et al. For instance, there was a higher rate of children hospitalized with pneumonia who were also underweight and malnourished in comparison to those in the community. The rate of underweight children in our study was higher than that identified in the study of Huong et al., but lower than that detected at the Nutrition Clinic of National Hospital of Pediatrics Vietnam. This may be due to the fact that participants from the study conducted at the Pediatric Department of Bach Mai Hospital included those who had many different diseases; participants in the study at the National Hospital of Pediatrics were patients treated in the respiratory, cardiology, neurology, and hematology departments. For the research of Mai et al., most children visited the nutrition clinic when they had problems related to nutrition (discovered by their families or by medical staff members who referred them to the nutrition clinic for further nutritional intervention), so the rate of malnourished children was higher.

The rate of stunting among children in our study was similar to that of the national survey, Mai CTP (2014) and Huong PTT (2014, 2015) [8,9,19]. This can be explained by the fact that malnutrition was noted as a major cause of pneumonia, so children who were hospitalized with inflammation also had a higher rate of wasting.

In terms of SGA classification, 75.5% of the children were without nutritional risk (level A), and the rest (24.5%) were in fact at risk of malnutrition (level B). In the group of children diagnosed with tuberculosis (*n* = 54), 41 (75.9%) had no risk of malnutrition and 13 (24.1%) were at risk. There was no difference in the diagnosis of SGA between the group of children with a TB diagnosis and the group of children diagnosed with common respiratory infections. Huong et al. (2015) identified the nutritional risk using SGA;

mild and moderate malnutrition accounted for 92.4% (134/145). The nutritional risk according to SGA classification was highest among those in the cardiology and hematology departments [16]. Thus, in pediatric patients, SGA assessment allows for recognition of the risk of malnutrition and other associated characteristics related to nutrition, such as weight progression (weight loss or gain) and factors related to the child's diet (such as anorexia, nausea, vomiting, and so on).

Currently, there are very few studies on the diets of hospitalized children. Huang et al. conducted a study on the family self-prepared dietary allowances of the hospitalized children in a US hospital. Results showed that 44% of the total diets exceeded the recommended energy requirement; 9% met the recommended energy and protein requirement. However, the limitation of the study was that the subjects' actual dietary intake may not have been taken into account, and the amount of food that the family could feed their children in addition to the hospital meals might not have been accounted for, either [20]. In another study, Vijfhuize evaluated the diets of 40 children who had burns over 2% to 55% of their body. The results showed that the energy intake was inadequate in 28 patients; 30 patients had excess protein intake; children only met the dietary requirement within 39/211 days [21].

In our study, when comparing dietary energy and protein intake from the first day to seventh day of hospitalization, the rate of chidlren given 100% of requirement had a fluctuating upward trend from 30% to 40% in energy intake and from 66% to 84% in protein intake. Moreover, the study reported the under energy intake and over protein intake in hospitalized children with lower respiratory tract infections in the tertiary lung hospital of Vietnam. This may be because the child's caregivers spend full time caring for the child and the concept of high protein diet is good when children get sick. A better response to medical treatment also helps children eat more. Therefore, the findings found in the study play an important role in in-hospital nutritional counseling to optimize nutritional intake for these children.

V. CONCLUSION

In conclusion, malnutrition was the most critical concern in children with infectious lung diseases, including pulmonary tuberculosis. The contrast was found between the under energy intake and over protein intake in hospitalized children. Protein and energy intake slightly increased during hospitalization and significant difference between the common pneumonia and tuberculosis groups.

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Author disclosures

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