Evaluation of Nutritional Status of Children with Acute Lower Respiratory Tract Infection

Mohammad Nagieb AboElfotoh[1], Ehab Mahmoud Rasheed [1],
Samar Mahmoud Sharaf [2], Noha Abdel Baset Tohamy*[1]

[1] Departments of Pediatric, [2] Departments of Clinical Pathology - Faculty of Medicine, Zagazig University
*Corresponding author: Noha Abdel Baset Tohamy; **Mobile**: (+20)01003220889; **E-mail**: bodytota2020@yahoo.com

ABSTRACT
Background: Pediatric respiratory disease remains an important cause of morbidity in both developing and developed world. Several risk factors are associated with acute respiratory infection (ARIs), some of them are un-modifiable (e.g. age and sex of the child), while others are modifiable and these include nutritional and environmental modifiable risk factors (e.g. lack of breastfeeding and severe malnutrition).
Objective: This study was designed to evaluate nutritional status of children with acute lower respiratory tract infection.
Patients and methods: This study included 40 children, aged from 1 to 5 years suffering from acute lower respiratory tract infection (ALRI). The children were subjected to complete history, clinical examination and laboratory investigation as estimation of serum level of zinc and pre-albumin.
Results: In children with ALRI, there was non-significant difference between children with pneumonia, bronchitis and bronchopneumonia as regard breast feeding, supplementation, MAC, Zinc and pre-albumin, however, the difference between them was significant as regarding BMI and nutritional status.
Conclusion: The results of this study concluded that there is positive relation between nutritional status of child and acute LRTI. There was significant decrease in mortality and morbidity due to RTI after improvement of nutritional status of children. The level of zinc and pre-albumin were affected by nutritional status of children.
Keywords: Zinc, Prealbumin, Nutritional Status, Children, LRTI.

INTRODUCTION

Pediatric respiratory disease remains an important cause of morbidity in both developing and developed world. Pneumonia or ALRI cause over 2 million deaths annually among children younger than 5 years of age. Responsible for about 19% of all children deaths. Pneumonia is the leading cause of children mortality [1]. Improvements in nutrition are a keystone of current global efforts to reduce the burden of mortality and morbidity due to ALRIs among children living in developing countries [2].

Clinical studies indicate that determination of the pre-albumin level may allow for earlier recognition of and intervention formal. Synthesis of pre-albumin increases above baseline levels within 48 hours of protein supplementation in children with severe protein calorie malnutrition and returns to normal levels within eight days. These observations and others led to the recommendation that pre-albumin levels should rise 2 g/dL (20 g/L) per day with adequate nutritional support [3].

Zinc deficiency is widely prevalent in the developing areas of the world, which also have a high incidence of ALRI. Zinc deficiency has been a particular focus of attention because of its high frequency in developing countries and its debilitating effects on immune function [4].

AIM OF THE WORK

The aim of our study was to evaluate nutritional status of children with acute lower respiratory tract infection.

SUBJECTS AND METHODS

- **Type of the study:** This was a cross sectional study.
- **Study setting:** Conducted in Pediatric Outpatient Clinics, Pediatric Department, Zagazig University Hospitals.
- **Study period:** From October 2017 to March 2018**.**
- **Sample size:** Total sample size included 40 children from 1 to 5years old.
- **Study group:** 40 children from 1 to 5 years old with ALRTI selected randomly from those attending the outpatient pediatric clinic.
- **Consent:** This study was ethically approved from Institutional Reviewer Board (IRB), in Faculty of Medicine, Zagazig University and consents from parents of children, participating in this research, were taken.

Inclusion criteria:
1. **Age:** 1-5 years old children.
2. **Sex:** both sexes are included.
3. Children with acute lower respiratory tract infection.

Exclusion criteria:
1. Absence of informed consent.
2. Children with other chronic disease (renal disease-cardiac disease).
3. Children with gastrointestinal disease.
4. Children with total parenteral nutrition (TPN) in the previous month.

Operational design:

1- A questionnaire interview for collection of personal data, sociodemographic data and complete history taking with particular emphasis on age, sex, initial clinical presentation and associated co-morbidities.

2- Full clinical examinations including anthropometric measurements (BW, HT, and BMI) and vital signs (HR, BP and RR) were recorded.

3- Laboratory investigations:

- Measurement of serum zinc and pre-albumin levels.
- Complete blood count and C-reactive protein.
  Estimation of serum level pre-albumin was done by ELISA technique, while serum level of zinc was done by colorimetric method.

Ethical approval:

The Ethical Review Board of the Faculty of Medicine, Zagazig University, approved this study.

Statistical analysis

Data were collected, tabulated and statistically analyzed using SPSS version 19. Continuous Quantitative variables were expressed as the mean ± SD & median (range). Categorical qualitative variables were expressed as absolute frequencies (number) & relative frequencies (percentage). Continuous data were checked for normality by using Kolmogorv-Smirnov test.

One-way ANOVA test was used to compare more than two groups of normally distributed data. Kruskall-wallis test was also used to compare between more than two continuous not normally distributed data. Categorical data were compared using Chi-square test. Pearson correlation was used to determine correlation coefficient between continuous variables. All tests were two-sided and p-value ≤ 0.05 was considered statistically significant (S), p-value < 0.01 was considered highly statistically significant (HS) and p-value ≥ 0.05 was considered statistically insignificant (NS).

RESULT

Table (1): Demographic data of the studied group

Variable	Studied group (n = 40)	
Age:		
Mean ± SD	2.36 ± 2.5	
Range	1 - 4	
	No	**%**
Sex:		
Female	17	42.5
Male	23	57.5

This table showed that the age of the participants ranged between 1 and 4 years with mean of 2 years. More than half of them were males (57.5%) and the remaining 42.5% were females.

Table (2): Anthropometric measurements of the studied group

Variable	Studied group (n = 40)
Weight: (Kg)	
Mean ± SD	12.61 ± 2.25
Range	9 – 16.7
Height: (cm)	
Mean ± SD	88.4 ± 8.45
Range	73 - 105
BMI:	
Mean ± SD	16.2 ± 2.56
Range	11.4 – 19.8
Head circumference:	
Mean ± SD	49.5 ± 1.89
Range	46 - 53
Mid arm circumference:	
Mean ± SD	15.7 ± 0.97
Range	13.5 – 17.5

This table showed that the mean weight of the studied group was 12.6 Kg, mean height was 88.4 cm and mean BMI was 16.2 kg/m². As regarding head and mid arm circumference, their mean were found to be 49.5 and 15.7 respectively.

Table (3): Comparison of clinical data among the studied groups

Variable:	Malnourished group (n = 22)		Normal group (n = 18)		χ^2	P
	No:	**%**	**No:**	**%**		
Breast feeding:						
Yes:	14	63.6	10	45.4	3.252	0.071 (NS)
No:	8	36.7	8	36.6		
Supplementation:						
No:	12	54.5	14	77.8	4.123	0.248 (NS)
Vitamin D:	5	22.7	4	22.2		
Zinc:	2	9.1	0	0		
Zinc and vit D:	3	13.6	0	0		
Appetite:						
Decreased:	19	86.3	6	33.3	11.88	0.0005 (S)
Normal:	3	13.7	12	66.7		

This table showed that there was non-significant difference between both groups as regarding breast feeding and supplementation, however the difference between them was significant in appetite pattern with 86.3% of malnourished infants had decreased appetite compared to 33.3% in the normal group.

Table (4): Comparison of Laboratory data among the studied groups

Variable	Malnourished group (n = 22)	Normal group (n = 18)	test	P value
Zinc:				
Mean ± SD	220.3 ± 331.5	211 ± 174.2	0.107	0.916 (NS)
Median	78.3	156.8		
Range	16.3 – 1038.3	33.6 – 742.7		
Pre-albumin:				
Mean ± SD	712.5 ± 567.7	654 ± 412.5	0.294	0.717 (NS)
Median	505	645		
Range	86 - 1800	95 - 1400		

Test: Mann-Whitney test.

This table showed that there was non-significant difference between the studied groups as regarding zinc and pre-albumin. It was noticed that zinc and pre-albumin levels were lower in malnourished when compared to the normal group (78.3 and 505 versus 505 and 645 respectively).

Table (5): Comparison of different clinical data among the studied groups

Variable	Pneumonia (n = 13)		Broncho-pneumonia (n = 11)		Bronchiolitis (n = 16)		χ²	P
	No.	%	No.	%	No.	%		
Breast feeding:								
Yes:	10	76.9	5	45.5	10	62.5	6.746	0.150 (NS)
No:	3	23.1	6	54.5	6	37.5		
Supplement:								
No:	10	76.9	8	72.7	7	43.8	5.623	0.467 (NS)
Vitamin D:	2	15.4	2	18.2	5	31.3		
Zinc:	0	0	0	0	2	12.5		
Zinc and vit D:	1	7.7	1	9.1	2	12.5		
Nutrition status:								
Malnourished:	9	69.2	10	90.9	3	18.8	15.29	0.004 (S)
Normal:	4	30.8	1	9.1	13	81.2		

Variable	Pneumonia (n = 13)	Broncho-pneumonia (n = 11)	Bronchiolitis (n = 16)	Test	P
BMI:					
Mean ± SD	17.6 ± 0.91	13.9 ± 0.75	18.7 ± 0.81	114.1*	<0.001 (HS)
Range	16.4 – 19.8	12.4 – 19.8	17.4 – 19.8		
MAC:					
Mean ± SD	15.1 ± 0.74	15.4 ± 1.15	15.9 ± 1.01	2.504 *	0.096 (NS)
Range	14 – 16.4	13.5 - 17	13.5 – 17.5		
Zinc:					
Mean ± SD	212 ± 157.6	256 ± 365	187 ± 186.3	1.557#	0.459 (NS)
Median	157.7	78.7	112.5		
Range	45.4 - 604	16.6 - 1038	16.3 – 742.7		
Pre-albumin:					
Mean ± SD	547 ± 366.6	794 ± 574	695 ± 461	1.392#	0.498 (NS)
Median	520	990	645		
Range	86 - 1120	90 - 1800	95 - 1600		

*: ANOVA test.   #: Kruskall-wallis test.

This table showed that there was non-significant difference between the three groups as regarding breast feeding, supplementation, MAC, zinc and pre-albumin. However, the difference between them was significant as regarding BMI and nutritional status.

Table (6): Correlation between body mass index and different parameters among the studied group

Variable	BMI	
	r	p
Zinc:	0.026	0.873
Albumin:	0.248	0.075
CRP:	0.196	0.300
Head circumference:	0.813	<0.001**
Weaning age:	-0.253	0.116

This table showed that there was non-significant positive correlation between BMI and zinc, albumin. However, the correlation was significant strong positive between BMI and head circumference.

DISCUSSION

Acute lower respiratory tract infections are ranked among the first five leading causes of mortality in children in developing countries. Mortality due to ALRI was 18% of total under five years mortality rates, which were 61 per $1,000 < 5$ yrs population. Half of children with symptoms of ARI were taken to a health facility or health provider. Seven percent of children with ARI symptoms received antibiotics [5].

The excess of morbidity and mortality rates from acute lower respiratory tract infections in the developing world indicate that several risk factors could be responsible. In developing countries malnutrition, lack of breast feeding, lack of immunization and overcrowding were reported as the usual risk factors of acute lower respiratory tract infections [6].

Our study was conducted on forty children with ALRTI who were examined and diagnosed clinically according to **WHO** [7]. All patients were subjected to thorough history taking, clinical assessment of respiratory infections, physical examination (both general and systemic examination particularly chest) and laboratory investigations including chest X-ray, measurement of zinc and pre-albumin levels, complete blood count and C-reactive protein.

Our study showed that the age of the participants ranged between 1 and 4 years with mean of 2 years old. More than half of them were males (57.5%) and the remaining 42.5% were females. In another study, compared to females, males seemed to suffer more commonly from most types of RTI [8]. **Tsai et al.** [9] demonstrated a higher incidence of respiratory tract infection in boys. **Goel et al.** [10] **and Silfeler et al.** [11] found that respiratory tract infections are common in young children, decrease in frequency with age, and predominate in boys. It also agrees with **Lin et al.** [12] who found that most of the respiratory viral infections are common in male children. **Muenchhoff and Goulder** [13] found that females are more commonly affected with infections of the upper respiratory tract, specifically sinusitis, tonsillitis, and otitis externa, while males are more commonly affected with otitis media, croup and most important lower RTIs. On the other hand, **Montasser et al.** [14] found that female patients were more infected with ARTI than males in Egypt.

Our study showed that the mean weight of the studied group was 12.6 Kg, mean height was 88.4 cm, and mean BMI was 16.2. As regarding head and mid-arm circumference, their mean were found to be 49.5 and 15.7 respectively. **Martorell** [15] reported that LRTI was significantly associated with decreased weight gain. **Heywood** [16] found strong relationships between all three indices of nutritional status and mortality in children with ALRTI aged 6-30 months. **Tomkins et al.** [17] found no relationship between prevalence of any respiratory illness and anthropometric indices.

In our study, 62.5% of the studied participants were breastfed and 62.5% had normal appetite. The mean age of weaning was 5 months with range between 3 and 6 months. **Kaymaz et al.** [18] investigated the relationship between parental perception of their child's body measurements and appetite. They found that perception of the parents of their children's growth is influenced by many factors and usually does not reflect the facts. The majority of the children with poor appetite were in normal weight range according to BMI percentile. Nevertheless, nearly one third of the children were underweight, a fact that should not be ignored. **Abdul Raheem et al.** [19] measured associations between feeding methods and ARTIs in a cohort study of 6 months. They found that the partial, predominant and exclusive breastfeeding rates at 1 month were 98.9, 67.6 and 26.9%, respectively. The risk of acquiring ARTIs is significantly reduced when the infants were predominantly breastfed for 3 months and 6 months. The risk of getting diarrhoea is significantly reduced even when the babies were partially breastfed for 6 months. They demonstrated that the risk lowers with longer duration of breastfeeding.

In our study, Zinc level ranged between 16.3 and 1038 µg/dl with mean of 214.3 and that of pre-albumin mean was 674.5 µg/dl. **Roth et al.** [20] concluded that zinc supplementation in zinc-deficient populations prevents about one-quarter of episodes of ALRI, which may translate into a modest reduction in ALRI mortality. Breastfeeding promotion reduces ALRI morbidity, while iron supplementation alone did not reduce ALRI incidence. Also, vitamin A supplementation beyond the neonatal period did not reduce ALRI incidence or mortality. **Reddy et al.** [1] identified various nutritional risk factors and serum

zinc level for ALRI in children aged 6 months to 5 yr. The significant nutritional risk factors were malnutrition, anaemia and low serum zinc level. Sociodemographic factors like partial immunization status and SES which were taken into study didn't have any significant association with ALRI. The interesting fact is nutritional factors, which were found to be significant in this study are actually either preventable or curable.

Regarding pre-albumin, according to the Academy's Evidence Analysis Library, serum proteins such as albumin and pre-albumin are not included as defining characteristics of malnutrition because evidence analysis showed that serum levels of these proteins did not change in response to changes in nutrient intake [21].

Our study showed that 45% of the studied participants were normal, while the remaining 55% were malnourished. **Chalabi** [22] studied the relationship between nutritional status and ARI among young children attending a teaching hospital in Erbil, Iraq. Children admitted to hospital with a diagnosis of ARI over a 4-month period were compared to a control group without ARI. Significantly more ARI cases were male and the mean age was lower. Weight and height were lower in the ARI group but there was no significant difference in weight-for-age or in height-for-age. They concluded that most cases of ARI in this hospital in Erbil occurred below the age of 1 year and boys were more prone to ARI than girls. Malnutrition significantly increase the risk of having ARI among children < 5 years of age.

In our study, there was non-significant difference between both groups as regarding breastfeeding, supplementation, zinc and pre-albumin. However, the difference between them was significant in appetite pattern where 86.3% of malnourished infants had decreased appetite compared to 33.3% in the normal group.

Our study showed that the commonest diagnosis among the studied group was bronchiolitis (40%), followed by pneumonia (32.5%) and 27.5% of them had bronchopneumonia. **Mishra et al.** [23] diagnosed 56% (60) as cases of severe pneumonia, 35% (37) as pneumonia and 9% (10) were very severe pneumonia.

According to WHO, pneumonia is the single largest cause of death in children worldwide. Every year, it kills an estimated 1.2 million children under the age of five years, accounting for 18% of all deaths of children under five years worldwide. More than 99% of all pneumonia deaths occurring in developing countries, and three-quarters take place in just 15 countries. The annual incidence of pneumonia in developing countries is 10-12 times higher than in developed countries that is 10-20/100. However, incidences exceeding 50/100 occur with high prevalence's of malnutrition and high HIV infection rates in children. More than 95% of all new cases of pneumonia in children, less than 5 years occur in developing countries, due to increased prevalence of under-nutrition, which is implicated in 53% of all deaths among children less than 5 years [23].

Our study found that there was non-significant difference between the three groups as regarding breast feeding, supplementation, MAC, Zinc and pre-albumin, however, the difference between them was significant as regarding BMI and nutritional status. Also, there was non-significant positive correlation between BMI, zinc, pre-albumin. However, the correlation was significantly strong positive between BMI and head circumference.

Prajapati and Talsani [24] reported highest risk of death from ALRI due to malnutrition among those below two years of age. It is well known that malnourished children have defective cell mediated immunity secondary to thymolymphocytic depletion leading to severe gram negative infections and sepsis. They may also have qualitatively abnormal immunoglobins, and impairment of key enzymes involved in bactericidal action of leucocytes, thereby making them all the time to be more prone to infections. **Mishra et al.** [23] concluded that wasted children were more prone to suffer from ALRI as compared to stunted children.

CONCLUSION

There is positive relation between nutritional status of children and acute LRTI. There is significant decrease in mortality and morbidity due to RTI after improvement of nutritional status of children. The level of zinc and pre-albumin were affected by nutritional status of child.

These results add to the growing attention to the role of nutritional status in the susceptibility to infection-related illness in children.

Implementation and rigorous evaluation of multicomponent nutritional intervention programs should be a high priority to reduce the incidence and mortality associated with severe ALRI, as well as the overall disease burden that persists among children in developing countries.

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