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Acute Respiratory Tract Infection in Children under Five- Year; Study of Prevalence, Risk Factors and Outcome in Minia University Children's Hospital, Egypt

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Abstract

Background
Acute respiratory infection is still the leading cause of morbidity and mortality in children under five in many countries. We aimed to assess the incidence and risk factors predicting the outcome of Acute Respiratory Infection (ARI).

Materials and Methods
This is a hospital-based case study conducted at Minia University Children's Hospital, Egypt from December 2016 until December 2018. Children from 2 months till five years and presented by criteria of ALRI according to WHO criteria were included in the study and evaluated for clinical presentation, risk factors and outcome. Routine investigations such as CBC, CRP and chest X-ray were done for all cases.

Results
Out of 586 children admitted to pulmonology unit only 215 (36.7%) fulfill the WHO criteria of ARI program, with higher incidence among infants below 6 months (48.8%) and male children (58.6%), majority of children had anemia (87%), and PEM (60%), according to WHO criteria we found that 18.6% of cases had pneumonia and 49.7% of cases had severe pneumonia. Need of change in antibiotics, duration of stay and outcomes were significantly associated in relation to pneumonia severity (p=0.04, p=0.03 and p=0.01, respectively); while need for oxygen therapy was highly significant (p=0.001) and 15% required mechanical ventilation. Lobar pneumonia (32.5%) was the most common diagnosis and sepsis was the most frequent cause of death and mortality rate was 9.3% (n=20).

Conclusion
Young age, malnutrition and poor socioeconomic status play an important role in in the morbidity; effective management of malnutrition, improving the living standards and proper health education programs, can reduce mortality from respiratory infection in children, ARI burden and severity.

Key Words: Acute Respiratory Infection, Children, Outcome, Risk factors.

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1- INTRODUCTION

Acute lower respiratory tract infection (ALRI) in children under-five years of age is the leading cause of mortality and morbidity (1). It includes a heterogeneous group of diseases caused by many microorganisms including virus, bacteria or fungi (2). ARIs not only affect the respiratory system but also have serious systemic complications due to spread of the infection or microbial toxins, inflammation, and reduced lung function (3). The prevalence of acute respiratory infection is higher in developing countries than in developed countries (4). This due to many environmental factors that play a role in the development of respiratory tract infections such as malnutrition, low birth weight, lack of breast feeding, air pollution, indoor crowding and lack of measles and pneumococci immunization and concomitant diseases e.g. asthma, diarrhea, heart disease (5, 6).

Recent studies from the World Health Organization (WHO) suggest that Acute lower respiratory tract infections (ALRTI) is responsible for 20% of deaths in under five years old children, every year about 120–156 million cases of ALRI occur globally, and about 1.4 million cases die every year. More than 95% of these deaths occur in underdeveloped and developing countries (7, 8). In Egypt, according to Egyptian Demographic Health Survey (EDHS 2008), one in 36 Egyptian children dies before the age of five, with approximately 80% of deaths occurring during the first birthday (9). Mortality rate was higher in rural compared to urban areas. In addition, the highest mortality was found in Upper Egypt compared to Lower Egypt (10).

As there is no standard definition of childhood ALRI, if the child presented with least one specific lower respiratory tract sign reported by a caregiver or study personnel (fast or difficulty breathing, chest wall in-drawing) and/or abnormal auscultatory findings (crackles/crepitations or bronchial breath sounds) they should be considered as ALRI (11). Further Integrated Management of Childhood Illness (IMCI) is classified as no pneumonia, pneumonia, severe pneumonia, very severe pneumonia based on respiratory rate according to age, presence or absence of chest retraction and general status of the patient (12). This study aimed to identify the clinical presentation, risk factors and outcome of ARI among children under-five years, and to assess the quality of medical services and efficacy of management protocol in our department

2- MATERIALS AND METHODS

2-1. Study design

This study is a prospective hospital-based case study conducted at pulmonology unit, Pediatrics Department, Minia University Children Hospital, Egypt, from December 2016 until December 2018. Any child aged from 2 months to 5 years and presented by manifestations suggestive of lower respiratory tract infection and onset of symptoms less than two weeks was included in the study.

The study was done according to the standards of local ethics committee and informed consent was taken from parents. According to WHO guidelines for diagnosis and treatment of ALRI (12), out of 586 cases admitted to pulmonology unit, only 215 (36.7%) children were included the study; they were classified into three groups according to in age: **Group 1**, children aged from two to six months included 105 children (48 males and 57 females), **Group 2**, children aged from six to 24 months included 72 children (40 males and 32 females), and **Group 3,** children aged from two to five years included 38 children (18 males and 20 females).

2-2. Methods

Children were subjected to detailed thorough history taking, particularly past history, family history, nutritional history, immunization status, also full clinical examination, assessment of weight, height, body mass index (BMI), manifestations of malnutrition and local chest examination for presence of tachypnea, nasal flaring, wheezes, chest retraction, presence of crackles and bronchial breathing were documented. Cases were followed until recovery or death. Those with manifestations of severe respiratory distress were admitted to PICU. Children with respiratory manifestations for more than two weeks, known congenital heart disease, immunodeficient states, receiving steroid therapy, neuromuscular or skeletal disorders, those who didnot complete treatment or that referred to other centers were excluded from the study.

2-3. Laboratory measurements

For all children, 3ml of venous blood withdrawn and 0.5 ml added to EDTA containing tube for blood picture (Sysmex KX-21N, Japan), and the other 2.5 ml was allowed to clot and was centrifuged, the resulting serum was used for CRP measurement by the standard nephelometric analysis method. Other investigation like culture and sensitivity for pleural fluid, tuberculin test were done for selected cases. Radiological examination by chest X- ray was performed for all included children and high-resolution CT chest was done for selected cases.

2-4. Statistical Analysis

The Statistical Package analyzed data for the Social Sciences (SPSS for windows, version 13.0). The prevalence rate of ARI was described in simple proportion. Group comparisons were done by the Chi-squared (χ^2) test or Fisher's exact test for categorical variables. Probability (p-value) of less than 0.05 was considered significant.

3- RESULTS

A total number of 215(36.7%) children out of 586 were admitted to pulmonology unit fulfilled the criteria of ARI control program and were included in the study. **Table.1** summarizes the demographic and clinical characteristics of the patients, there were more males than females (58.6% and 41.4 %, respectively), and children below 6 months constitute the majority of cases (48.8%). Regarding residence, the incidence increased in children living in rural areas (61%), lack of breast-feeding was present in 50.7% of children and improper weaning in 65%. As regards nutritional status, most of the children were under weight (60%), in addition, rickets was found in 44% of cases and protein energy malnutrition (PEM) in 35. Cough was the main presenting symptom (100%) followed by fever (84.3%), and dyspnea (73.9%).

Laboratory investigations in **Table.2**; revealed that anemia was present in (85.5 %) of patients varying from mild to severe anemia, most of them due to iron deficiency, total leucocytes increased in (46%), and decreased in 18%, in addition C-reactive protein (CRP) was positive in (85.5%) of patients. Radiological findings consolidation was by far the most common presentation (39.5%), followed by bilateral infiltrates (15.5%); while normal findings was present in (14.8%) of cases (**Table.3)**.

Table-1: Baseline and clinical characteristics of the patients.

Variables	Frequency Total number (215)	Percentage
Gender		
Male	126	58.6%
Female	89	41.4%
Age		
Below 6 months	105	48.8%
From 6-24months	72	33.4%
From 24-60 months	38	17.8%
Residence		
Urban	84	39%
Rural	131	61%
Breast feeding Yes	80	49.3%
No	97	50.7%
Weaning; Proper	62	35%
Improper	113	65%
Nutritional status		
Average	87	40 %
Underweight	118	60%
PEM	76	35%
Rickets	95	44%
Symptoms		
Fever	182	84.6%
Stridor	43	20%
Cough	215	100%
Tachypnea	185	85.8%
Wheezes	120	55%
Chest indrawing	128	59.5%
Cyanosis	32	14.8%
Fully vaccinated;		
Yes	190	88.3%
No	25	11.4%

Table-2: Laboratory finding of the studied patients.

Investigation	Frequency	Percentage
Anemia; Mild Hb 10-8 gm/dl	65	30%
Moderate Hb6-8gm/dl	94	44%
Severe Hb ≤ 6gm/dl	25	12%
Total leucocytic counts		
≤ 4000	39	18%
4000-12000	77	36%
≥ 12000	99	46%
CRP +ve	128	85.5%
-ve	87	14.5%
Pleural fluid culture +ve	15	7%
-ve	8	4%

+ve: positive; -ve: negative.

Table-3: Radiological findings on chest X-ray.

Radiological finding	Total number, 215	Percentage
Consolidation	69	39.5%
Unilateral infiltrate	22	10.2%
Bilateral infiltrate	34	15.6%
Collapse	15	6.9%
Effusion	23	10.6%
Pneumothorax	9	4.1%
Hyperinflation	11	5.1 %
Normal	32	14.8%

Table.4 shows the distribution pattern of ARI, out of 215 cases the most common clinical diagnosis was lobar pneumonia (32%), followed by bronchopneumonia (21%), and bronchiolitis in 20%; croup was diagnosed in 6.9%, pleural effusion in 10.6% of cases, and WALR was diagnosed in 9.3% of cases. Change in antibiotics, duration of stay and outcomes were significantly associated to pneumonia severity (p=0.04, p=0.03 and p=0.01, respectively); while need for oxygen therapy was highly significant p=0.001). As seen in (**Table.5**), 32(14.8%) cases required mechanical ventilation, 20 (9.3%) of them died because of complications of sepsis and mechanical ventilation.

Table-4: Clinical pattern according to clinical and laboratory findings.

Final diagnosis	Below 6 months, n=105	6- 24 months, n=72	24- 60 months, n=38	P-value
Croup, number (%) No= 15(6.9%)	3 (20 %)	8 (53%)	4 (27%)	0.09
Bronchiolitis No=43 (20%)	15 (21.5 %)	21 (63.5%)	7 (15%)	0.08
Bronchopneumonia No=45(21%)	29 (55%)	10 (25%)	6 (20%)	0.05
Lobar pneumonia No=69(32%)	48 (54%)	13 (54%)	8 (16%)	0.04
WALRTI No=20(9.3%)	7 (10%)	12 (60%)	6 (30%)	0.07
Pleural effusion No=23(10.6%)	3 (4%)	8 (60 %)	7 (36%)	0.09

WALARTI: Wheeze associated lower respiratory tract infection.

Table-5: Outcome according to WHO classification for ARI.

Variables	Sub-group	Pneumonia 40 cases (18.6%)	Severe Pneumonia 107cases 49.7%)	Very severe Pneumonia 68cases (31.7%)	Total, n=215	P-value
Changes of antibiotics	Yes	0	30	46	76	0.04
	No	40	87	22	139	
Oxygen	Yes	30	107	68	205	0.001
	No	10	0	0	10	
Duration of stay, day	≤ 7 d	34	67	28	129	0.03
	7-14	6	23	22	51	
	≥ 14	0	17	18	35	
Outcome	Improved	40	99	58	195(90.7%)	0.01
	Died	0	8	12	20(9.3%)	

4- DISCUSSION

This study aimed to assess the incidence of ARI in children under 5 years, admitted to Minia University Children's Hospital, and to detect the main risk factors for the morbidity and mortality from ARI. Acute respiratory infections in children less than 5 years of age are a major concern in developing countries (13); the incidence of respiratory infection in our study was 36.7%. Srinivasa et al. (14) reported incidence in their study was 17.5%; while in a study by Paramesh (15) the incidence was 12.85%, the increased incidence in our study may be due to increased number of referred cases from primary and secondary health care units to our tertiary unit. Many factors contribute to incidence, like age group selection for a study, seasonal variation and other risk factors in a community (16).

In our study there was a slight increase in incidence in males (58.6%) than females (41.4%), this is in agreement with many previous studies by Srinivasa et al. (58%) (14), Savitha et al. (64.4%) (17), Broor et al. (73.1%) (18), Sehgal et al. (58.25%) (19), and Drummond et al. (58%), (20); these results may be attributed to cultural factors, such as preference in seeking medical care for boys. Concerning age distribution, in our study ALRI among infants less than 6 months was 48.5%, this is in accordance with previous studies by Srinivasa et al. (14), Savitha et al. (17), Broor et al. (18) and Sehgal et al. (19), where infants with ALRI accounted for 58%, 52% and 62%, respectively. This may be due to functional immaturity of the immune system and other anatomic factors such as narrow airways, short bronchial tree and under development of lungs. In addition, there was a significant association between age and ALRI severity, which is in agreement with El-Zanaty et al. (21), and Khalek and Abdel-Salam (22). In present study, the incidence of ARI was common in children living in rural areas (61% of cases) compared with those in urban area (39%) these findings may be due to poor housing, overcrowding and low socio-economic factors. This is in agreement with Savitha et al. (17), and Hamid et al. (23). As to malnutrition, in our study 60% of cases were under weight, 35% had PEM and 44% had features of rickets, in addition, anemia was present in 85.5% of cases, 12% of them were severe and required blood transfusion and most of them were due to iron deficiency. These results are similar to studies by Kumar et al. (24) and Srinivasa et al. (14).

In addition, 50.7 % of cases were not breast-fed and inappropriate weaning was found among 65% of cases. These findings are in agreement with Broor et al. (18), and Savitha et al. (17), they reported high incidence of ARI among children who are not exclusively breast-fed or who did not receive proper weaning. In our study, 100% of the cases presented with cough and 84.5% with fever 14.8% of cases had cyanosis and altered sensorium. Among signs, tachypnea and chest indrawing were seen in 85.9% and 55% of cases and wheeze (55%), these findings were comparable with other studies like Kabra et al. (25), Ujunwa and Ezeonu (26) in their study found cough and fever in 95% and difficult breathing in 38% of cases. Out of 215 cases, 18.6%, 49.95% and 31.7% were pneumonia, severe and very severe pneumonia, respectively.

These studies are similar to those reported by Savitha et al. (17), 12.51% were pneumonia, 82.69% were severe and 4.8% were very severe pneumonia and Yousif and Khaleq (27) graded 23.4% as no pneumonia, 48.2% as pneumonia, 19.6% as severe and 8.8% as very severe pneumonia. Among 215 cases the most common clinical diagnosis was lobar pneumonia 32.5% followed by bronchopneumonia 21.5% and bronchiolitis 20% of cases. Pleural effusion was diagnosed in 10%, WALRT

in 9.6% and Croup in 6.95%. These are in accordance with a study by Reddaiah and Kapoor (28); bronchopneumonia was diagnosed in 64%, lobar pneumonia in 6.4% and post measles bronchopneumonia in 4.0% of cases. In this study, oxygen was required by 95.5% of cases, continuous positive airway pressure therapy (CPAP) administration in 12.5% and mechanical ventilation in 10.5% of cases.

Sepsis was the frequent complication occurred in 7% of mechanically ventilated infants cases. In this study change of antibiotics was required in 30% of cases, and the duration of stay in hospital was significantly less in cases of severe pneumonia compared to very severe pneumonia; these results are in agreement with Duke et al. (29), which reported that change in antibiotics in 11% of patients and 44.5% had hospital stay of more than 7 days. Mortality in our study was 9.3%; most cases were younger, less than 6 months and died from complications of sepsis and mechanical ventilation.

The results are relatively higher than those reported by Mishra et al. (30) that noted a mortality of 7.7% and Kumar et al. (24) which was 8%, this is due to many cases with severe and very severe pneumonia referred to our unit from many centers, and most of them were complicated by sepsis and multiple organ failure. Pneumonia is the main killer disease in children under 5 years in our locality most governmental and non-governmental agencies should collaborate to combat deaths from ARI via training of local health personnel in early recognition, treatment and referral of sick and at-risk children help in decreasing the morbidity and mortality.

5- CONCLUSION

Pneumonia in children less than 5 years is one of the major causes of morbidity and mortality. Criteria mentioned in the WHO ARI control program are very sensitive in diagnosis of the ALRI cases. The incidence of ARI in our hospital was 36.7% and the mortality rate was 9.3%, we found that young age, malnutrition anemia and poor socioeconomic status are the main risk factors for the morbidity and mortality from ARI; so breaking this vicious cycle is important in decreasing the morbidity and mortality from ARI. In addition, improving the living standards can help in preventing the ARI burden.

6- CONFLICT OF INTEREST: None.

7- ACKNOWLEDGMENT

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