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Clinicoepidemiological Profile of Recurrent Pneumonia in Children

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ABSTRACT

Background: Pneumonia is considered the leading cause of morbimortality in children all over the world**.** About 9% of children with pneumonia will have recurrent pneumonia (RP). RP has a major financial burden on the healthcare system owing to frequent hospitalization. Many studies focused on some underlying diseases that cause RP, RP have several possible causes such as deficits in host defenses or underlying situations affecting lung defense mechanisms.

Objective: To evaluate pattern of RP and its accompanying risk factors in children admitted to Mansoura University Pediatric Hospital.

Patients and Methods: The present study was an observational cross-sectional study with analytic component that was carried out on 180 patients. All patients were admitted to Mansoura University Children Hospital and aged >2 years old and < 18 years old.

Results: RP represented 20% of all cases with pneumonia of studied patient. There was statistically significant positive correlation between RP and positive consanguinity (P <0.001), parental smoking (P 0.03), underweight (P 0.005) and Down syndrome (P 0.02).

Conclusion: Recurrent pneumonia is a threatening problem contributing to 20% of total children admitted in Mansoura University with pneumonia during the period of our study. Concerning predisposing factors for RP, our study shows that there was significant increase in prevalence of recurrent pneumonia within cases with positive consanguinity, parental smoking, underweight and Down syndrome.

Keywords: Recurrent pneumonia, Clinicoepidemiological profile, Risk factors, Positive consanguinity.

INTRODUCTION

Recurrent pneumonia (RP) could be described as presence of at least two attacks of pneumonia over a period of one year or three attacks overall with radiographic clearance in between. Pneumonia is considered the leading cause of morbimortality in children worldwide**.** About 9% of children with pneumonia will have RP **(1,2).**

In Egypt**, El–Saied *et al.* (3)** found that RP represented 12.61% of all cases of pneumonia among children admitted with diagnosis of pneumonia over a period of one year**.** The clinical presentation of childhood pneumonia differs based on the responsible pathogen, the particular host, and the degree. The presenting symptoms and signs are non-specific; no isolated symptom or sign is distinctive for pneumonia in pediatric population **(4)**.

Manifestations of pneumonia may be complex, in particular among infants, the presence of fever and cough together is indicative of pneumonia; other respiratory manifestations (such as tachypnea, dyspnea) may precede the cough.

The alveoli have few cough receptors, so cough may not be a feature at the beginning till irritation of cough receptors in the airways by products of infection. The probability of pneumonia increases when the duration of fever, cough, and respiratory symptoms increases. Neonates could present with feeding difficulty, irritability, cough and abnormal breath sounds. Fever and leukocytosis may be the only presentation in neonates, young infants, and young children up to10 years of age **(5).**

Older children and adolescents may suffer from pain with respiration, but this is an unreliable finding **(4).** RP have several possible causes such as deficiencies in host defenses or underlying situations affecting lung defense mechanisms. RP has a large financial burden on the healthcare system due to frequent hospitalization **(6)**.

In developed countries, **Hoving and Brand (7)** stated that many studies focused on some underlying diseases that cause RP, which comprised recurrent aspiration, immune deficiency disorders (IDD), asthma, pulmonary anomalies, and gastroesophageal reflux disease (GERD). While In Egypt, **El–Saied *et al.* (3)** noticed that the commonest underlying cause for RP was cardiac diseases followed by immunodeficiency diseases, then bronchial asthma. Other factors for RP included low socio-economic status of studied cases, prematurity, exposure to passive smoking and pollutions, overweight, under nutrition, lack of breast feeding, GERD and corticosteroids use.

Then **Abdel Baseer and Sakhr (8)** revealed that prematurity, low birth weight (LBW) and the existence of respiratory distress at birth were significant factors accompanied by RP. Diagnosis of RP has to be established or rule out with the least possible number of the least-invasive confirmatory tests. Cases have to undergo a blood test to evaluate their immune condition, nasal fiberoptic endoscopy, sweat test and/or genetic analysis for cystic fibrosis (CF), 24-h oesophageal pH monitoring, tuberculosis screening, nasal NO measurement, and ciliary motility/ultrastructure study. If all of such investigations are negative, bronchoscopy with bronchoalveolar lavage (BAL) and

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a cytologic examination are recommended to evaluate the lipid burden in alveolar macrophages [9].

There is a limited number of studies on RP in children in the developing nations, so we conducted this study to analyze the clinical characteristics, underlying causes and predisposing factors of RP in children.

PATIENTS AND METHODS

This study was an observational cross-sectional study with analytic component that was carried out for 6 months from January 2022 till July 2022 on 180 patients. This study included all cases that were admitted to Mansoura University Children Hospital and aged >2 years old and < 18 years old, from both genders, diagnosed with pneumonia. But in this study, we ruled out patients diagnosed with cystic fibrosis or obliterative bronchiolitis.

Patients

All subjects were subjected to: data collection of age, sex, residence, history of parental consanguinity, history of parental smoking, weight, gestational age, history of feeding during first six months, history of vaccination, accompanied diseases found in studied patients, medical history, and if the child were diagnosed with pneumonia for the first time or had recurrent pneumonia, and clinical features of studied cases.

Ethical consideration

The study design was approved by Institutional Research Board (IRB) of Mansoura Faculty of Medicine was taken before starting this study (Code number: MS.21.12.1767). Informed verbal consent was obtained from the mothers or relatives of all children. Confidentially and person privacy were respected in the study. The Helsinki Declaration was followed throughout the study's conduct.

Statistical analysis

The collected data were coded, processed and analysed using SPSS program, version 26.0. Continuous data were displayed as mean ± standard deviation (SD), whereas categorical data were presented as number and percentage. To compare categorical data between two groups, the Chi-square test was performed. When the predicted count in any cell was less than 5, the Fisher exact test was applied. Student's t-test was used to compare normally distributed continuous data between 2 groups. The COR with its 95% CI was estimated using the Epi Info software. Significant univariate factors linked with recurrent pneumonia were incorporated into forward Wald binary logistic regression analysis to identify significant independent predictors and AOR and 95% CI. In terms of all the previously utilized tests, P-value was considered significant when it was less than 0.05.

RESULTS

Table 1 demonstrates that there was no statistically significant correlation between recurrence of pneumonia and age, sex or residence of our studied cases. But positive consanguinity was significantly associated with the risk of recurrent pneumonia.

Table (1): Socio-demographic data in recurrent versus non-recurrent pneumonia patients.

Variable	Recurrent pneumonia N=36	Non-recurrent pneumonia N=144	P value	COR (95%CI)
	N (%)	N (%)		
Age(year)				
<4	17(19.5%)	70(80.5%)	0.9	1r
≥4	19(20.4%)	74(79.6%)		1.1(0.5-2.2)
Sex				
Male	19(23.5%)	62(76.5%)	0.4	1.5(0.7-3.01)
Female	17(17.2%)	82(82.8%)		1r
Residence				
Rural	28(21.9%)	100(78.1%)	0.3	1.5(0.7-3.6)
Urban	8(15.4%)	44(84.6%)		1r
Consanguinity				
Positive	22(41.5%)	31(58.5%)	<0.001	5.7(2.6-12.5)
Negative	14(11%)	113(89%)		1r

COR: Crude Odds Ratio, CI: Confidence Interval.

Table 2 shows that exposure to smoking was statistically significantly related to recurrent pneumonia. Twins, overweight, underweight, gestational age, and type of feeding didn't relate significantly to recurrent pneumonia.

Table (2): Health related data in recurrent versus non-recurrent pneumonia patients.

Variable	Recurrent pneumonia N=36	Non-recurrent pneumonia N=144	P value	COR (95%CI)
	N (%)	N (%)		
Parental smoking				
Yes	23(27.4%)	61(72.6%)	0.02	2.4(1.1-5.1)
No	13(13.5%)	83(86.5%)		1r
Twins				
Yes	4(30.8%)	9(69.2%)	0.3	1.9(0.5-3.5)
No	32(19.2%)	135(80.8%)		1r
Weight				
Normal	24(16.1%)	125(83.9%)		1r
Underweight	10(38.5%)	16(61.5%)	0.007	3.3(1.3-8.1)
Overweight	2(40%)	3(60%)	0.2	3.5(0.6-21.9)
Gestational age				
Preterm	1(14.3%)	6(85.7%)	0.9	1r
Full term	35(20.2%)	138(79.8%)		1.5(0.2-13.1)
Feeding				
Breast feeding	14(15.1%)	79(84.9%)	0.09	1r
Artificial feeding	22(25.3%)	65(74.7%)		1.9(0.9-403)

Table 3 shows that Down syndrome was significantly associated with the risk of recurrent pneumonia.

Table (3): Medical history data in recurrent versus non-recurrent pneumonia patient.

Variable	Recurrent pneumonia N=36	Non-recurrent pneumonia N=144	P value	COR (95%CI)
	N (%)	N (%)		
Heart disease				
Yes	8(20.5%)	31(79.5%)	0.9	1.04(0.4-2.5)
No	28(19.9%)	113(80.1%)		1r
Immunodeficiency disorders and Immunomodulators use			0.4	1.5(0.6-3.4)
Yes	10(25%)	30(75%)		1r
No	26(18.6%)	114(81.4%)		
FMF				
Yes	6(40%)	9(60%)	0.08	3(0.99-9.1)
No	30(18.2%)	135(81.8%)		1r
Down syndrome				
Yes	4(50%)	4(50%)	0.05	4.4(1.04-18.4)
No	32(18.6%)	140(81.4%)		1r
Bronchial Asthma				
Yes	1(14.3%)	6(85.7%)	0.9	1r
No	35(20.2%)	138(79.8%)		1.5(0.2-13.1)
Others				
Yes	11(18.3%)	49(81.7%)	0.7	1r
No	25(20.8%)	95(79.2%)		1.2(0.5-2.6)
History of foreign body inhalation				
Yes			0.9	1.1(0.3-3.5)
No	4(21.1%)	15(78.9%)		1r
	32(19.9%)	129(80.1%)		
Cortisone				
Yes	1(33.3%)	2(66.7%)	0.5	2.02(0.2-23)
No	35(19.8%)	142(80.2%)		1r

Table 4 shows that chest wall deformity was significantly associated with the risk of recurrent pneumonia.

Table (4): Clinical signs in recurrent versus non-recurrent pneumonia patients.

Variable	Recurrent pneumonia N=36	Non-recurrent pneumonia N=144	P value
Temperature (Mean ± SD)	38.3 ± 0.4	38.2 ± 0.58	0.6
Respiratory rate (Mean ± SD)	36.97 ± 6.1	36.8 ± 5.1	0.9
Crackles - N (%)			
Yes	36(20.3)	141(79.7)	0.9
No	-	3(100)	
Chest wall deformity - N (%)			
Yes	22(41.5)	31(58.5)	<0.001
No	14(11)	113(89)	
Stridor - N (%)			
Yes	-	9(100)	0.2
No	36(21.1)	135(78.9)	
Nasal flare - N (%)			
Yes	34(20)	136(80)	0.9
No	2(20)	8(80)	

Table 5 shows that consolidation and pleural effusion were significantly associated with recurrent pneumonia.

Table (5): Radiological findings in recurrent versus non-recurrent pneumonia patients.

Variable	Recurrent pneumonia N=36	Non-recurrent pneumonia N=144	P value
	N (%)	N (%)	
Collapse			
Yes	32(21.9)	114(78.1)	0.2
No	4(11.8)	30(88.2)	
Hyperinflation			
Yes	31(22.5)	107(77.5)	0.2
No	5(11.9)	37(88.1)	
Consolidation			
Yes	36(30.5)	82(69.5)	<0.001
No	-	62(100)	
Interstitial infiltrates			
Yes	4(19)	17(81)	0.9
No	32(20.1)	127(79.9)	
Pleural effusion			
Yes	36(30)	84(70)	<0.001
No	-	60(100)	
Empyema			
Yes	4(25)	12(75)	0.5
No	32(19.5)	132(80.5)	

Table 6 shows that after logistic regression analysis, the following were the most significant predictors for recurrent pneumonia: positive consanguinity, parental smoking, underweight and down syndrome.

Table (6): Independent predictors of recurrent pneumonia among studied patients.

Variable	Regression coefficient (B)	P value	Adjusted Odds Ratio (95%CI)
Consanguinity Positive Negative	2.2	<0.001	8.6(3.5-21.5) 1r
Parental smoking Yes No	0.97	0.03	2.6(1.1-6.3) 1r
Weight Normal Underweight Overweight	 1.5 1.9	 0.005 0.09	 1r 4.6(1.6-13.3) 6.4(0.7-54.7)
Down syndrome Yes No	2.05	0.02	7.7(1.4-44.3) 1r
Constant % Correctly predicted Model $X^{2,}$ p value	-3.27 82.2 40.1, <0.001		

CI: Confidence Interval.

DISCUSSION

Pneumonia has been considered as a major public health problem globally, and it is one of the main causes of morbimortality among under-five children [(10)]. **Weigl *et al.*** [(11)] stated that RP happens in about 7.45 % of the overall children in industrialised nations, later in 2017, **Montella *et al.*** [(2)] told that RP occurs in 7.7%–9% of children with community-acquired pneumonia.

This study aimed to highlight the prevalence of RP and risk factors for recurrence. Based on the present results, the prevalence of RP in Mansoura University Children Hospital was 20% of total cases of pneumonia admitted in Pediatric Department of Mansoura University Hospital, however other studies in other governorates in Egypt showed variation in reported rates. The prevalence of RP in children in Assiut University Children's Hospital was 9.2% as reported by **Saad *et al.*** [(12)], while in the same hospital in 2019, **El–Saied *et al.*** [(3)] stated that the prevalence of recurrent pneumonia in children younger than 16 years old was 12.61%. At Qena, recurrent pneumonia represented 11.40% of 763 children admitted with pneumonia [(8)]. The variation of reported rates may be attributed to the difference of study design, sample size, different age groups of children, duration of the study and season of studied cases admission. The lower prevalence of recurrent pneumonia in upper Egypt like Assiut than Mansoura may be due to less exposure to pollutants and less environmental contamination of air.

The higher prevalence of recurrent pneumonia in our study might have resulted from difference in methods of study, detailed history taking with careful examination and widening of the age range. Recurrent pneumonia is usually resulted from deficiencies in the local pulmonary or systemic host defenses or from underlying disorders that modify the pulmonary defenses.

The age was a non-significant risk factor in the present study. The median age of cases of pneumonia was 4 years old which approximately agree with one of Egyptian studies in Assiut University by **El–Saied *et al.*** [(3)], in which age was 3.9 years old. However, it slightly differs from that stated by **Saad *et al.*** [(12)] at the same Hospital, as age was 3.2 years. While, **Abdel Baseer and Sakhr** [(8)], reported that the mean age of pneumonia cases admitted at South Valley University Qena Faculty of Medicine was 7.15 years.

Regarding international studies, **Ciftçi *et al.*** [(13)] in Singapore reported that median age of 1702 children admitted with CAP was 4.2 years old. While in Milano, Italy, **Patria and Esposito** [(9)] showed that median age of recurrent pneumonia was 7.9 years old. Females presented 55% of cases and males presented 45%, but it does not agree with Qena study which included 55.2 % males and 44.8% females [(8)], nor with what stated by **El–Saied *et al.*** [(3)] whose study included 65.45% males and 34.54% females, which was similar to previous study in the same hospital by **Saad *et al.*** [(12)], as male cases represented 65 % and female cases represented 35%. On another hand, in Milano, Italy, **Patria and Esposito** [(9)] included 50% males and 50% females.

Most of our cases were from rural areas, which represented 71.1%. About 21.9% of them were recurrent pneumonia. Where urban cases represented 28.9%, about 15.4% of them were recurrent pneumonia. That was statistically non-significant. Our study is in line **El–Saied *et al.*** [(3)] who reported that RP was significantly frequent in rural areas, low socioeconomic standards and those living in over-crowded regions due to poor housing, bad hygiene, and improper nutrition. In addition, improper ventilation because of overcrowding increases internal house dampness and offers nourishing media for mites and respiratory viruses, which play an

essential role with regard to respiratory disease induction. But our study doesn't agree with **Abdel Baseer and Sakhr** [8] who stated that rural residence was significant risk factor for recurrent pneumonia in children and represented 63.2%. This may be attributed to the absence of medical facilities in rural areas and the lesser awareness of parents in low-income areas, that might be accompanied by a more critical conditions for their children as reported by **Abdou and Ahmed** [6] whose study included 77% rural cases and 23% urbans.

Consanguineous marriages are reported to play a major role in occurrence of several diseases especially pneumonia. In the current study, 29.4% of studied cases had history of positive consanguinity. About 41.5% of cases with positive consanguinity have recurrent pneumonia. That was statistically significant and is in accordance with **Zhang *et al.*** [14] who showed that 6.1% of children suffered from COVID-19 pneumonia had been born to consanguineous parents. They ensured that the ratio of cases born to consanguineous parents was significantly greater than that in controls. Also, consanguinity was observed as an essential predisposing factor for RP in Ankara, Turky [15] whose study contained 35% of studied cases who were born to consanguineous parents.

In the current study, 46.7% of studied cases have history of exposure to parental smoking and 27.4% of them have recurrent pneumonia. That was statistically significant and coincides with **El–Saied *et al.*** [3] whose study included 6.36% cases with history of exposure to smoking from total cases of recurrent pneumonia with P value < 0.001. While **Abdel Baseer and Sakhr** [8] reported that exposure to smoking is non-significant risk factor for recurrent pneumonia. Their study included 42.5% of cases of recurrent pneumonia with positive history of exposure to smoking.

In the present study, cases of twins represented 7.2 % of all studied cases. About 30.8 % of twins' cases were recurrent pneumonia, which was non-significant according to our results. Twins deliveries were reported to increase the incidence of respiratory morbidity as told by **Groene *et al.*** [16]. Up to our knowledge, the factor of twins' deliveries wasn't observed in previous studies about recurrent pneumonia as risk factor.

Body weight was one of the most important risk factors in our study. Previous studies ensured the effect of body weight on respiratory health. For example, obesity has been reported to be accompanied by a negative effects on respiratory functions, mostly owing to mechanical factors and the metabolic effects of the excess adipose tissue [17]. As a result, it may be assumed that obese cases might have reduced respiratory reserve functions to cope with extensive pulmonary infections in comparison to normal-weight cases.

Up to our results, overweight cases represented 2.8% of total cases of pneumonia. About 40% of them were recurrent pneumonia. That was statistically non-significant and is similar to **El–Saied *et al.*** [3] whose overweight cases represented 7.27% from cases of recurrent pneumonia and was considered statistically nonsignificant with P value 0.07%. Also, **Abdel Baseer and Sakhr** [8] stated that overweight is nonsignificant risk factor for recurrent pneumonia. On another hand, underweight cases represented 14.4% of total cases with pneumonia, about 38.5% of them were recurrent pneumonia with P value = 0.005%. Also, our study agrees with most of preceding studies performed in the developing nations that recorded strong relationship between under malnutrition and RP as **El–Saied *et al.*** [3] who reported that 19.09% of studied cases of recurrent pneumonia have undernutrition, which was considered significant with P value < 0.001%. That can be explained by that underweight is often associated with malnutrition. There is increasing evidence that malnutrition is accompanied by an impairment of responses with regard to several forms of the immune system, which include lymphocyte count and function, stimulation of macrophages, phagocytosis and cytokine release [18].

In addition to associated malnutrition, some other factors may be related to a worse prognosis for underweight patients in the case of infection. Correspondingly, cases with low BMI could have decreased leptin formation throughout sepsis. Leptin has been demonstrated to act as a proinflammatory and immunomodulatory cytokine, improving CD4 lymphocyte responses towards a T helper type I phenotype. Low leptin values throughout sepsis are accompanied by increased mortality in adults. In addition, underweight cases demonstrating protein malnutrition are expected to have reduced respiratory muscle strength and, as a result, impaired respiratory function compared with well-nourished ones [19].

Similar to other studies, the gestational age was a non-significant risk factor in the present study. Total cases of preterm with pneumonia represented 3.9% of total cases of pneumonia. About 14.3 of them recurrent pneumonia, which was statistically non-significant. That was in line with **El–Saied *et al.*** [3] whose studied cases of recurrent pneumonia were 110 cases. About 7.27% of them were preterm, which was considered a non-significant result. However, **Abdel Baseer and Sakhr** [8], whose cases of preterm children represented 32.1% of total cases of recurrent pneumonia, while represented 18.3% of control, and the difference was considered statistically significant with P value <0.05.

Our current study shows that artificial feeding during first six months was non-significant risk factor for recurrent pneumonia in children. Total cases of artificial feeding represented 48.3 % of total cases of pneumonia. About 25.3% of them had recurrent pneumonia. That was identical with **El–Saied *et al.*** [3], whose cases of artificial feeding represented 51.81% of total cases with recurrent pneumonia. **Abdel Baseer and Sakhr** [8] found cases of artificial feeding represented 56.3% of recurrent pneumonia cases while represented 46% of control, which was considered statistically non-significant.

Based on our current study, about 68.9% of total cases were associated with other accompanied diseases. About 22.2% of total cases of pneumonia had a history of immunodeficiency and history of immunomodulators use, 25% of them had recurrent pneumonia, which was statistically non-significant risk factor for recurrent pneumonia. The current study was in accordance with **El–Saied *et al.*** [3], whose cases with immunodeficiency represented 20.9% of recurrent pneumonia cases, and that also was non-significant. Also, we agree with **Abdou and Ahmed** [6], whose cases of recurrent pneumonia with immunodeficiency represented 20.9% and that was non-significant. However, **Hoving and Brand** [7] and **Patria and Esposito** [9] recorded that IDD were present among 7.7–17.75 % of cases of RP. They showed that Ig replacement therapy has significantly decreased the rate and degree of acute infections in primary immunodeficiencies, even though long-term pulmonary consequences, which include chronic lung disease, could happen. Clinically, screening for IDD is helpful in assessing RP, it has to be suspected in children with infections, which are particularly severe and recurrent, that are caused by uncommon microbes, or that include numerous sites including the lungs [20].

An immunomodulator is a substance, which modifies, or modulates, the immune system to help the human body respond to diseases. It includes antibodies, cytokines, chemokines, and immune cells. Some examples of these are TNF antagonists, corticosteroids, IL supplements, and cytokine antagonists. Immunomodulators have found applications in the treatment of various autoimmune disorders, often targeting specific aspects of the immune system while not directly affecting others to reduce collateral injury. The alteration in immune response induced by immunomodulators could increase liability for infections, in particular those caused by frequently encountered respiratory microbes [21].

Congenital heart diseases (CHD) were recognized in 21.7% of our patients. About 20.9% of them were recurrent pneumonia, which was statistically non-significant with P value 0.9. The current results were in agreement with **El–Saied *et al.*** [3], whose cases with CHD represented 25.45% of cases with recurrent pneumonia and this result was considered non-significant. On another hand, **Abdel Baseer and Sakhr** [8] revealed that CHD was significant predisposing factor for recurrent pneumonia with P value < 0.001%. Also, **Çapanoğlu *et al.*** [15] recorded that CHD were the most essential etiology for RP in 33.9% of children with RP. This can be explained by the fact that dilated blood vessels or chambers of the heart may compress the bronchi, causing impaired drainage of pulmonary segments. Also patients with congenital lesions causing left-to-right shunting and an increased pulmonary blood flow have an increased susceptibility to respiratory infections [22]. A left-to-right shunt could negatively affect lung functions, and superimposed lower respiratory tract infections cause further compromise and may be accompanied by respiratory failure [9].

The present study shows no significant increase in cases of RP within FMF cases. About 8.3% of our studied cases had FMF, 40% of them had RP and that was statistically non-significant. Up to our knowledge, familial Mediterranean fever (FMF) wasn't observed as risk factor for recurrent pneumonia in previous studies. But it was observed in our studied cases but it was non-significant according to our results. FMF is an immunological disorder featured by episodes of fever and serositis. Generalized peritonitis, unilateral pleuritis, pericarditis and monoarthritis could happen during FMF attacks too [23]. Our study shows significant association between Down syndrome and RP with P value = 0.05%. **De Lausnay *et al.*** [24] studied the prevalence of lower airway anomalies in children with Down syndrome in comparison with controls and stated that recurrent infections represented 36.9% within cases of Down syndrome compared with 11.3% within controls with P value <0.001. **Kapoor *et al.*** [25] revealed that the major symptoms for the first consultation in children with Down syndrome were tachypnea and pneumonia (36 %) and RP in 16 %.

Conditions affecting the larynx and trachea are also common. Laryngomalacia, a congenital softening of the laryngeal tissues above the vocal cords causing stridor, is the commonest finding in infants and children with Down syndrome in the initial two years of life [26], with a prevalence of about 50% [25]. Cases with DS had a higher possibility of dysphagia and silent aspiration, making them more liable for pneumonia [27]. In our study, bronchial asthma was observed in our studied cases. It represented 3.9% of total studied cases. About 14.3% of them were recurrent pneumonia and 85.7% were non-recurrent. That was considered statistically non-significant. This is familiar with **Cashat-Cruz *et al.*** [28], who recorded that asthma wasn't a frequent underlying predisposing factor of RP in children. In contrast to our study, **Ciftçi *et al.*** [13] recorded asthma as the commonest underlying disease in RP followed by GERD, IDD and CHD. Also, **Abdel Baseer and Sakhr** [8], reported that cases of bronchial asthma represented 35.6% of recurrent pneumonia cases and 10.3% in controls with P value < 0.001.

In the current study, history of foreign body aspiration (FBA) was observed in 10.6% of total studied cases. About 21.1% of them had recurrent pneumonia and 78.9% had non-recurrent. That was statistically non-significant. That doesn't agree with **Abdel Baseer and Sakhr** [8] who stated that FB aspiration was significant risk factor for recurrent pneumonia with P value <0.01%. In addition, FBA is a rare but potentially fatal event [29]. Manifestations characteristically consist of a choking attack followed by cough and dyspnea [30]. Although chest radiography is the primary imaging modality used to identify a foreign body in the lower airway, a study by **Sehgal *et al.*** [31] showed that only 24.6% of foreign body inhalation has the radiological manifestations of FBA

and direct visualization of the foreign body in the case of radiopaque foreign bodies. When a diagnosis is not established immediately, retained foreign bodies may lead to recurrent pneumonia, recurrent hemoptysis, bronchiectasis, or other complications [31].

In our current study, history of cortisone intake represented 1.7% of our studied cases. About 33.3% of them had recurrent pneumonia and 66.7% had non-recurrent. That was considered statistically non-significant. In contrast to our study, **Blum *et al.*** [32] stated that cortisone therapy is significant predisposing factor for RP with P = 0.007%. Also, much researches assessing adverse effects after short-term prescription of corticosteroids have demonstrated an increase of secondary infections even beyond day 30 [33].

During our study, we noticed the clinical signs in recurrent and non-recurrent pneumonia and they were approximately the same in both. Recurrent and non-recurrent pneumonia presented with fever, tachypnea, crackles, nasal flare but chest wall deformities were more associated with recurrent pneumonia than non-recurrent pneumonia with P value <0.001. That is in line with **Abdel Baseer and Sakhr** [8] who demonstrated that 73.5% of recurrent pneumonia cases presented with chest wall indrawing. Concerning radiological findings, about 21.9% of cases presented with collapse having recurrent pneumonia and 78.1% non-recurrent. That is in line with **Abdel Baseer and Sakhr** [8] who demonstrated that 26.4% of cases of recurrent pneumonia presented with collapse. About 76% of our studied cases presented with hyperinflation. About 22.5% of them having recurrent pneumonia and 77.5% non-recurrent which was considered statistically non-significant. **Abdel Baseer and Sakhr** [8] reported that about 6.9% of cases of recurrent pneumonia had hyperinflation.

Cases with recurrent pneumonia represented about 30.5% of cases with consolidation while non-recurrent pneumonia represented 69.5%. That was considered statistically significant for recurrent pneumonia with P value<0.001. That agrees with **Abdel Baseer and Sakhr,** [8] whose cases with consolidation represented about 29.9% of cases of recurrent pneumonia. Cases with recurrent pneumonia represented about 19% of cases with interstitial infiltrates while non-recurrent pneumonia represented 81%. That was considered statistically non-significant for recurrent pneumonia. This is in line with the study of **Abdou and Ahmed** [6] who stated that cases with infiltrates represented only 7% of cases with recurrent pneumonia. About 30% of cases presented with pleural effusion in our studied cases, had recurrent pneumonia and 70% of them non-recurrent, which was considered statistically significant for recurrent pneumonia with P value < 0.001. That is in line with **Abdou and Ahmed** [6] who stated that 13% of cases of recurrent pneumonia presented with pleural effusion. Also, we agree with **Porcel *et al.*** [34] who found that 19 % of pleural effusion caused by pneumonia.

Cases presented with empyema within our studied cases were 16 cases. About 25% of them had recurrent pneumonia and 75% non-recurrent. That is non-significant and in line with **Grisaru-Soen *et al.*** [35] who stated that 75.4% of children having pneumonia presented without empyema and 24.6% having empyema but these children with empyema don't have CAP alone. They added that immunization could interfere with the possibility of pediatric empyema and must be evaluated in a prospective manner.

Despite the promising outcomes of the current study, the small sample size and being a single centered study have been considered main limitations. Only hospitalized patients were included in the study and some children with recurrent pneumonia could have been treated at outpatient clinics. Additionally, certain cases with pneumonia at one time may have the disease later and treated at another hospital so escape our detection. As a result, we mightn't identify the precise percent-age of cases with RP in the current hospital. Also, we can't be sure if all associated diseases were found before diagnosis of pneumonia or not, that makes possibility for pneumonia to be risk factor for other diseases, not the opposite.

CONCLUSION

Recurrent pneumonia is a threatening problem contributing to 20% of total children admitted in MUCH with pneumonia during the period of the study. Recurrent pneumonia can be presented by nonspecific symptoms and signs as cough, fever, tachypnea, respiratory distress, crackles, nasal flaring and stridor. Radiology of recurrent pneumonia may reveal consolidation, pleural effusion, interstitial infiltrates or even empyema. Concerning risk factors for recurrent pneumonia, this study shows that there was significant increase in prevalence of recurrent pneumonia within cases with positive consanguinity, history of parental smoking, underweight and Down syndrome cases. About 41% of cases having positive consanguinity, 27.4% of cases having history of parental smoking, 38.5% of underweight cases and 50% of Down syndrome cases were recurrent pneumonia.

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