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Clinical Outcomes of Lower Respiratory Tract Infections: An Epidemiological Study Comparing Viral and Non-Viral Lower Respiratory Tract Infections in Jeddah

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Abstract

Objective: The aim of this study is to find if Viral Lower Respiratory Tract Infections (V-LRTI) occurs more common on top of existing Chronic Lung Diseases (CLD) or has no relation. The study also aimed to learn about the clinical presentation V-LRTI in young children in Jeddah.

Materials and methods: This was a retrospective study of 136 young patients of 5 years or less who were presented to the department of pediatrics at doctor Soliman Fakeeh hospital, Jeddah. The children diagnosed primarily as LRTI were enrolled in the acute phase and through the chronic stage of the disease. Dr. Soliman Fakeeh Hospital is a private (tertiary care) hospital uniquely located to serve a wide catch population from South and North Districts of Jeddah. A database was developed to provide the information about preliminary diagnosis, clinical examination, laboratory investigations, treatment and final diagnosis. Among the 136 patients, seven patients were lost to follow up and hence, excluded from analysis. Nasopharyngeal Aspirate (NPA) test type was done to identify causative viral infection. End-point was calculated as per protocol on 129 patients.

Results: A total number of 34 patients out of 129 had positive NPA Viral Test (26%); 19 patients out of the 34 (56%) had CLD and 15 patients (44%) had no CLD. On the other side, 95 patients out of 129 had negative NPA Viral Test (74%); 59 patients out of the 95 (62%) had CLD and 36 patients (38%) had no CLD. The results are not significant (p-value=0.524). We concluded that there is no significant difference between occurrences of V-LRTI on top of existing CLD. Results show that there is significant difference between V-LRTI and non-V-LRTI presence in the following variables (p-value<0.05): In V-RTIs; Age at time of diagnosis is less (0.36+0.31 vs 0.79+0.07), admission to hospital is more (91.2% vs 55.8%), oxygen saturation is less (92.50+3.72 vs 95.96+0.57), Crackles is more (65.6% vs 40%.0%) Wheezing is more (71.9% vs 43.2%), Dyspnea is more (44.1% vs 9.5%) and Diarrhea is more (5.9% Vs 0.0%).

Conclusion: The study shows that V-LRTI constitutes (27%) with RSV being the commonest causative virus (79.4%). V-LRTI statistically occurs in younger age with more hospitalization. Dyspnea, crackles and wheezing are statistically more frequent in V-LRTI with less Oxygen saturation than Non-V-LRTI. CLD is not a predisposing factor in V-LRTI in preschool age.

Keywords: *C. albicans*; *Caspofungin*; Fluconazole; Disc diffusion; Broth microdilution

Introduction

Respiratory tract infection is considered as a very common type of infectious disease worldwide. Many viruses cause respiratory tract infections and are identified by a method called Polymerase Chain Reaction (PCR).

Acute Lower respiratory tract (LRT) infections are thought to cause nearly 75% of all acute illnesses and are considered the main cause of hospitalization amongst infants and young children globally.

These infections vary depending on the age group, season, underlying disease and upper or lower respiratory tract involvement. Viral respiratory tract infections play a major role as a national health issue due to increased hospital admissions, labor mortalities and school absenteeism of children and the socio-economical affection of viral respiratory infections are observed especially in wintertime.

Influenza A, Influenza B, Rhinovirus (RV), Respiratory Syncytial Virus (RSV), Corona Virus (CV), Para Influenza Virus (PIV), Human Meta Pneumo Virus (HMPV) and Human Boca Virus (HBOV) are the common cause of viral respiratory tract infections. In the last decade, many new respiratory viruses have emerged, including HMPV, new subtypes of Human Corona Viruses (HCoV) and Boca Virus (HBoV).

Acute attacks of severe lower respiratory tract illness are very common in preschoolers, and almost 14% to 26% of preschoolers show symptoms of recurrent wheezing during the first six years of life [1,2]. These severe attacks are often associated with morbidity, resulting in multiple visits to physicians, and emergency departments. Most of these cases were diagnosed with asthma, and among them, 20.9% seek emergency care, and 6.5% are hospitalized every year [3,4].

Children diagnosed with LRT infections with wheezing are more prone to develop recurrent wheezing and/or asthma later in childhood than those having LRT infections without wheezing, even though they

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are affected by the same virus, previous studies have reported a higher risk for young children who are more likely to have wheezing during or following a viral LRT infection or Chronic Lung Diseases (CLD) [5,6].

In our study, clinical outcomes of patients with acute LRTIs in preschool age were studied to compare between the clinical outcomes of V-LRTI and Non-V-LRTIs with a primary objective to investigate whether V-LRTI occurs more common in preschool children with Chronic Lung Diseases (CLD).

Materials and Methods

In this study, we enrolled 136 young patients of 5 years or less, diagnosed primarily as LRTI between January 2008 and January 2009. All the patients were in the acute phase and followed up until cure. Finally, the diagnosis of the presence of chronic lung disease was made.

Study design

This retrospective study involved children 0 to 5 years of age who were presented to the pediatric outpatient and emergency departments at doctor Soliman Fakeeh hospital, Jeddah with LRTI and positive respiratory culture for respiratory virus.

The study sample was sourced from virus cultures of the positive specimens. Subsequently, a chart review (emergency department, outpatient and inpatient records) was done on the positive culture cases and those with a diagnosis of LRTI were selected for analysis.

Recognition of pediatric LRTI was based on the physician diagnosis of pneumonia, bronchitis and bronchiolitis. (All medical codes at Doctor Soliman Fakeeh hospital, Historical Abstracting System, WinRecs that contain the words "pneumonia", "bronchitis" or "bronchiolitis" were included.) Only the first respiratory isolate, during a single clinical event, was included in the analysis. The studied cases did not include readmissions. Participants' demographic, clinical and radiologic findings were collected. Clinical outcome data were assessed according to days of hospitalization, use of mechanical ventilation, and mortality.

The statistician developed a database to provide the following information:

1. Patient demographics (initials of a name; date of birth; age, weight and height at presentation; sex, ethnicity; place of residence).

2. Detailed clinical history – to include any associated underlying medical condition/s, physical examination on admission, discharge and subsequent medical course over time.

3. Pertinent laboratory and/or ancillary tests (CXRs, CT scan, histopathology, bronchoscopy, capillary blood gases, and pulmonary function tests) at presentation and subsequent clinic follow up.

4. Results of Respiratory Virus Test: Nasopharyngeal Aspirate (NPA) was taken from each patient and tested by Polymerase Chain Reaction (PCR) to detect major respiratory viruses namely; Influenza A, Influenza B, Respiratory Syncytial Virus (RSV), Rhinovirus, Enterovirus, Parainfluenza 1 2 and 3, Adenovirus, Human Metapneumovirus (HMPV) and Bordetella virus.

5. Treatment of supportive therapy, antibiotics, steroid or mechanical ventilation.

6. We follow up cases through the acute phase to cure.

Statistical analysis

Frequency distribution using count and percentage were used to describe categorical data and descriptive statistics using appropriate statistics as a mean average, standard deviation, median, lower quartile and upper quartile to describe numerical data. The data entry and analysis were done using computer package Statistical Packages of Social Sciences (SPSS) version Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.

Results

Tables showing detailed findings; Demography, Significant social history, Clinical Presentation, Signs, Initial Diagnosis, Symptoms, Significant Past Medical History, Investigations, Therapies Interventions, Referral Pattern and Final Diagnosis are presented at the end (Tables 1-12).

Discussion

Our study aims to find the relation between occurrences of V-LRTI on top of CLD. It also aims to study the clinical presentation of LRTI and to compare viral versus non-viral infection specifically.

We enrolled 136 children of 5 years or less with LRTI between January 2008 and January 2009 in Jeddah with a preliminary diagnosis of LRTI [7,8]. We proceeded with detailed clinical history, laboratory investigations, and treatment of the acute phase through to cure and diagnose the presence of chronic lung disease [9,10]. All patients were subjected to Respiratory Virus Test. Nasopharyngeal Aspirate (NPA) was taken from each patient and tested by Polymerase Chain Reaction (PCR) to detect major respiratory viruses [11,12].

Our study showed that V-LRTI constituted 26.4% (34 patients out of 129 LRTI patients) and Non-V-LRTI constituted 73.6%. Our results near to results obtained by Leena Ravindra et al. that showed "Viral antigens were detected in 28.6% of LRTI [13]. The primary objective of our study is to find if V-LRTI occurs more common on top of existing CLD or not. Our results showed that 20 (28.8%) out of 34 patients with V-LRTI had CLD whereas 58 (61.1%) out of 95 patients with none-V-LRTI had CLD. The difference is not significant. Respiratory syncytial virus (RSV) is the commonest causative virus; it is the causative virus alone in 79.4% of our cases (27 out of 34) and with other viruses in other 5.8% (2 patients). This result matches Leena Ravindra et al. and Gooskens et al., in which RSV was the commonest cause of V-LRTI [13,14].

		Overall Sample		Positive Viral Test		Negative Viral Test		p-value
		Count or Mean	% or SD	Count or Mean	% or SD	Count or Mean	% or SD	
Age at Dx (Yrs)	Mean and SD	0.67	0.61	0.36	0.31	0.79	0.07	**0.001**
Age in Months	Mean and SD	8.20	7.30	4.35	3.71	9.70	0.85	<0.001
Gender	Male	79	61.2%	20	58.8%	59	62.1%	0.736
	Female	50	38.8%	14	41.2%	36	37.9%	
Weight (Kg)	Mean and SD	8.61	2.67	10.28	3.70	8.46	0.39	0.194

Table 1: Demography.

		Overall Sample		Positive Viral Test		Negative Viral Test		p-value
		Count or Mean	% or SD	Count or Mean	% or SD	Count or Mean	% or SD	
Sick contacts (Upper respiratory disease or fever)	Yes	30	23.3%	10	29.4%	20	21.1%	0.322
	No	99	76.7%	24	70.6%	75	78.9%	
Crowding at home (Family member more than 6)	Yes	16	12.4%	4	11.8%	12	12.6%	0.895
	No	113	87.6%	30	88.2%	83	87.4%	
Smoking	Yes	21	16.3%	8	23.5%	13	13.7%	0.182
	No	108	83.7%	26	76.5%	82	86.3%	

Table 2: Significant Social History.

		Overall Sample		Positive Viral Test		Negative Viral Test		p-value
		Count or Mean	% or SD	Count or Mean	% or SD	Count or Mean	% or SD	
Days of admission	Mean and SD	2.75	1.93	3.10	1.42	2.55	0.30	0.210
Admission to hospital	Yes	84	65.1%	31	91.2%	53	55.8%	**<0.001**
	No	45	34.9%	3	8.8%	42	44.2%	
Chest CT	Yes	29	22.5%	8	23.5%	21	22.1%	**0.864**
	No	100	77.5%	26	76.5%	74	77.9%	
Barium	Yes	5	3.9%	1	2.9%	4	4.2%	**0.742**
	No	124	96.1%	33	97.1%	91	95.8%	

Table 3: Clinical Presentation.

		Overall Sample		Positive Viral Test		Negative Viral Test		p-value
		Count or Mean	% or SD	Count or Mean	% or SD	Count or Mean	% or SD	
Saturations	Mean and SD	94.12	3.70	92.50	3.72	95.96	0.57	**0.001**
Crackles	Yes	59	45.7%	21	61.8%	38	40.0%	**0.029**
	No	70	54.3%	13	38.2%	57	60.0%	
Wheezing	Yes	64	49.6%	23	67.6%	41	43.2%	**0.014**
	No	65	50.4%	11	32.4%	54	56.8%	
Clubbing	Yes	1	0.8%	1	2.9%	0	0.0%	**0.093**
	No	128	99.2%	33	97.1%	95	100.0%	

Table 4: Signs.

Our study showed that cases with positive V-LRTI required higher hospital admissions rate 91.2% (31 of 34) compared to 55.8% (53 of 95) in the non-viral group. In studies done by Gooskens et al. and Akturk et al. showed that RSV is the predominate V-LRTI [14,15]. The mean age in our study was 8.20+7.30 (mean+SD) months. The mean age in viral group is less than that of non-viral group (4.35+3.71 and 9.70+0.85 respectively). The different is significant ($p<0.001$). LRTI is more common in males. 61.2% (70 out of 129) were males, and 38.8% were female. The difference in gender between viral and non-viral groups is not significant. Many studies showed that the incidence of LRTI is more common in males [16,17]. 23.3% (30 of 129) of cases had a history of sick contacts, and 12.4% had crowded family history (6 persons or more). There is no statistically significant difference between viral and non-viral groups.

In a study done by Lemke et al., secondhand (SHS) smoking history was present in 57% of infants [18]. This result is higher than what we have obtained where SHS in our study was 16.3% (21 of 129). There was no statistically significant difference between viral and non-viral groups (23.5% and 13.7% respectively). "Cough" was the predominant symptom. It was a complaint in 98.4% in our sample, this match many other studies. Cough is a symptom in 99.8% (Wood et al.) and 99.0% (Harris et al.) [19,20]. There was no statistically significant difference between viral and non-viral groups. “Dyspnea” was a complaint in 18.6% (24 of 129 patients). It was 44.1% (15 of 34) in V-LRTI group compared to 9.8% (9 of 95) in Non-V-LRTI group. The differences between other symptoms between the two groups are not significant. The following charts shows the incidence of symptoms in our study (Figures 1-3). 65.1% (84 of 129 patients) needed hospitalization. 31 (37%) out the of 84 patients that admitted to hospital were due to the virus. This result is near to what is given by Michelow et al. (45%) [21]. Admission to hospital is more common in viral group 91.2% (31 of 34) compared to 55.8% (53 of 95) in non-viral group. The difference is statistically significant.

		Overall Sample		Positive Viral Test		Negative Viral Test		p-value
		Count or Mean	% or SD	Count or Mean	% or SD	Count or Mean	% or SD	
Pneumonia+Wheezing bronchitis	Yes	48	37.2%	12	35.3%	36	37.9%	0.788
	No	81	62.8%	22	64.7%	59	62.1%	
Pneumonia	Yes	2	1.6%	0	0.0%	2	2.1%	0.394
	No	127	98.4%	34	100.0%	93	97.9%	
Wheezing bronchitis	Yes	3	2.3%	1	2.9%	2	2.1%	0.781
	No	126	97.7%	33	97.1%	93	97.9%	
Bronchitis	Yes	57	44.2%	10	29.4%	47	49.5%	0.043
	No	72	55.8%	24	70.6%	48	50.5%	
Bronchiolitis	Yes	60	46.5%	21	61.8%	39	41.1%	0.038
	No	69	53.5%	13	38.2%	56	58.9%	
No of diagnosis	0	24	18.6%	4	11.8%	20	21.1%	0.488
	1	88	68.2%	25	73.5%	63	66.3%	
	2	17	13.2%	5	14.7%	12	12.6%	
Presentation	Nothing	24	18.6%	4	11.8%	20	21.1%	0.002
	Bronchiolitis	45	34.9%	20	58.8%	25	26.3%	
	Bronchitis	41	31.8%	4	11.8%	37	38.9%	
	Bronchitis, Bronchiolitis	14	10.9%	4	11.8%	10	10.5%	
	Pneumonia	2	1.6%	0	0.0%	2	2.1%	
	Wheezing bronchitis, Bronchiolitis	2	1.6%	2	5.9%	0	0.0%	
	Wheezing bronchitis, Bronchitis	1	0.8%	0	0.0%	1	1.1%	

Table 5: Initial Diagnosis.

		Overall Sample		Positive Viral Test		Negative Viral Test		p-value
		Count or Mean	% or SD	Count or Mean	% or SD	Count or Mean	% or SD	
Cough	Yes	127	98.4%	34	100.0%	93	97.9%	0.394
	No	2	1.6%	0	0.0%	2	2.1%	
Sputum (Productive cough)	Yes	6	4.7%	2	5.9%	4	4.2%	0.691
	No	123	95.3%	32	94.1%	91	95.8%	
Hemoptysis	Yes	38	29.5%	7	20.6%	31	32.6%	0.186
	No	91	70.5%	27	79.4%	64	67.4%	
Wheeze	Yes	95	73.6%	28	82.4%	67	70.5%	0.179
	No	34	26.4%	6	17.6%	28	29.5%	
Fever	Yes	92	71.3%	27	79.4%	65	68.4%	0.224
	No	37	28.7%	7	20.6%	30	31.6%	
Dyspnea/SOB	Yes	24	18.6%	15	44.1%	9	9.5%	**<0.001**
	No	105	81.4%	19	55.9%	86	90.5%	
Conjunctivitis	Yes	7	5.4%	4	11.8%	3	3.2%	0.057
	No	122	94.6%	30	88.2%	92	96.8%	
Missing School	Yes	12	9.3%	3	8.8%	9	9.5%	0.911
	No	117	90.7%	31	91.2%	86	90.5%	
Ear problems	Yes	1	0.8%	0	0.0%	1	1.1%	0.548
	No	128	99.2%	34	100.0%	94	98.9%	
Sinus problems	Yes	17	13.2%	4	11.8%	13	13.7%	0.776
	No	112	86.8%	30	88.2%	82	86.3%	
Vomiting	Yes	18	14.0%	5	14.7%	13	13.7%	0.883
	No	111	86.0%	29	85.3%	82	86.3%	
Diarrhoea	Yes	2	1.6%	2	5.9%	0	0.0%	**0.017**
	No	127	98.4%	32	94.1%	95	100.0%	

Table 6: Symptoms.

		Overall Sample		Positive Viral Test		Negative Viral Test		p-value
		Count or Mean	% or SD	Count or Mean	% or SD	Count or Mean	% or SD	
Prematurity	Yes	17	13.4%	4	12.1%	13	13.8%	0.804
	No	110	86.6%	29	87.9%	81	86.2%	
Oxygen dependency	Yes	2	1.6%	0	0.0%	2	2.1%	0.394
	No	127	98.4%	34	100.0%	93	97.9%	

Table 7: Significant Past Medical History.

		Overall Sample		Positive Viral Test		Negative Viral Test		p-value
		Count or Mean	% or SD	Count or Mean	% or SD	Count or Mean	% or SD	
NPA - type	None	95	73.6%	4	11.8%	91	95.8%	0.000
	Parainfluenza	5	3.9%	4	11.8%	1	1.1%	
		0	0.0%		0.0%	0	0.0%	
	RSV	27	20.9%	24	70.6%	3	3.2%	
	RSV-ROTA	1	0.8%	1	2.9%	0	0.0%	
	RSV+Para influenza	1	0.8%	1	2.9%	0	0.0%	
PPD	Yes	1	0.8%	0	0.0%	1	1.1%	0.548
	No	128	99.2%	34	100.0%	94	98.9%	
WBC	High	18	28.1%	4	20.0%	14	31.8%	0.167
	Low	11	17.2%	6	30.0%	5	11.4%	
	Normal	35	54.7%	10	50.0%	25	56.8%	
HGB	Low	30	38.5%	9	37.5%	21	38.9%	0.907
	Normal	48	61.5%	15	62.5%	33	61.1%	
Plts	High	17	21.3%	6	24.0%	11	20.0%	0.870
	Low	8	10.0%	2	8.0%	6	10.9%	
	Normal	55	68.8%	17	68.0%	38	69.1%	

Table 8: Investigations.

	Positive Viral Test	
	No	%
RSV	27	79.40%
Parainfluenza	5	14.70%
RSV-ROTA	1	2.90%
RSV+Parainfluenza	1	2.90%

Table 9: NPA Type.

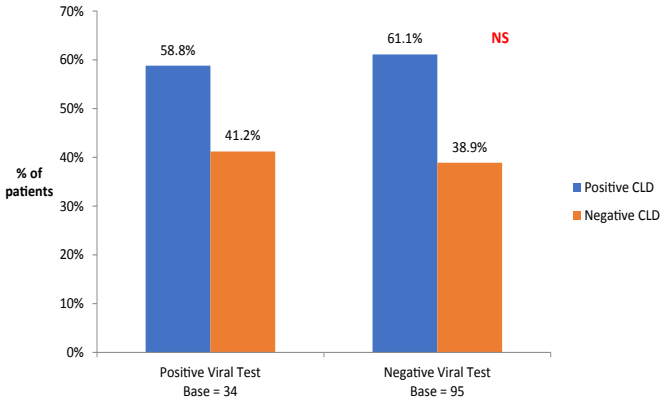

Figure 1. Incidence of Viral Lower Respiratory Tract Infection on top of Chronic Lung Disease.

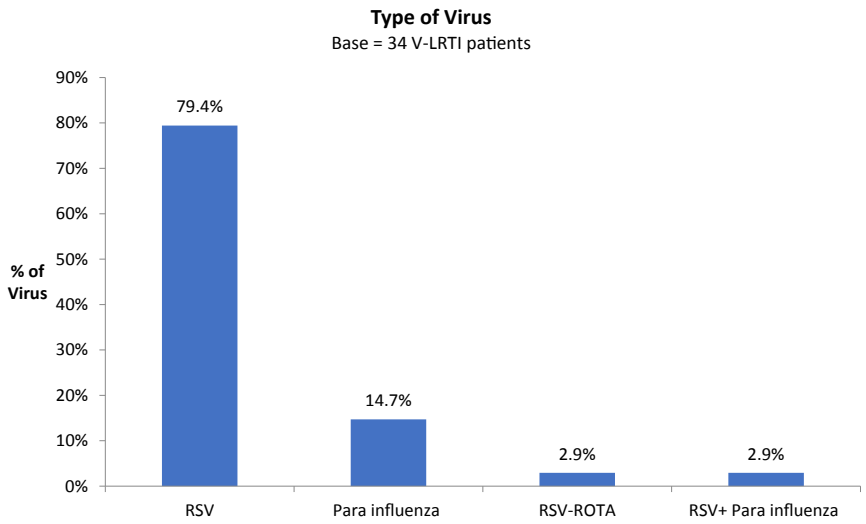

Figure 2. Causative of virus in 34 V-LRTI patients.

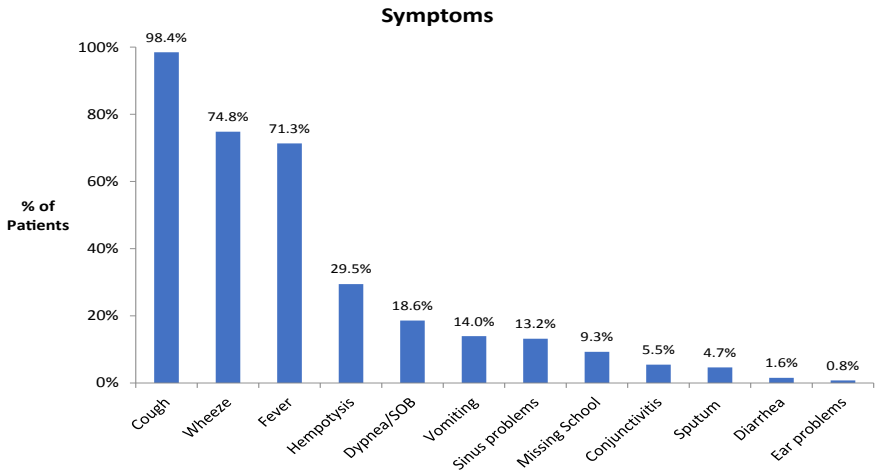

Figure 3. Symptoms by the overall Sample: Base=129 patients.

		Overall Sample		Positive Viral Test		Negative Viral Test		p-value
		Count or Mean	% or SD	Count or Mean	% or SD	Count or Mean	% or SD	
Oxygen	Yes	70	54.3%	28	82.4%	42	44.2%	**<0.001**
	No	59	45.7%	6	17.6%	53	55.8%	
Aerosolized Salbutamol	Yes	94	72.9%	29	85.3%	65	68.4%	0.147
	No	33	25.6%	5	14.7%	28	29.5%	
	Not Known	2	1.6%	0	0.0%	2	2.1%	
Steroids	Yes	50	38.8%	20	58.8%	30	31.6%	**0.017**
	No	77	59.7%	14	41.2%	63	66.3%	
	Not Known	2	1.6%	0	0.0%	2	2.1%	
Ventilatory Assistance	Yes	18	14.0%	6	17.6%	12	12.6%	0.551
	No	109	84.5%	28	82.4%	81	85.3%	
	Not Known	2	1.6%	0	0.0%	2	2.1%	
Antibiotics	Yes	95	73.6%	22	64.7%	73	76.8%	0.168
	No	34	26.4%	12	35.3%	22	23.2%	
Singulair	Yes	22	17.1%	6	17.6%	16	16.8%	0.915
	No	107	82.9%	28	82.4%	79	83.2%	

Table 10: Treatment.

		Overall Sample		Positive Viral Test		Negative Viral Test		p-value
		Count or Mean	% or SD	Count or Mean	% or SD	Count or Mean	% or SD	
Referral to Respirology	Yes	6	4.7%	3	8.8%	3	3.2%	0.178
	No	123	95.3%	31	91.2%	92	96.8%	
Bronchoscopy	Yes	5	3.9%	1	2.9%	4	4.2%	0.742
	No	124	96.1%	33	97.1%	91	95.8%	
Outpatient FU	Yes	12	9.3%	11	32.4%	1	1.1%	0.000
	No	117	90.7%	23	67.6%	94	98.9%	

Table 11: Patients' Referral.

		Overall Sample		Positive Viral Test		Negative Viral Test		p-value
		Count or Mean	% or SD	Count or Mean	% or SD	Count or Mean	% or SD	
Chronic Lung Disease	Positive CLD	78	60.5%	20	58.8%	58	61.1%	0.820
	Negative CLD	51	39.5%	14	41.2%	37	38.9%	

Table 12: Final Diagnosis.

Conclusion

- LRTI is a common disease in preschool age. It is more in males than females (61.2% and 38.8% respectively), and Cough and wheezes are the predominant symptoms.
- V-LRTI constitutes 27% with RSV being the commonest causative virus (79.4%).
- V-LRTI statistically occurs in younger age than Non-V-LRTI (4.35+3.71 and 9.70+0.85 months respectively). Admission to hospital is statistically more in V-LRTI (91.2%) than Non-V-LRTI (55.8%). Dyspnea, crackles and wheezing are statistically more frequent in V-LRTI than Non-V-LRTI with less Oxygen saturation.
- CLD is not a predisposing factor in V-LRTI in preschool age.

Recommendations

- Study the clinical outcomes of LRTI in a large number of patients.
- Study the effect of existing CLD on the clinical outcomes of LRTI.

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