Original Article

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Correlation Between Laboratory Findings and Clinical Diagnosis of Viral Upper Respiratory Tract Infection in Children

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Author`s Contribution

[1,2]Substantial contributions to the conception or design of the work; or the acquisition, [4,6]Active participation in active methodology, [2,3]analysis, or interpretation of data for the work, [5]Drafting the work or revising it critically for important intellectual content

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ABSTRACT

Objective: To evaluate the correlation between laboratory investigations and clinical diagnosis of upper viral respiratory tract infection in children.

Methodology: This prospective observational study was done at the Paediatric department of Combined Military Hospital, Bahawalnagar, from 1st Jan 2023 to 30th June 2023. Children aged 6 months to12 years, without signs of respiratory distress and children with fever, flu, cough and sore throat and clinically diagnosed as viral infection of either gender, were enrolled. A comprehensive clinical examination of all participating children was done. Following the clinical assessment, a 5ml blood sample was collected from each case and promptly sent to the hospital diagnostic laboratory to undergo thorough analysis, focusing on Hb, TLC, neutrophils, lymphocytes and C-reactive protein (CRP) levels. Subsequently, the collected data underwent statistical analysis using the Statistical Package for the Social Sciences (SPSS) version 26.

Results: The mean age of the participants was 5.13±2.93 years. Boys were 62% while girls were 38%. Average body temperature was 99.670°F. Mean total Leukocyte Count (TLC) was 9.47. The mean Lymphocyte count was 54.22 and mean Neutrophil count was 37.57. Throat inflammation was in 9.0% cases, tonsil enlargement was in 6.5%, while tonsil inflammation was relatively less prevalent. Average of lymphocytes was higher in patients with throat inflammation and tonsils inflammation. Although HB, TLC and Neutrophils average were statistically insignificant according to clinical findings, (p->0.05). Frequency of raised C reactive protein was statistically insignificant according to clinical findings (p=>0.05).

Conclusion: Study collectively highlights that the lymphocyte counts appear to have a discernible correlation with certain clinical features. However, CRP levels might not be a reliable indicator for discriminating specific clinical presentations in the context of upper respiratory tract infections and may require more consideration.

Keywords: Viral URTI, TLC, Lymphocytes, Neutrophils, CPR

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Introduction

Childhood is often marked by frequent respiratory tract infections, as the extensively branched system of ducts in the respiratory tract is highly susceptible to microorganisms transmitted through the air.[1] This vulnerability contributes to the elevated occurrence of infections, particularly during the early years of life.[1]

Simple infections commonly manifest as a runny nose, congestion, fever, sore throat, and cough.[2] Upper respiratory tract infections (URTIs) can stem from either viral or bacterial sources, and their occurrence significantly rises during the winter months, posing a threat to public health.[2,3] Respiratory illnesses have a significant impact on the pediatric population in developing countries, contributing to 30% of global pediatric mortality in these regions, and 12% in developed nations.[4] . In South Asia, 48 out of every 1000 children succumb to such infections before reaching the age of five.[5,6] Pakistan, currently the sixth most populous country with a population of 199 million, faces a considerable burden, with an estimated 20% to 30% of all deaths in children under five attributed to respiratory infections.[5,7] Viruses account for the overwhelming majority (90%) of respiratory tract infections (RTIs).[8]

Influenza virus, Rhinoviruses, RSV, and adenoviruses and the parainfluenza viruses are frequently implicated in URTIs among preschool children, constituting a significant portion of colds in both children and adults.[9] This leads to Hospital admissions for 180 out of every 10,000 children.[9]

The diagnosis of upper respiratory tract infections (URTI) is typically based on clinical assessment, and laboratory tests are generally unnecessary for healthy children experiencing uncomplicated URTI. Nevertheless, in emergency rooms and occasionally in outpatient clinics, swift diagnostic methods such as rapid viral testing through direct immunofluorescent-antibody staining and reverse transcriptase-PCR may be employed for prompt diagnosis.[9] Symptoms linked to viruses were assessed, encompassing conditions such as fever exceeding 38.5°C, rhinitis, cough, pharyngitis, crepitations, wheezing, tachypnea or dyspnea.[10] Dyspnea was defined based on clinical indicators such as chest wall retractions, nasal flaring, moaning, or breathing difficulty.[10]

Typically, symptoms of rhinovirus in children manifest within 1–3 days after exposure, with an additional 7–10 days generally needed for full recovery from the illness.[11] The presence of yellow, thick, or green mucous discharge is a normal progression of viral upper respiratory tract infections (URTI) and does not necessitate antibiotic treatment.[11] Clinical symptoms, along with various tests and investigations, have been employed to identify the underlying cause. One of the most effective methods for monitoring the physical condition of patients is the blood routine test, which typically assesses levels of white blood cell count (WBC), neutrophil cells (NC), lymphocyte cells (LC), monocyte cells (MC), and C-reactive protein (CRP) in the blood. Neutrophils, lymphocytes, and monocytes, among these parameters, are commonly used indicators to assess the inflammation and immune status of the human body.[12] While biomarkers are not typically recommended as a primary means of identifying pathogens, however C-reactive protein (CRP) can serve as a biomarker for inflammation.[13] This allows for tracking the progression of infection or monitoring the effectiveness of treatment.

Consequently, research has been actively pursued on the relationship between CRP and various sources of infection. Recently, there have been observations suggesting that CRP may be utilized to detect various viruses in clinical settings.[13,14] The correlation between laboratory findings and clinical diagnosis of viral upper respiratory tract infections (URTIs) in children is a crucial area of investigation, especially considering the lack of specific studies addressing this objective at the local level. However, this study has been conducted to evaluate the correlation between laboratory investigations and clinical diagnosis of upper viral respiratory tract infection in children.

Methodology

This prospective observational study was conducted in the Paediatric Department of Combined Military Hospital, Bahawalnagar, over a six-month period from January 1, 2023, to June 30, 2023. The study included children aged 6 months to 12 years of either gender, who presented without signs of respiratory distress and were clinically diagnosed with viral upper respiratory tract infections (URTI), such as fever, flu, cough, and sore throat. Children who were already using antibiotics or were clinically diagnosed with bacterial infections, as indicated by symptoms such as markedly inflamed throat, enlarged or inflamed tonsils, tender lymph nodes, or coexisting infections, as well as those with respiratory distress, were excluded.

Written informed consent was obtained from the parents or legal caregivers after explaining the study objectives, assuring them that all personal information would be kept confidential. A detailed clinical examination of all participants was conducted, during which symptoms and signs related to URTI were carefully documented. Following the clinical assessment, a 5 ml blood sample was collected from each participant and promptly sent to the hospital's diagnostic laboratory for analysis. The analysis included a complete blood count (CBC) and C-reactive protein (CRP) levels. The CBC provided detailed information on blood components, aiding in identifying abnormalities linked to viral infections.

Upon receiving the laboratory results, all relevant clinical and laboratory data were systematically recorded using a structured study proforma. The collected data were then analyzed statistically using the Statistical Package for the Social Sciences (SPSS) version 26.

Results

The mean age of the participants was 5.13$\pm$2.93 years. Boys were most common 62% while girls were 38%. The average body temperature is 99.670°F, with standard deviation of 6.34°F. For Hemoglobin levels (HB%), the mean was 11.22%. The Total Leukocyte Count (TLC) has a mean of 9.47, with a substantial standard deviation

Table I: Descriptive statistics of numerical variables. (n=200)

Statistics	Age	Temperature	HB%	TLC	Lymphocytes	Neutrophils
Mean	5.13 years	99.67^0F	11.22%	9.47	54.22	37.57
Std. Deviation	2.93 years	6.34^0F	1.39%	3.68	15.26	14.55
Minimum	0.7 years	97^0F	6.40%	2.70	16.00	6.00
Maximum	11 years	103^0F	14.10%	704.0	92.00	80.00

of 3.68, suggesting a wide range in white blood cell counts among the participants. The mean Lymphocyte count was 54.22, while the standard deviation was 15.26, indicating some variability in lymphocyte levels. The Neutrophil count has a mean of 37.57, with a standard deviation of 14.55. Table I

According to the clinical findings, the throat inflammation was in 18 individuals (9.0%), tonsil enlargement was reported in 13 cases (6.5%), while the majority, 187 individuals (93.5%), do not exhibit this clinical feature. However, Tonsil inflammation was relatively less prevalent, only among 2 cases. Notably, lymph node tenderness was entirely absent in all study population. Table II

Table II Clinical findings of the study subjects. (n=200)

Clinical findings		N	%
Throat inflammation	Yes	18	9.0
	No	182	91.0
	Total	200	100.0
Tonsil's enlargement	Yes	13	6.5
	No	187	93.5
	Total	200	100.0
Tonsil's inflammation	Yes	2	1.0
	No	198	99.0
	Total	200	100.0
Lymph node tenderness	Yes	00	00
	No	200	100.0
	Total	200	100.0

Average of lymphocytes was higher in patients with throat inflammation and tonsils inflammation. Although the average of HB, TLC and neutrophils were statistically insignificant according to clinical findings, (p->0.05) Table III. Frequency of raised C reactive protein was statistically insignificant according to clinical findings (p=>0.05). Table IV

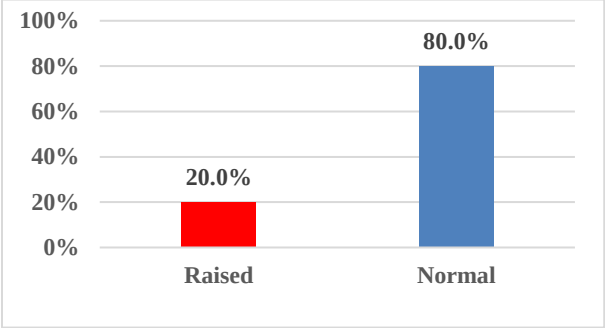

Figure 1. Frequency of raised CRP level in study subjects. (n=200)

Discussion

Upper Respiratory Tract Infections (URTI) are common in children and are often caused by viral pathogens. The diagnosis of viral URTI in children involves a combination of clinical evaluation and, in some cases, laboratory investigations. It's important to note that most cases of viral URTI are self-limiting and do not require specific treatment. Present study aimed to provide a comprehensive assessment of laboratory investigations and clinical diagnosis for viral URTI in children. The study included 200 participants with an average age of 5.13 ± 2.93 years, with boys comprising 62% and girls 38% of the sample. Comparatively Yen CY et al[15] reported that the average of the children was 2.68 ± 2.88 years and male children were 59.2%. However, Marom T et al[16] reported lower average of children 19.3±8.4 months and inconsistently they found female predominance.[16] In the comparison of this study Seçilmiş Y et al[2] demonstrated that the out of all 104 cases males were 56.7% and females were 43.3%, within the age range of 5 to 12 years participated in their study. Variations in average age and gender distribution

Table III: Average of HB, TLC, Lymphocytes and Neutrophils according to clinical findings. (n=200)

	Throat inflammation	Mean±SD	p-values	Enlarged Tonsils	Mean±SD	p-value	Tonsil's inflammation	Mean±SD	p-value
HB	Yes	11.38±1.46	0.875	**Yes**	11.75±1.0	0.407	**Yes**	11.45±0.6	0.922
	No	11.30±2.02		**No**	11.28±2.0		**No**	11.31±1.9	
TLC	Yes	8.78±3.3	0.404	**Yes**	8.21±3.0	0.302	**Yes**	6.30±0.1	0.221
	No	9.54±3.71		**No**	9.56±3.7		**No**	9.50±3.6	
Lymphocytes	Yes	61.94±17.5	0.24	**Yes**	57.69±12.3	0.398	**Yes**	76.0±22.6	0.041
	No	53.45±14.8		**No**	53.97±15.4		**No**	54.0±15.0	
Neutrophils	Yes	29.83±14.7	0.018	**Yes**	33.15±11.8	0.259	**Yes**	19.00±16.9	0.070
	No	38.33±14.3		**No**	37.87±14.7		**No**	37.75±14.4	

Table IV: C-reactive protein according to clinical findings. (n=200)

Clinical findings		C-reactive protein			p-value
		Raised	Normal	Total	
Throat inflammation	Yes	4(2.0%)	14(7.0%)	18(9.0%)	0.805
	No	36(18.0%)	146(73.0%)	182(91.0%)	
	Total	40(20.0%)	160(80.0%)	200(100.0%)	
Tonsil's enlargement	Yes	3(1.5%)	10(5.0%)	13(6.5%)	0.774
	No	37(18.5%)	150(75.0%)	187(93.5%)	
	Total	40(20.0%)	160(80.0%)	200(100.0%)	
Tonsil's inflammation	Yes	1(0.5%)	1(0.5%)	2(1.0%)	0.286
	No	39(19.5%)	159(79.5%)	198(99.0%)	
	Total	40(20.0%)	160(80.0%)	200(100.0%)	

observed in this study compared to others may be attributed to differences in sample size and the criteria used for selecting participants in each study.

In this study the average body temperature is 99.670°F, total Leukocyte Count mean was 9.47, mean Lymphocyte count was 54.22, and the Neutrophil count mean was 37.57. Furthermore, Throat inflammation was in (9.0%) cases, tonsil enlargement was in (6.5%), while Tonsil inflammation was relatively less prevalent. Average of lymphocytes was higher in patients with throat inflammation and tonsils inflammation, while HB average and frequency of raised C reactive protein was statistically insignificant according to clinical findings (p=>0.05). Comparatively Jadhav SA et al[17] reported that the cough emerged as the predominant presenting symptom, observed in the majority, specifically 286 patients (96%) in their study. Following this, other common symptoms included fever in 277 patients (93%) and rhinitis in 254 patients (85.2%). The analysis of symptoms in CRP-positive patients revealed no significant association with cough, fever, rhinitis, earache, and throat pain. However, they observed statistically significant association between breathlessness and CRP positivity ($p < 0.001$).[17] No more relevant studies were found in the literature for such findings. However, some studies, like the one conducted by Melbye H et al, partially supported the findings. They observed a common occurrence in viral upper respiratory tract infections, which is a moderately increased CRP value ranging from 10 to 60 mg/l, reaching its peak between days 2 and 4 of the illness.[17] However in their study they did not corelate the CRP with clinical findings.

Jeon JS et al[13] also partially supported our findings in terms of CRP abnormalities in 62.3% of the cases with viral respiratory tract infection. The current study possess certain limitations like the sample size in this study was limited, which may affect the generalizability of the findings to a broader population. Additionally, the study did not analyze the potential effects of demographic variables on the correlation between laboratory results and clinical diagnosis, leaving a gap in understanding how factors such as age, gender, or socioeconomic status might influence the observed associations. Moreover, the study faced limitations in the unavailability of relevant literature, which could not have provided a more comprehensive context for the interpretation of results. However, it is recommended that researchers consider larger and more diverse sample sizes to improve the external validity of their findings. Furthermore, future studies should incorporate a thorough analysis of demographic variables to discern their potential impact on the relationship between laboratory findings and clinical diagnosis. Longitudinal studies with extended observation periods can provide a more comprehensive understanding of the dynamics of viral URTI in children.

Conclusion

In conclusion, the findings revealed a notable association between specific laboratory parameters and clinical manifestations. Average lymphocyte counts were raised in patients exhibiting throat inflammation and tonsil inflammation, suggesting a potential link between these clinical features and a heightened immune response. Conversely, the CRP levels were observed without significant differences based on clinical findings, indicating that this laboratory parameter may not be reliable indicators for discriminating specific clinical presentations in the context of upper respiratory tract infections, and may require a more consideration.

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