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## Study of eosinophil count in nasal smear and peripheral blood smear in allergic rhinitis children

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### Abstract

**Background:** Allergic rhinitis and asthma are two very common allergic diseases of respiratory tract in pediatric patients. In this geographical area, where the prevalence of allergens exists, the role of allergens as the etiological factor is higher in allergic respiratory disorders. Confirmation of allergen as etiologic agent is cumbersome in a small setup, where IgE estimation and allergy tests are not accessible. With an appropriate history and detailed examination the diagnosis usually may not be problematic. Routine investigations may not contribute much for the final diagnosis but may help in ruling other possibilities. This study is done to know the eosinophil counts in nasal and blood smear and to assess the feasibility of nasal cytogram which is simple, economical and reliable investigation in patients of allergic respiratory disorders. In this study, the simple test of peripheral smear and nasal smear eosinophil count as a reliable diagnosis to solve the above problem and establishing allergy as etiological agent has been tried.

### Objectives

1. To know eosinophil count in nasal smear and blood smear in children with allergic rhinitis.
2. To assess the feasibility of nasal cytogram which is simple, economical and reliable investigation in the diagnosis of allergic rhinitis.

**Methodology of study:** This is prospective clinical correlation study conducted in outpatient visiting Department of Paediatrics and ENT Department hospital. 60 children of age group between 2 to 18 years were selected to estimate the eosinophil count in nasal and peripheral smear in allergic rhinitis. All allergic rhinitis cases based on clinical signs and symptoms were selected and investigated for nasal and blood eosinophilia. The nasal and blood eosinophilia were compared with each other and the clinical findings of allergic rhinitis were studied.

**Results:** In this study peak age incidence is between 6-10 years and there is equal gender distribution. Seasonal variation and pollen allergens were the most common risk factors for allergic rhinitis. Running nose and the nasal obstruction were the most common symptoms in children with allergic rhinitis followed by sneezing and itching. One tenth of the children with allergic rhinitis had bronchial asthma. Nasal eosinophilia contributes to the diagnosis of allergic rhinitis as compared blood eosinophilia. Mild intermittent variety of allergic rhinitis was the most common form of allergic rhinitis. Among various risk factors for allergic rhinitis, seasonal variation and pollen allergens have significant association with the severity of allergic rhinitis. Among various symptomatology, only itching had a significant relation to the severity of allergic rhinitis.

**Keywords:** Allergic rhinitis and eosinophil

### Introduction

Allergic respiratory diseases are very common in pediatric patients. Allergic rhinitis and asthma are two very common allergic diseases of respiratory tract. Clemens Vonpirquet coined the term allergy from Greek "allos" meaning "others" and "ergon" meaning reaction to describe hypersensitivity reaction in 1906. Allergic rhinitis is an IgE mediated hypersensitivity disease of mucous membrane of nasal airway characterized by sneezing, itching, watery nasal discharge and sensation of nasal obstruction. Asthma is a chronic condition characterized by recurrent bronchospasm resulting from a tendency to develop reversible narrowing of the airway lumina in response to stimuli. Allergic rhinitis involves the mucosa of lining of upper respiratory tract only, whereas asthma is confined to bronchial tubes of lower respiratory tract.

There is mounting evidence that eosinophils are implicated in the pathophysiology of allergic respiratory diseases. The direct and easy access of airborne allergens and irritants to the airways stimulate mast cells to produce IgE and cytokines which serves as enhancing factors for eosinophilic infiltration in allergic disease<sup>[1]</sup>.

Since allergic rhinitis and asthma are such prominent disorders of immediate hypersensitivity, it is not surprising that identification of eosinophil leukocytes within the nasal and bronchial mucosa and corresponding eosinophilia of the nasal secretion and sputum are common place findings in atopic populations. In geographical areas, where the prevalence of allergens exists, the role of allergens as the etiological factor is higher in allergic respiratory disorders. Confirmation of allergen as etiologic agent is cumbersome in a small setup, where IgE estimation and allergy tests are not accessible. In this study, the simple test of peripheral smear and nasal smear eosinophil count as a reliable diagnosis to solve the above problem and establishing allergy as etiological agent has been tried. This may enable the pediatricians in instituting proper therapy instead of resorting to antibiotics earlier than necessary [2].

The diagnosis of allergic rhinitis is based on a typical history of allergic symptoms and investigation. When two or more symptoms out of sneezing, watery rhinorrhea, nasal obstruction and nasal purities persist for  $\geq 1$  hour on most days, allergic rhinitis is strongly suspected. Some diagnostic tests like Skin Prick Test (SPT), Radio-Allergosorbent Test (RAST), estimation of IgE antibodies and Enzyme linked Immunosorbent assay (ELISA) are used for the diagnosis of rhinitis. But these are expensive, complicated, invasive and difficult to collect sample from children. Moreover it may be not possible to perform in peripheral set up. Nasal smear eosinophil count could be a useful test for diagnosis of allergic rhinitis, which is simple, easy to perform, cost effective and would help early diagnosis and to assess patient outcome after treatment. The aim of the present study was designed to evaluate the diagnostic value of nasal smear eosinophil count for allergic rhinitis [2, 3].

### Objectives

1. To know eosinophil count in nasal smear and blood smear in children with allergic rhinitis.
2. To assess the feasibility of nasal cytogram which is simple, economical and reliable investigation in the diagnosis of allergic rhinitis.

### Methodology

The aim of the present study was to analyse the eosinophil count in the blood and nasal smears of children with allergic rhinitis.

For the present study which was conducted during December 2017 to December 2019, children between 2 and 18 years who attended the outpatient Department of Paediatrics and department of ENT, Medical College were selected on the random basis.

**Method of study:** Sample size was taken as 60. The history, clinical features and investigations were noted in a proforma specially designed for the study. Peripheral venous blood and nasal smear sample are collected from allergic rhinitis children selected for the study from each children.

**Nasal Smear Preparation:** Nasal secretion was collected by asking the child to blow his nose into a plastic wrap and then placed on a glass slide. If he was too young to do this or insufficient secretion was obtained, cotton tipped swab was inserted into a nostril and left for 60 seconds. The nasal secretion which was obtained was transferred onto a glass slide, teased out and allowed to air dry.

**Peripheral smear preparation:** A small drop of blood was

placed about 1 or 2 cm from one end of a pre-cleaned slide and immediately another slide with a pre-cleaned edge was placed at an angle of 25 degrees and moved backwards to make contact with the drop. The drop of blood was spread quickly along the line of contact of spreader with the slide and allowed to air dry. Peripheral blood smear was studied using Leishman's stain whereas nasal smear was studied by Haematoxylin and Eosin (H&E) stain.

**Inclusion criteria:** Allergic rhinitis based on typical history and clinical features in the age group 2 to 18 year old Children attending outpatient department of Shadan Institute of Medical Sciences, Hyderabad, Telangana, India.

**Exclusion criteria:** Children using nasal steroid spray, Children who were coexisting / operated for deviated nasal septum, Chronic sinusitis, chronic tonsillitis, CSOM, Snuff powder users and pregnant mothers, Patients with symptoms of allergic rhinitis who are not on any anti-histamines and steroid preparation since last one month.

### Results

In the present study, majority of the patients with allergic rhinitis were in the age group of 6-10 years (60%), followed by 11-15 years (36%) and remaining 4% were in the age group of less than 5 years. Chi-square test revealed a significant difference between these age groups ( $p=.001$ ). Patients in the age group 6 to 10 years showed high incidence of allergic rhinitis. In this study, incidence of allergic rhinitis was equal in both males and females.

**Table 1:** Distribution of the study population based on age and gender

Age groups (In years)		Sex		Total
		Male	Female	
<5	Number	0	2	2
	Percent	0.0%	4.0%	4%
6-10	Number	20	15	35
	Percent	68.3%	55%	60%
11-15	Number	11	12	23
	Percent	38.7%	40.0%	36%
Total	Number	31	29	60
	Percent	100.0%	100.0%	100.0%

A non-significant association was observed between gender and age ( $CV=.196$ ;  $p=.322$ ), where we found the pattern of distribution in male and female patients was the same irrespective of their age groups. The mean age of male patients was  $9.2 \pm 2.4$  (6.00 - 15.00), females was  $9.4 \pm 2.2$  (4.00 - 15.00) and for the entire sample it was  $9.5 \pm 2.9$  (4.00 - 15.00).

**Table 2:** Distribution of risk factors for allergic rhinitis in the study population

Sl. No.	Risk Factors	Numbers of patients exposed	Percent
1	Animal dander	16	28%
2	Food Allergy	4	8.7%
3	Pollen	22	45.3%
4	Seasonal Variation	36	59.7%
5	Family History	18	22.7%

In this study, seasonal variation was the most common risk factor for allergic rhinitis accounting for 59.7%, followed by

pollen with 45.3%. Animal allergens and family history of allergic rhinitis each showed an incidence of 28% in allergic rhinitis. Allergic rhinitis was least associated with food allergens (8.7%). Chi square test revealed a significant difference among risk factors like animal allergens (p=.001), food allergy (p=.001), seasonal variation (p=.001), and family history (p=.001). Exposure to pollen did not serve as a significant risk factor for allergic rhinitis (p=.302).

**Table 3:** Distribution of symptoms in the study population

Sl. No.	Symptoms	Number of subjects(n=60)	Percent
1	Running nose	55	91.6%
2	Sneezing	46	76.7%
3	Nasal obstruction	52	86.7%
4	Itching	45	75.0%
5	Epistaxis	5	8.33%
6	Cough	2	3.33%
7	Wheezing	21	35%
8	Fever	6	10%

In this study, running nose (91.6%) was the most common presenting symptoms in allergic rhinitis, followed by nasal obstruction (86.7%), itching(75.0%) and sneezing (76.7%). 35% of children who presented with allergic rhinitis had associated wheezing. Epistaxis (8.33%) and cough (3.33%) were the least common presenting symptoms in allergic rhinitis. Chi square test showed no significant association of wheezing (43.3%, p=.302) with allergic rhinitis.

**Table 6:** Distribution of study population based on the nasal eosinophil and blood eosinophil count

Nasal Eosinophil count		Blood Eosinophil count		Total
		<440 Cells/mm <sup>3</sup>	>440 Cells/ mm <sup>3</sup>	
<10 Cells/hpf	Numbers	10	2	12
	Percent	83.3%	16.7%	100.0%
>10 Cells/hpf	Numbers	30	18	48
	Percent	62.5%	37.5%	100.0%
Total	Numbers	40	20	60
	Percent	66.7%	33.3%	100.0%

We found no significant association between nasal and blood eosinophil count (p=.417). Among 40 children with blood eosinophil count of <440cells/ mm<sup>3</sup>, 30 children had a nasal eosinophil count of >10cells/hpf and remaining 10 children had a nasal eosinophil count of <10cells/hpf.

**Table 7:** Distribution of the study population based on the severity of allergic rhinitis

Severity	Number(n=60)	Percent
Mild Intermittent	34	56.7%
Severe persistent	14	23.3%
Mild Persistent	9	15%
Moderate Persistent	6	10%
Moderate Intermittent	2	3.3%
Total	60	100.0%

In this study, 34 children had mild intermittent variety (56.7%) of allergic rhinitis. Six children had moderate persistent variety which was least prevalent. There was significant difference in severity of allergic rhinitis among the study population (p=.001). In this study, only seasonal risk factor (p=.044) and pollen

exposure (p=.001) have significant association with mild intermittent severity of allergic rhinitis. Animal allergen (p=.419), food allergen (p=.251) dust exposure (p=.375) did not have significant association with severity of allergic rhinitis.

**Table 4:** Distribution of study population based on nasal eosinophil count

Nasal Eosinophil count	Number (n=60)	Percent
<10 Cells/hpf	14	23.3%
>10 Cells/hpf	46	76.7%
Total	60	100.0%

In this study population of 60 children, 46 children (76.7%) showed a nasal eosinophil count of >10cells/hpf, and the remaining 14 children (23.3%) had a nasal eosinophil count of <10cells/hpf which was statistically significant (p=.001).

**Table 5:** Distribution of study population based on the blood eosinophil count

Blood Eosinophil count	Number (n=60)	Percent
<440 Cells/mm <sup>3</sup>	42	70.0%
>440 Cells/mm <sup>3</sup>	18	30.0%
Total	60	100.0%

In this study only 18 children (30%) showed blood eosinophil count of >440cells/ mm<sup>3</sup> and the remaining 42 children (70%) had a blood eosinophil count of <440cells/mm<sup>3</sup> which was not significant (p= .020).

Among 20 children with blood eosinophil count of >440 cells/ mm<sup>3</sup>, 18 children had a nasal eosinophi count of >10cells/hpf and remaining 2 children had a nasal eosinophil count of <10cells/hpf.

**Table 8:** Distribution of symptoms in relation to the severity of allergic rhinitis

Severity		Symptoms						
		Running Nose	Sneezing	Nasal Obstruction	Itching	Epistaxis	Cough	Wheezing
Mild Intermittent (n= 34)	No.	28	19	26	23	2	0	11
	%	82.3	55.9	76.5	67.7	5.9	0.0	32.4
Mild Persistent (n= 14)	No.	8	7	4	3	0	0	4
	%	57.2	50.0	28.6	21.4	0.0	0.0	28.6
Severe Persistent (n = 9)	No.	8	8	7	7	1	0	6
	%	88.9	88.9	77.8	77.8	11.11	0.0	66.7
Moderate Persistent (n= 6)	No.	5	5	6	4	0	1	4
	%	83.3	83.3	100	66.7	0.0	16.7	66.7
Moderate Intermittent (n= 2)	No.	2	2	2	2	0	0	1
	%	100.0	100.0	100.0	100.0	0.0	0.0	50.0

In this study, among the severity of symptoms of allergic rhinitis, itching was the most common symptom associated with all forms of allergic rhinitis which was statistically significant (p=.023).

**Discussion**

Allergic respiratory diseases are very common in pediatric patients. Allergic rhinitis and asthma are two very common allergic diseases of respiratory tract. They are usually diagnosed by appropriate history and detailed examination. Routine investigations may not contribute much for the final diagnosis but may help in ruling other possibilities. There are many tests like skin tests, IgE, RAST, ELISA etc to confirm disease as allergic but they are complicated and cumbersome and may not be possible in many hospital setups. Hence nasal and blood smear eosinophil count as a simple, noninvasive and reliable investigation for finding out allergy as an etiological agent has been tried. Hence this study tries to find the feasibility of the nasal eosinophil count over the blood eosinophil count in allergic rhinitis children. Clinical profile nasal smear eosinophil, peripheral smear was analyzed as follows; In the study majority of allergic rhinitis cases visiting the OPD were in the age group of 6-10

years, accounting for 68.3% of cases.

In this study, seasonal variation was the most common risk factor for allergic rhinitis accounting for 59.7%, followed by pollen with 45.3%. Animal allergens and family history of allergic rhinitis each showed an incidence of 28% in allergic rhinitis. In the study there was equal gender distribution of allergic rhinitis, which was also found in the study by Venkateswarlu V *et al.* [5], 2015.

In this study, all children with allergic rhinitis and asthma had rhinorrhea (100%). It is high as compared to other studies where nasal obstruction, sneezing and cough had similar frequency in allergic rhinitis in this study while in bronchial asthma cough and wheezing were present in all patients followed by nasal obstruction and dyspnea. Among all the clinical findings, symptoms contribute more than signs for the diagnosis. (100) cases and nasal eosinophil count of >10 cells were considered as positive as per IAP text recommendation. Many studies have taken different cut off value.

Among 60 children, running nose was the most common symptom accounting for 90% of cases followed by nasal obstruction (83.3%). Similar results were seen in the study by Dr. Shreepad S Shetty *et al.*, [6] 2014 and Naveen Kumar *et al.*, [7] 2011.

**Table 9:** Distribution of signs and symptoms in various studies

Signs and symptoms	Bahram Mirsaid Ghazi <i>et al.</i> [8] (2003)% (n=455)	Naveen Kumar <i>et al.</i> [7] (2011)% (n=100)	Shreepad S Shetty <i>et al.</i> [6] (2014)% (n=42)	V. Venkateswarlu <i>et al.</i> [5] (2015)% (n=50)	Present Study% (n=60)
Rhinorrhoea	73.4	100.0	97.6	100.0	91.6%
Nasal obstruction	67.0	80.9	19.0	22.2	76.7%
Sneezing	63.0	50.8	52.4	94.4	86.7%
Itching	45.5	38.1	69.0	-	75.0%
Epistaxis	-	-	-	-	8.33%
Cough	-	36.5	-	-	3.33%
Wheezing	-	1.6	-	7.0	35%
Fever	-	12.7	-	-	10%

In the present study, 90% of the children had running nose as the most common symptom which was similar to the study conducted by V.Venkateswarlu *et al.* [5] and Naveen Kumar *et al.* [7] where all children in the study had running nose.

In the present study, 83.3% of the children had nasal obstruction as the second most common symptom which was similar to the study conducted by Naveen Kumar *et al.* [7] where 90.9% of the children had nasal obstruction.

In the present study, 73.3% of the children had sneezing. Study by Dr. Shreepad S Shetty *et al.* [6] also found similar results where 52.4% of the children had sneezing.

Nasal eosinophil and blood eosinophil count was done in all 60 cases and nasal eosinophil count of > 10 cells/hpf is consider positive as per IAP recommendation. Many studies have taken different cut off values. Crobach M *et.al* (1996)9 etc., have considered >10 cells/hpf as significant similar to the present study.

Similarly, Chowdary VS *et.al*10 considered blood eosinophil count of >440 cell/mm3 is considered as significant and this cut off value. In present study also blood eosinophil count of >440 cell/mm3 is considered as significant.



**Table 10:** Comparison of Nasal eosinophil count in allergic disorders

Sl. No.	Study	Nasal eosinophil cutoff value/hpf	Percent
1.	Robert E. Miller (1982) <sup>[12]</sup>	> 5 cells	80.0
2.	Losada Cosmes E, <i>et al.</i> (1984) <sup>[13]</sup>	> 10 cells	59.5
3.	Lans DM <i>et al.</i> (1989) <sup>[14]</sup>	>20 cells	43.0
4.	Crobach M <i>et al.</i> (1996) <sup>[9]</sup>	> 10 cells	18.0
5.	Sanil A <i>et al.</i> (2006) (n=41) <sup>[11]</sup>	> 10 cells	57.0
6.	Naveen Kumar <i>et al.</i> (2011) (n=100) <sup>[7]</sup>	> 10 cells	57.0
7.	V. Venkateswarlu <i>et al.</i> (2015)(n=50) <sup>[5]</sup>	> 10 cells	55.5
8.	Present study (n=60)	> 10 cells	66.7

Various studies have found various results for nasal smear eosinophilia ranging from 18.0% to 80.0%. Our study showed nasal smear eosinophilia of 80.0%. Similar results were found in the study conducted by Sanil A *et al.* <sup>[11]</sup> and Naveen Kumar *et al.* <sup>[7]</sup> where there was nasal smear eosinophilia of 57%. Children having allergic rhinitis with bronchial asthma (38cases) of which 27 (71.1%) were nasal eosinophilia, of which reliable in this group.

In comparison to blood eosinophil count, nasal smear for eosinophil count is considered better diagnostic tool as it is simple.

Eosinophils count increase in blood in patients suffering from allergic Rhinitis due to exposure of abnormal exogenous or endogenous antigens leads to an immunological reaction. In these allergic conditions, eosinophils dampen host response by limiting the antigen induced release of mediators of inflammations. Eosinophils are present in large number in allergic rhinitis initially 2 wks., later enter tissue and develop tissue eosinophilia and eosinophil count in blood decreases.

### Conclusion

Absolute Eosinophil Count was the preferred investigation for this study as it is an easy OPD procedure, is cost effective and gives accurate results. This helps people to get early treatment thereby minimizing complications. It also helps in guiding people to take preventive measures.

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### Conflict of Interest

None

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Nil

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