

# Study of Eosinophil Count in Nasal and Blood Smear in Allergic Respiratory Diseases

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## Abstract

**Introduction:** 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. 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. **Material and Methods:** For the present study which was conducted over 2 years in children between 2 to 12 years who visited tertiary health care center, Nashik. The allergic respiratory cases based on typical history and clinical features were included in the study and investigated for nasal and blood eosinophilia. Children with TB, recurrent and chronic pneumonia, malnutrition, malignancy, collagen vascular disorders and those who are on steroid therapy were excluded from the study. The clinical profile of allergic rhinitis with or without asthma and nasal and blood eosinophils are studied. **Result:** Out of 100 patients, there was male predominance and incidence was increasing as age increases. Dust is the most common risk factor for allergic rhinitis followed by weather changes, whereas in allergic rhinitis with bronchial asthma, weather change is common risk factor followed by dust and family history. In children with allergic rhinitis with or without bronchial asthma, there is positive relation between nasal and peripheral smear eosinophil count. **Conclusion:** So, nasal eosinophil count which is simple, non-invasive, economical and reliable can be used as an alternative to invasive peripheral smear eosinophil count as both are equally efficacious in diagnosing allergic respiratory diseases.

**Keywords:** Allergic Rhinitis, Bronchial Asthma, Eosinophilia

## 1. 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<sup>1</sup>. 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.

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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.

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 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.

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. Method

The aim of the present study is to analyze the eosinophil count in the blood and nasal smears of children with allergic respiratory diseases especially allergic rhinitis with or without bronchial asthma.

For the present study which was conducted during August 2012 to December 2014, children between 2 to 12 years who attended the outpatient and in-patient Department of Pediatrics, in tertiary health care center, were selected on the random basis.

The allergic respiratory cases based on typical history and clinical features were included in the study.

Children with TB, recurrent and chronic pneumonia, malnutrition, malignancy, collagen vascular disorders and those who are on steroid therapy were excluded from the study.

The history, clinical features and investigation were noted in a proforma specially designed for the study. Data was analyzed using statistical software.

The following investigations were done:

Blood studies, nasal discharge smear for eosinophil count, Montoux test and Chest X-ray in all the children taken for the study.

Nasal and peripheral smear examination was done as follows:

### 2.1 Nasal Smear Preparation

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

### 2.2 Blood Studies

With strict aseptic precautions, blood sample was drawn by venepuncture and 3 ml of blood was collected in EDTA anticoagulant. The sample collected was subjected to investigations like Hb%, TC, DC, ESR, Absolute eosinophil count, and peripheral smear examination.

### 2.3 Peripheral Smear Preparation

A small drop of blood was placed about 1 or 2 cm from one end of a pre cleaned slide. Immediately another slide with a precleaned edge was placed at an angle of 25 degree and moved backwards to make contact with the drop. The drop of blood should spread quickly along the line of contact of spreader with the slide and allowed it to air dry. Peripheral blood smear was studied using Leishmans stain whereas nasal smear was studied by H and E stain.

## 3. Results

### 3.1 Study Design

A prospective clinical correlation study consisting of 100 children is undertaken to study the eosinophil count in nasal and blood smear in allergic respiratory diseases such as allergic rhinitis and bronchial asthma.

In the above Table 1, 49% of the allergic respiratory cases were in the age group 9-12 years which is most

**Table 1.** Age distribution

Age( in yrs.)	Frequency	Percent
2-4	18	18
5-8	33	33
9-12	49	49
Total	100	100.0

common. 33% cases were in age group 5-8 years and remaining 18% were in 2-4 years age group.

In this Table 2, the incidence of allergic disorder is more common in male (60%) compared to female (40%).

In this Table 3, dust is the most common risk factor for allergic rhinitis accounting for 87.1% followed by weather changes 59.7%, whereas in allergic rhinitis with bronchial asthma, weather change is common risk factor accounting for 89.5% followed by dust 78.9% and family history 71.1%.

Clinical findings in this Table 4 showed 100% of patients with allergic rhinitis had rhinorrhea, following that cough (58.1%). In allergic rhinitis with asthma all

patients had rhinorrhea, cough and wheezing. The incidence of fever is almost similar in both groups.

In the previous Table 5, the mean eosinophil count in allergic rhinitis with bronchial asthma (24.66 cells) showed higher than allergic rhinitis (20.19) and the mean blood eosinophil count in allergic rhinitis with asthma (525.7) showed higher than allergic rhinitis (460.4) but statistically not significant ( $p = 0.914$ ).

In this Table 6 all 100 cases were investigated with both nasal and blood eosinophil count. The positive nasal eosinophilia (>10cells) cases were 61%. Similarly, the positive blood eosinophilia (>440 cells/cc mm) were 57%.

**Table 2.** Sex incidence

Sex	Frequency	Percent
Male	60	60
Female	40	40
Total	100	100.0

Female:Male Ratio=1:1.5

**Table 3.** Distribution of risk factors

RiskFactor	Allergic Rhinitis (n=62)		Allergic Rhinitis with Bronchial Asthma (n=38)	
	Frequency	Percent (%)	Frequency	Percent (%)
Dust	54	87.1	30	78.9
Weather change	37	59.7	34	89.5
Animal	13	21.0	11	29.0
Food	11	17.8	12	31.6
H/o Family Atopy	27	43.6	27	71.1

**Table 4.** Distribution of signs and symptoms

Symptoms and symptoms	Allergic Rhinitis (n=62)		Allergic Rhinitis with Bronchial Asthma(n=38)	
	Frequency	Percent	Frequency	Percent
Rhinorrhea	62	100.0	38	100.0
Nasal Itching	26	42.0	14	36.9
Nasal obstruction	35	56.5	26	64.4
Sneezing	34	54.9	16	42.1
Cough	36	58.1	38	100.0
Wheezing	0	0	38	100.0
Dyspnea	0	0	12	31.6
Fever	6	9.7	6	15.8

**Table 5.** Distribution according to mean

	Diagnosis	n	Mean	SD	Minimum	Maximum	't' value	'p' value
Nasal Eosinophils	Allergic Rhinitis	62	20.19	19.65	0	74	0.66	0.418
	Allergic Rhinitis with Bronchial Asthma	38	24.66	17.93	0	70		
	Total	100	21.89	18.99	0	74		
Blood Eosinophils	Allergic Rhinitis	62	460.4	278	75	1240	0.12	0.914
	Allergic Rhinitis with Bronchial Asthma	38	525.7	292	80	1328		
	Total	100	503.29	286.54	75	1328		

**Table 6.** Incidence of eosinophilia in study

		Frequency	Percent
Nasal Eosinophil	<10cells	39	39.0
	≥10 cells	61	61.0
	Total	100	100.0
Blood Eosinophil	≤440 cells/cumm	43	43.0
	>440 cells/cumm	57	57.0
	Total	100	100.0

**Table 7.** Distribution of nasal eosinophils according to the diagnosis

Nasal eosinophils	Allergic Rhinitis	Allergic Rhinitis with Bronchial Asthma	Total
<10	28	11	39
	45.16%	28.95%	39.0%
≥10	34	27	61
	54.84%	71.05%	61.0%
Total	62	38	100
	100.0%	100.0%	100.0%

Chi-Square Value	df	'p' value
2.603	1	0.107

Nasal eosinophilia is more common in allergic rhinitis with asthma compare to only allergic rhinitis (71.05 vs. 54.84) but statistically not significant ( $p = 0.107$ ).

In the above Table 8, blood eosinophilia is more common in allergic rhinitis with asthma compare to only allergic rhinitis (68.42 vs 50) but statistically not significant ( $p = 0.071$ ).

In this Table 9, distribution of nasal smear and peripheral blood eosinophils in allergic rhinitis patients with or

without asthma showed that out of 43 cases with AEC counts less than 440/cumm, 16(26.2%) showed increased nasal eosinophils. Of 57 children AEC counts more than 440/cumm, 45(73.5%) showed nasal eosinophila. Thus, there is positive association between nasal and peripheral blood smear eosinophilia.

In this Table 10, children having only allergic rhinitis (62 cases), 34(54.8%) showed significant nasal eosinophilia (>10/HPF), of which 23(67.6%) showed increased

**Table 8.** Distribution of blood eosinophils according to the diagnosis

Blood eosinophils	Allergic Rhinitis	Allergic Rhinitis with Bronchial Asthma	Total
≤440	31 50.00%	12 31.58%	43 43.0%
>440	31 50.00%	26 68.42%	57 57.0%
Total	62 100.0%	38 100.0%	100 100.0%

Chi-Square Value	df	'p' value
3.262	1	0.071

**Table 9.** Distribution of nasal and blood smear eosinophil counts in allergic rhinitis and allergic rhinitis with bronchial asthma

Nasal eosinophil	Blood eosinophil			Sensitivity	Specificity	PPV	NPV
	>440	≤440	Total				
≥10	45(73.8)	16(26.2)	61(100)	78.9	62.8	73.8	69.2
<10	12(30.8)	27(69.2)	39 (100)				
Total	57(57)	43(43)	100(100)				

Figures in parenthesis indicate percentage.

**Table 10.** Distribution of nasal and blood smear eosinophil counts in allergic rhinitis without bronchial asthma

Nasal eosinophil	Blood eosinophil			Sensitivity	Specificity	PPV	NPV
	>440	≤440	Total				
≥10	23(67.6)	11(32.4)	34(100)	74.2	64.5	67.6	71.4
<10	8(28.6)	20(71.4)	28(100)				
Total	31(50)	31(50)	62(100)				

Figures in parenthesis indicate percentage.

peripheral smear eosinophils and in 31(50%) cases with blood eosinophilia (>440/cumm), of which 23(74.1%) patients showed nasal smear eosinophilia.

In this Table 11, children having allergic rhinitis with bronchial asthma (38 cases) of which 27 (71.1%) were nasal eosinophilia, of which 22 (81.5%) showed increased in peripheral smear eosinophilia. Out of 26(68.4%) cases with peripheral smear eosinophilia 22 (84.6%) showed nasal smear eosinophilia. Thus, nasal smear eosinophilia is more reliable in this group.

The sensitivity of nasal eosinophilia is higher in allergic rhinitis with bronchial asthma compared to other group (84.6 vs. 74.2)

## 4. 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

**Table 11.** Distribution of nasal and blood smear eosinophil counts in allergic rhinitis with bronchial asthma

Nasal eosinophil	Blood eosinophil			Sensitivity	Specificity	PPV	NPV
	>440	≤440	Total				
≥10	22(81.5)	5(18.5)	27(100)	84.6	58.3	81.5	63.6
<10	4(36.4)	7(63.6)	11(100)				
Total	26(68.4)	12(31.6)	38(100)				

Figures in parenthesis indicate percentage.

**Table 12.** Comparison of allergic rhinitis vs allergic rhinitis with asthma

	Allergic rhinitis (%)	Allergic rhinitis with asthma (%)
Sensitivity	74.2	84.6
Specificity	64.5	58.3
PPV	67.6	81.5
NPV	71.4	63.6

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 efficacy of nasal and blood eosinophilia in allergic respiratory disorders like allergic rhinitis and allergic rhinitis with bronchial asthma.

The clinical profile, nasal smear eosinophilia, and peripheral smear eosinophilia is analyzed as follows.

In this present study, majority of the allergic respiratory cases were of age group 8-12 years accounting 49%, this findings correlates with other studies like<sup>2</sup>. In this study it also shows the incidence of allergic rhinitis in children increases with age.

In this study out of 100 children, 60% were males and 40% were females. Female as to male ratio was 1.5:1. Male predominance was also observed by<sup>2,3,4</sup>.

Dust is the most common risk factor for allergic rhinitis accounting for 87.1% followed by weather changes 59.7%, whereas in allergic rhinitis with bronchial asthma, weather change is common risk factor accounting for 89.5% followed by dust 78.9% and family history 71.1%.

Among 100 children 54 have the family history of allergic respiratory disorder. There is no difference in family history between allergic rhinitis and bronchial asthma. And this is comparatively similar with the observation made by<sup>2</sup> (47.9%), (50%)<sup>5</sup>, (52.3%)<sup>4</sup> and (52%)<sup>6</sup>.

Among other risk factors like food allergy and pet animal have less contribution for allergic respiratory dis-

order accounting for 23% and 24% respectively which is still higher when compared to other studies done by<sup>7</sup> (6% and 12%). But allergy to pet animal is less as compared to study<sup>8</sup> (35.4%).

In this study, all children with allergic rhinitis and asthma had rhinorrhea (100%). It is high as compared to other studies<sup>7,8</sup>, 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. Authors in<sup>9,10</sup>, etc., have considered >10cells as significant similar to the present study. Similarly, blood eosinophil count >440 cell/cumm is considered as significant and this cut off value is also considered in<sup>5</sup>.

Various workers have found varying results for nasal smear eosinophilia, ranging from 18% to 81%. In this study nasal eosinophilia was 61% which correlates well with<sup>9,12</sup>.

The mean eosinophil count in allergic rhinitis with bronchial asthma (24.66 cells) showed higher than allergic rhinitis (20.19) and the mean blood eosinophil count in allergic rhinitis with asthma (525.7) showed higher than allergic rhinitis (460.4) which was similar to<sup>14</sup>.

Distribution of nasal smear and peripheral blood eosinophils in allergic rhinitis patients with or without asthma showed that out of 43 cases with AEC counts less than 440/cumm, 16 (26.2%) showed increased nasal eosinophils. Of 57 children AEC counts more than 440/cumm, 45 (73.5%) showed nasal eosinophila. Thus, there is positive association between nasal and peripheral blood smear eosinophilia.

Children having only allergic rhinitis (62 cases), 34 (54.8%) showed significant nasal eosinophilia (>10/HPF),

**Table 13.** Table showing studies for nasal eosinophilia in allergic diseases

Sl. No.	Study	Nasal eosinophil Cutoff value	%
1.	Crobach M et al (1996) <sup>10</sup>	>10 cells	18.0
2.	Lans DM et al (1989) <sup>11</sup>	>20 cells	43.0
3.	Losada Cosmes E, et al (1984) <sup>9</sup>	>10 cells	59.5
4.	Sanil A et al (2006) <sup>12</sup>	>10 cells	57.0
5.	Robert E. Miller (1982) <sup>13</sup>	>5 cells	80.0
6.	Present study	>10 cells	61.0

of which 23 (67.6%) showed increased peripheral smear eosinophils and in 31 (50%) cases with blood eosinophilia (>440/cumm), of which 23 (74.1%) patients showed nasal smear eosinophilia >10 cells.

Children having allergic rhinitis with bronchial asthma (38 cases) of which 27 (71.1%) were nasal eosinophilia, of which reliable in this group.

## 5. Conclusion

This clinical profile study of nasal and peripheral smear eosinophilia in 100 children between 2 to 12 years presenting with allergic rhinitis with or without bronchial asthma can be concluded as follows:

- Peak age incidence is between 8-12 years and the disease occurs more commonly in males than in females.
- Rhinorrhea, cough, nasal obstruction were the most common presenting symptom in children with allergic rhinitis.
- Cough, wheezing, rhinorrhea were present in all the cases of allergic rhinitis with bronchial asthma.
- Dust and weather changes were the common triggering factors.
- Family history of atopy is seen more in allergic rhinitis with bronchial asthma than in allergic rhinitis.
- Blood eosinophil count contributes equally in diagnosing allergic rhinitis with bronchial asthma and allergic rhinitis, whereas nasal eosinophil count contributes more in allergic rhinitis with bronchial asthma than allergic rhinitis.
- In children with allergic rhinitis with or without bronchial asthma, there is positive relation between nasal and peripheral smear eosinophil count are equally efficacious.

- So, nasal eosinophil count which is simple, non-invasive, economical and reliable can be used as an alternative to invasive peripheral smear eosinophil count as both are equally efficacious in diagnosing allergic respiratory diseases.

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